NEEDLESTICK INJURIES IN NURSING AND LABORATORY PERSONNEL

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Needlestick Injuries in Nursing and Laboratory Personnel

by

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A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Science

Faculty of Medicine
Memorial University of Newfoundland
July, 1990

ISBN 0-315-61837-X

ABSTRACT

This study was designed to increase understanding of needlestick injuries in order to make recommendations for appropriate preventive measures.

Needlestick injury rates for the period 1985-1989 were calculated for nursing and laboratory employees at three tertiary care hospitals, using staff health records and an anonymous self-administered questionnaire.

In 1989, hospital-recorded needlestick rates ranged from 12 to 24 per 100 FTE (full-time equivalents) for nurses and 4 to 23 per 100 for laboratory employees in the study hospitals. No decline in rates of reported needlesticks for all hospital employees or for nurses was seen; a decline in needlestick frequency was seen in two of the three laboratories.

A random sample of nurses who ordinarily use needles in their work and all laboratory employees who regularly collect blood were invited to participate in a survey describing needle use patterns and needle injury experiences. Responses were received from 86% of nurses and 83% of laboratory employees contacted, for a total of 342 survey participants.

Rates of self-reported needlesticks for the previous twelve months were 74 per 100 nurses and 24 per 100 laboratory employees. Forty-one percent of nurses and 20% of laboratory

employees had one or more injuries in the last year. The risk of needlestick injury was not associated with an employee's sex, education level, job status, knowledge and beliefs about needlesticks, or personal health practices. Factors associated with having been injured included:

1) need to carry used needles to a disposal container,
2) recapping used needles using two hands,
3) inconsistent discarding of uncapped needles,
4) work area,
5) working experience, and
6) number of needles used.

Most needlestick injuries occurred after the needle had been used; 42% involved recapping the used needle. Most of the recent needlesticks experienced by nurses involved disposable syringes or automatic spring-loaded lancets. Almost all needlesticks described by laboratory employees involved vacuum-tube blood collection equipment.

Programs to reduce needlestick injuries should include:

1) point-of-use placement of disposal containers;
2) attention to equipment and situations requiring special handling, e.g., devices needing disassembly;
3) education strategies targeted at groups at higher risk, such as newly employed nurses;
4) evaluation of the efficacy of needlestick prevention programs.

ACKNOWLEDGEMENTS

I wish to thank the many individuals who have helped in the preparation of this thesis.

I appreciate the interest shown by the hundreds of hospital employees who completed questionnaires, provided background information, promoted the survey or assisted with questionnaire distribution and return.

The financial support of the Faculty of Medicine of Memorial University, which enabled me to attend the Fifth International AIDS Conference and the 1990 New England Epidemiology Institute, is gratefully acknowledged.

It has been a pleasure to be associated with the faculty, staff and graduate students of the Division of Community Medicine and Behavioural Sciences. Their friendship and expert assistance throughout the past two years were much appreciated.

Thank you to Dr. Kevin Hogan, Dr. Doreen Neville and Dr. Jorge Segovia for serving on my supervisory committee, reading the thesis, and making many helpful suggestions.

My sincere thanks and appreciation go to my supervisor, Dr. Sharon Buehler, who has been extraordinarily generous with her time, expertise and support. I was inspired by her kindness, unfailing energy and enthusiasm.

Finally, I would like to thank Jim Miller, my husband, for his confidence, support and understanding.

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CHAPTER 1. INTRODUCTION

The needles used to perform diagnostic and therapeutic procedures can be hazardous to the health professionals handling them. An uncovered needle may pierce the skin, resulting in an open wound and exposure of the individual to substances present on the needle.

Description of the problem

Puncture wounds caused by needles used in patient care are one of the most common occupational injuries experienced by hospital employees. Needle injuries, usually called needlesticks, affect employees such as physicians, nurses and technologists who routinely use needles when performing diagnostic tests or therapeutic procedures. In addition, other categories of health care orkers who do not normally utilize needles in their work encounter them inadvertently. For example, nursing assistants may be injured when clearing away used equipment, laundry workers occasionally find loose needles in soiled linens, and housekeeping personnel are endangered when needles are discarded into containers not designated for such use.

Most needles used in North American hospitals are single-use, disposable items. They are packaged to maintain sterility and to protect the handler before use. The needle

may be purchased separately or already attached to ancillary equipment, for example, a disposable syringe. The needle shaft is usually covered with a plastic cap which requires a deliberate twisting motion to detach it from the base or hub of the needle. An over-wrap of paper, clear plastic or other disposable material may envelope the capped needle. Properly capped needles pose no hazard, but from the time the needle is uncapped until it is safely removed from the work-site, the potential for injury is present.

Some injuries occur before the needle's intended use and may therefore involve a sterile instrument. Used needles may have been exposed to drugs or chemicals, to the blood or other body fluids of a patient, or to blood products used for transfusion or injection. It is the exposure to human blood which causes greatest concern, since blood may harbour infectious agents. Most people who experience a needle injury have no more serious outcome than a sore finger for a few days, but the potential for serious illness does exist.

It has been recognized for many years that needlesticks place health care workers at risk for a wide variety of transmissible diseases. This risk may generate little apprehension if the infection is mild, rare or not easily transmitted by needlestick. Other infections are widely feared and do pose serious risks to health workers. The two diseases responsible for increased interest in needle

injuries in the past decade are hepatitis B (HB) and the acquired immune deficiency syndrome (AIDS).

Because of its high morbidity and its relative ease of transmission, hepatitis B has long been a concern of those exposed to human blood. Advances in testing and treatment have improved post-exposure management for those reporting needlestick injuries. Prompt initiation of primary and/or secondary preventive measures (hepatitis B vaccine and hepatitis B immune globulin) can reduce the likelihood of a needlestick-related infection.

Recognition in the mid-1980's that AIDS is a blood-borne disease greatly heightened concern about needlestick injuries. Health professionals and the hospital administrators charged with their welfare have attempted to reduce job-related AIDS risk. Needlestick injuries are the occupational exposure presenting the most serious risk of infection with the human immunodeficiency virus (HIV), the causative agent for AIDS.

Purpose of study

The present study has been undertaken to increase knowledge and understanding of factors contributing to the occurrence of needlestick injuries and to suggest appropriate preventive measures.

Research questions

The questions which this study will address are:

1. What are the rates of hospital-recorded needlestick injuries for nurses and laboratory employees in three selected hospitals for the years 1985-1989? Have rates changed over this time period?

2. What are the rates of self-reported needlestick injuries for the same groups of employees in a twelve-month period, as determined through an anonymous, self-administered questionnaire?

3. Which of the following factors affects the likelihood of an employee experiencing a needlestick injury?
   1) age and sex,
   2) education and experience,
   3) type of service in which employed,
   4) number and types of needles used,
   5) needle handling and disposal practices,
   6) risk awareness and management,
   7) self-initiated health practices.

CHAPTER 2. BACKGROUND TO THE STUDY

Consequences and costs of needlestick injuries

Medical consequences of needlesticks

At least twenty-one different infectious agents are known to cause disease in hospital employees injured by needles or other "sharps", such as metal instruments and broken glass (Collins and Kennedy, 1987). Studies of the medical consequences of needlestick injuries have focused on two blood-borne viruses, hepatitis B virus (HBV) and the human immunodeficiency virus (HIV).

Hepatitis B: Exposure of a non-immune person to HBV via needlestick carries a risk of developing hepatitis B as high as 25-30% (CDC, 1989; Werner and Grady, 1982). Until recently, the protocol for managing needlestick injuries in hospital employees has concentrated on the prevention of hepatitis B infection in the injured staff member.

AIDS/HIV: Recognition that the etiologic agent for AIDS is transmitted in blood and other body fluids has enhanced interest in controlling job-related infection risks. Results of prospective studies monitoring health care workers exposed to HIV-infected blood and body fluids indicate where the risk

is greatest. The Cooperative Needlestick Surveillance Group of the U.S. Centers for Disease Control (CDC) has identified needlestick exposure to HIV-infected blood as the event associated with greatest risk of seroconversion (Marcus, 1988). In this study, the largest of its kind, 80% of exposures as of July 31, 1988 were by needlestick injury; the two occupational groups with the largest number of exposures were nurses and laboratory technologists/phlebotomists.

Inclusion criteria have been modified since the project began in 1983 (McCray, 1986) and now include parenteral, mucosal or non-intact skin exposure to the blood of a HIV-infected individual. A Canadian prospective study was initiated in 1985 and had enrolled 336 health care workers by May, 1990 (Federal Centre for AIDS, 1990). Parenteral, mucous membrane and non-intact skin exposures to HIV-infected blood and body fluids are included; needlestick injuries account for 53% of exposures. In a British study (McEvoy et al., 1987) monitoring the same categories of exposures, needlesticks accounted for thirty-five percent of injured health care workers (n=150).

The differences among the studies in proportion of exposures due to needlesticks may be related to variations in inclusion criteria and method of data collection. Proportions of occupational groups among enrollees also vary; for example, San Francisco General Hospital, which takes a proactive approach to recruiting subjects, has a higher proportion of

physicians and, consequently, lower proportions of some other occupational groups than other studies (Gerberding et al., 1987).

Participation in a surveillance program is voluntary, both for the exposed individual and for the hospital. In addition to national programs, hospitals treating large numbers of HIV-infected patients may elect to establish their own surveillance programs (Gerberding et al., 1987; Strickler, 1988). Study enrollees are tested for evidence of seroconversion at intervals up to one year after exposure and they are counselled regarding measures to prevent HIV transmission (CDC, 1989). They may be required to complete a confidential questionnaire about non-occupational risk factors.

Rate of infection with HIV, as measured by incidence of seroconversion (production of antibody to the virus), has been estimated at 0.4 - 0.5% for persons exposed through needlestick to blood containing the virus (Gerberding, 1987; Marcus, 1988; CDC, 1989). Seroconversions following cutaneous exposures have not been documented in the prospective studies; the seroconversion rate has been estimated at <0.13% per exposure (Weber and Rutala, 1989). Eighteen documented instances of occupationally-acquired HIV infection in health care workers have been reported worldwide (CDC, 1989); there have been no seroconversions reported in Canada to date (Federal Centre for AIDS, May, 1990).

Published reports of seroconversion rates and numbers of work-related HIV infections have been criticized as underestimates (Baddour, 1987; Kelen, 1988b; Schaffner, 1989). The critics maintain that conservative criteria for classifying work-related HIV infection result in infected health care workers being placed into other risk categories.

Additional medical consequences: Detailed examination of medical risks associated with injury by needles contaminated with infectious agents other than HBV or HIV, or with hazardous agents such as chemotherapeutic drugs has not been published.

The emotional impact of needlestick injuries may include anxiety and anger at one's self (Marrie et al., 1989). Two weeks after an needlestick injury, 18% of subjects reported sleep loss due to anxiety and 9% had a change in appetite.

Financial costs related to needlesticks

Hospital expenditures related to needlesticks include costs of prevention measures, injury management and treatment of needlestick-related disability. All costs quoted are in U.S. dollars, unless otherwise specified.

Costs of preventive measures: Spending on needlestick prevention pays for special equipment and supplies plus staff education and training to introduce new policies. Ribner et al. (1987) reported that new disposal containers in a 720-bed hospital cost $8000 per year, about $3100 more than the cardboard boxes used previously; they estimated a consequent reduction in disposal-related needlesticks would save $4000 annually. Contaminated material containers for one year in a 904-bed hospital cost $38,500; point-of-use placement of the containers in each patient room was expected to cost $27,500 (Sanborn et al., 1988). Sanborn anticipated that the high costs of the disposal containers could be offset by a decrease in costs ($62,000) of treating needle injuries.

Stock et al. (1990) estimated the cost of disposal containers and supplies such as bleach at $30,770 (Canadian) for a 450-bed hospital. Education expenses were placed at $13,155, which covered partial salary for the infection control officer ($6000) and one-half hour lost working time for 1000 employees ($7155).

Costs of needlestick treatment: A typical needlestick follow-up protocol includes several components, as follows:

(1) Basic management:

- immediate care of the injury site,

- completion of an incident report by the employee, often in conjunction with the immediate supervisor,
- an interview of the injured employee conducted by the staff health department,
- a review of the employee's vaccination records to ascertain the need for tetanus prophylaxis,
- identification of the patient-source (the person on whom the needle was used).

(2) Hepatitis B prophylaxis:

- determination of immunization status of the employee through records and, if necessary, blood testing,
- testing the patient-source for hepatitis B surface antigen (HBsAg),
- administration of hepatitis B vaccine, hepatitis B immune globulin (HBIg) and/or immune serum globulin (ISG).

Appendix A, page 156, gives a more complete description of post-exposure prophylaxis for hepatitis B.

(3) Human immunodeficiency virus (HIV) testing:

- if the patient-source is known or suspected to be HIV-antigen positive, the employee may elect to undertake periodic testing for anti-HIV. This will necessitate pre-test counselling and

may involve enrolment in an external surveillance program (Federal Centre for AIDS, 1987).

- the patient-source may be asked to undergo HIV testing, which will require informed consent and pre-test counselling of the patient.

Reported costs of managing needlestick injuries are high and increasing (Table 1). An unpublished study at St. Clare's Mercy Hospital in St. John's, Newfoundland (Scanlon, 1990) calculated costs for treating needlestick injuries between January 1987 and April 1988, under the protocol outlined in Appendix A, page 156. Total costs for testing and hepatitis B vaccination following 71 needlesticks were $9072.95.

Needlestick management costs will be affected by how many components of the model protocol are implemented. Routine testing of the injured employee and the patient-source for hepatitis B virus (HBV) markers following needlestick injury is now recommended by the CDC (1985) and the Newfoundland Department of Health (1989). Testing of either employee or patient for evidence of HIV exposure is complicated by the requirement to provide counselling and to obtain informed consent (Health and Welfare Canada, 1989). Decisions regarding HIV testing are made on a case-by-case basis.

Table 1: Reported costs per needlestick injury

INVESTIGATORS/ TYPE OF HOSPITAL	AVERAGE COST (Range) Per needlestick	COMMENTS
McCormick and Maki, 1979 University hospital.	$33	HB vaccine and HBIg not administered.
Reed et al., 1979 Veterans' hospital.	$60	HBIg administered, but not HB vaccine.
Kirkman-Liff and Dandoy, 1984 Six non-federal, non-university hospitals.	$92 ($0-496)	Included other percutaneous and mucosal exposures as well as needlesticks.
Ribner et al., 1987 Tertiary care hospital.	$95-183	
Edmond et al., 1988 Teaching hospital.	$120 ($11-480)	
Sanborn et al., 1988 Tertiary care hospital.	$363	Amount quoted was most frequent cost of treatment, not an average.
Scanlon, 1990 Tertiary care hospital.	$127*	Costs of HBIg, ISG and salary not included.

* Canadian dollars. All others are $U.S..

Costs of needlestick-related disability: Kirkman-Liff and Dandoy (1984) describe one work-related case of hepatitis B which cost $13,376 for medical care, Workers' Compensation payments and 82 days lost employment. Stock and colleagues (1990) estimate the direct costs of a hypothetical case of work-related AIDS at almost $45,000 Cdn. for medical care, and the indirect costs resulting from lifetime wage losses at $510,000. Recognition of AIDS as a compensable condition by

one Workers' Compensation jurisdiction is pending (Heard, 1989). Civil claims against employing hospitals are also likely; one such case is said to have been settled out-of-court for more than $1,000,000 U.S. (Alpert, 1990).

Epidemiology of needlestick injuries

Needlestick injuries as an occupational health problem

The National Institutes of Occupational Health and Safety (NIOSH) in the United States found that, among occupational injuries treated in hospital emergency rooms in 1982, fingers were the most commonly affected site, with 25.7% of all injuries (CDC, 1982). In the NIOSH study, 9.4% of finger injuries - an estimated 77,200 - were needle punctures. While not all of those injured were hospital workers, the figures do suggest that needlesticks are a significant public health concern.

Needlesticks comprise approximately one third of all work-related accidents among hospital employees (McCormick and Maki, 1981; Osterman, 1975).

Needlestick injury rates

A variety of measurements have been employed when calculating needlestick injury rates in hospitals. While some

reported rates have been based on number of beds (for example, Jacobson et al., 1983) or number of devices purchased (Jagger et al., 1988), the more common approach has been to use staffing figures as denominator. This denominator has evolved from number of employees to number of full-time equivalents (FTE). The number of FTE is calculated by dividing the total paid hours for an employee group by the normal number of paid hours for a full-time person; this enables comparisons of groups with varying compositions of full-time and part-time staff members. Needlestick injury rates are now usually recorded as number of injuries per 100 FTE per annum.

Table 2 shows the findings of several studies of needlestick injuries. In addition to genuine differences in needlestick injury rates, the wide variation in annual rates may be influenced by factors such as the following:

1) injury reporting and recording procedures,
2) needlestick injury definition (for example, are injuries with clean needles included in the rate calculation?),
3) attitudes and beliefs influencing whether an employee reports an injury (Does the injury impose a significant risk? Will reporting to staff health lead to actions which will reduce that risk? Will there be unpleasant repercussions for acknowledged violations of safety guidelines?), and
4) method of data gathering.

Table 2: Rates of hospital needlestick injuries

INVESTIGATORS		ALL STAFF	NURSING	LABORATORY	DENOMINATOR
Recorded by staff health:					
McCormick and Maki, 1981		8.2	9.3	10.5	100 staff
Ruben et al., 1983		16	23	12	100 staff
Neuberger et al., 1984		4.9	12.4	6.7	100 FTE
Fishman et al., 1985	(a)	NA*	7.6	NA	100 staff
	(a)	NA	9.3	8.3	100 FTE
	(b)	NA	14.5	NA	100 staff
	(b)	NA	28.0	15.8	100 FTE
Waldron, 1985		NA	3.0	3.9	100 staff
Ribner et al., 1987		8.7	23.2	7.6	100 FTE
Self-reported anonymously:					
Hamory, 1983		42	61.1	25.5	100 staff

* NA = not available.

Wide rate ranges were found for all hospital departments; most studies found the highest injury rates among nurses. Hamory's self-reported rates were far higher than those recorded by staff health departments in all other studies. Fishman's results (Table 2) illustrate that when injuries are reported per 100 FTE the rates will be higher than when presented as rates per 100 (full- and part-time) employees; the degree of difference is not constant. For

example, 7.6 injuries per 100 nurses in Hospital (a) became 9.3 per 100 FTE, while 14.5 injuries per 100 nurses in Hospital (b) almost doubled when expressed as needlesticks per 100 FTE. The more part-time employees a hospital has and the fewer hours worked by each, the greater will be the difference between the rate per 100 staff and rate per 100 FTE.

A study from Britain (Anon., 1982) was not included in Table 2. Its remarkably low rate of injuries recorded by the occupational health department (1.7 per 100 nurses) was contradicted by a survey which found that a small sample of the same nurses had an injury rate in the previous year of 50 per 100, thirty times the recorded rate. In addition, needlesticks comprised only 4.5% of injuries to hospital employees compared with 25-36% reported elsewhere (McCormick and Maki, 1981; Osterman, 1975). In the British study, the onus to report injuries to the occupational health department fell to the supervisor; occupational health apparently did not coordinate management of needlesticks. The absence of direct communication between injured employees and occupational health may have contributed to under-reporting.

Also excluded from Table 2 were studies limited to specialized occupational situations, such as blood donor clinics (McGuff and Popovsky, 1989) or the operating room (Mansour, 1989).

Proportionate rates

Another way needlestick injury rates have been evaluated is by determining the proportion of injuries contributed by employees from various hospital departments (Table 3). With the exception of Waldron's small study, the proportionate range of needlesticks contributed by the nursing department is fairly narrow, at 60-75%. The combination of a high injury rate for nurses and the magnitude of this occupational group within the hospital makes nursing departments the source of most reported needlestick injuries.

The proportionate range for the laboratory is wide, with the percentage of injuries from one hospital three times that of another. Needle injury rates may be related in part to whether or not blood collection is performed by laboratory employees. While phlebotomy teams are usually attached to the laboratory, in some hospitals they are a separate department and in others they are affiliated with nursing.

The "other" category includes all remaining hospital employees reporting needlesticks. Many of these are not actual users of needles, but are in areas (housekeeping, central supply, laundry) where they encounter improperly discarded needles.

Table 3: Proportionate needlestick injury rates*

INVESTIGATORS	n	NURSES %	LABORATORY %	OTHER %
McCormick and Maki, 1981	316	60	15	26
Hamory, 1983	148	66	11	24
Ruben et al., 1983	579	66	10	24
Neuberger et al., 1984	286	62	9	29
Fishman et al., 1985	115	63	8	29
Ribner et al., 1985	238	70	5	25
Waldron, 1986	64	45	16	39
Krasinski et al., 1987	315	75	5	19
Jagger et al., 1988	326	64	NA**	35

* Study totals may not be 100% due to rounding.
** Laboratory personnel not listed as a separate category.

Studies by Reed et al. (1983) and Jacobson et al. (1983) were not considered appropriate for comparison, since they included injuries caused by sharps other than needles.

Extent of under-reporting of needlestick injuries

Needlestick injuries are not always reported to staff health departments. Jagger et al. (1988) interviewed hospital employees who reported a needlestick injury and found that 39% had failed to report a previous injury.

Additional estimates of under-reporting came from data gathered through anonymous surveys. Forty percent of nurses and physicians in a two-hospital survey conducted by Jackson et al. (1986) said they had done nothing about needlestick injuries incurred in the past year. In Hamory's 1983 survey of ten hospital departments, 60% of those who stated on a questionnaire that they had experienced a needlestick injury in the past three months said they had not reported it. Jacobson et al. (1983) found that half of nurses surveyed and 92% of laboratory workers did not seek treatment for puncture wounds experienced in the preceding year. Employees in the latter two studies explained their failure to report by the fact that the needle involved was sterile, the injury was considered unimportant, the reporting procedure was inconvenient or they were unaware of any treatment program.

Participants in all four studies which estimated the extent of needlestick under-reporting were self-selected in that they had reported a recent needlestick injury (Jagger et al., 1988) or had voluntarily participated in a survey. It is not known whether their reporting practices are representative of health care workers in general.

Mechanisms of needlestick injuries

Activities associated with needlestick injuries

Early attempts to classify needlestick injury mechanisms were limited to affixing blame. In 1980, Reed et al. (and Jacobson et al., 1983, following their example) divided needlestick injuries into two types:

1) "innocent victim", those resulting from the actions of someone other than the injured person (e.g. injuries to housekeeping staff from improperly discarded needles), and
2) "personal carelessness", injuries which occurred to the employee in control of the needle.

The latter classification offered neither understanding nor solutions to nurses, laboratory staff and others who were blamed for their misfortune.

More objective attempts at categorization described the activity occurring at the time of injury. Comparisons of studies are difficult since categories have not been used consistently and the survey populations differ in composition. Classifications extrapolated from seven studies are summarized in Table 4.

Procedural needlesticks are those which happen while giving an injection, drawing blood or performing another clinical or laboratory technique. Recapping injuries occur

while replacing caps back on the used needle. The disposal category used here is a broad one, including injuries resulting from equipment disassembly, carrying used needles, inserting material into disposal units, and encountering needles protruding from trash or on a surface or in bedding. "Other" includes injuries whose circumstances were not on record and activities associated with only small proportions of needlesticks.

Table 4: Categories of needlestick injuries*

INVESTIGATORS/ DEPARTMENTS	PROCEDURAL %	RECAPPING %	DISPOSAL %	OTHER %
McCormick and Maki, 1981 Nursing and laboratory	61	9	18	12
Ruben et al., 1983 Nursing	19	25	32	24
Neuberger et al., 1984 Nursing and laboratory	51	24	11	14
Krasinski et al., 1987 Nursing	20	13	37	30
Ribner et al., 1987 Nursing and laboratory	54	26	20	..
Edmond et al., 1988 All departments	55	22	22	2
Jagger et al., 1988 All departments	17	30	47	6
Means	40	21	27	13

* Study totals may not equal 100% due to rounding.

Measures to control needle injuries need to take into account the events surrounding those injuries. While individual studies differ considerably, the calculated means (Table 4) suggest that most needlesticks occur either during procedures or in the process of needle disposal, with needle-recapping third in frequency. It must be noted that employees in all studies listed except that of Jagger et al. (1988) were providing injury descriptions which would become part of the hospital's official records; whether they would have described the circumstances differently if anonymity was ensured is unknown.

Equipment associated with needlestick injuries

Jagger et al. (1988) first documented that needlestick injury rates were different for various types of equipment used with needles. Rates per equipment type were calculated using as denominator the number of units of that device purchased by the hospital. Disposable syringes, which were associated with the greatest number of reported injuries, had the lowest rate of injury at 6.9 needlesticks per 100,000. Devices involved in far more injuries on a per-item basis included intravenous tubing needle assemblies (36.7 per 100,000), vacuum-tube blood collection sets (25.4), intravenous catheters (18.4) and butterfly-type needles (18.2). Apart from the Jagger study, the contribution of

equipment type to the risk of incurring a needlestick injury has received little attention.

To pursue this line of investigation, participants in the present study were asked to identify the various types of needled instruments they ordinarily use and state which type had been involved in their most recent needlestick injury.

Factors affecting needlestick injuries

McCurdy et al. (1989), in a study of mucocutaneous injuries, and Hamory, examining needlesticks (1983), found that recently-employed persons had more injuries than other hospital employees. McCurdy also found that nurses who "float" among various nursing areas had higher injury rates. Neuberger and colleagues (1984) identified part-time and night-shift personnel as having greater risk of injury; they also speculated that factors contributing to high rates in night shift workers might include inadequate staffing, fatigue, poor lighting and less opportunity to attend educational sessions. On the other hand, injured and uninjured nurses in a blood donor clinic did not differ with respect to age, length of employment or time elapsed into work shift (McGuff and Popovsky, 1989).

CDC measures to prevent needlesticks

Until the last decade, it was standard practice for health professionals to place caps back onto used needles, manually detach the needle from the syringe or other equipment, and discard the needle by itself into a designated container. Many hospitals cut the tips off needles to render them inoperable. With increasing concern about hepatitis B and, later, AIDS transmission, strategies were sought to reduce the number of needlestick injuries. Needle recapping and disassembly and the collection of used needles in easily-punctured containers were all believed to contribute to the occurrence of needlestick injuries. Needle cutting devices were problematic since they sometimes splashed the user with blood.

CDC guidelines

In August, 1987, the Centers for Disease Control (CDC, 1987) recommended that all patients be treated with the blood and body fluid precautions previously reserved for those known or suspected of carrying blood-borne pathogens (Williams, 1983). This approach, called "Universal Precautions", has been endorsed by many agencies, including, in Canada, the Federal Centre for AIDS, the Bureau of Communicable Disease Epidemiology and the Laboratory Centre

for Disease Control (Health and Welfare Canada, 1987). The recommendations are updated from time to time and include the following principles related to needle handling (CDC, 1989):

1) Needles should not be recapped, purposely bent or broken by hand, removed from disposable syringes or otherwise manipulated by hand. ...sharp items should be placed in puncture-resistant containers for disposal; the puncture-resistant containers should be located as close as practical to the use area.

2) Barrier precautions, including gloves, masks and gowns, should be used to prevent skin and mucous membrane exposure when contact with blood and body fluids is anticipated.

3) Gloves should always be available to those who wish to use them for phlebotomy and should be worn when the risk of blood exposure is increased. Institutions in areas with a low prevalence of blood-borne pathogens which do not require gloves to be worn by skilled phlebotomists should review this policy periodically.

The CDC document also states that implementation of universal blood and body-fluid precautions for all patients eliminates the need for identifying and isolating those known or suspected of having blood-borne disease. It recommends that employers of health care workers ensure that policies

exist for education and training of staff regarding HIV and universal precautions, and that staff be monitored for adherence to recommended procedures.

Effectiveness of CDC guidelines

The most common approach to reducing needlestick injuries, both before and after the introduction of Universal Precautions, has included three main aspects:

1) education and training sessions to introduce changes,
2) provision of puncture-resistant containers for used needles, and
3) prohibition of recapping, cutting or bending used needles.

Krasinski et al. (1987) and Ribner et al. (1987) described studies which incorporated all of these elements. In both cases, needlesticks directly related to the nature of the disposal container (for example, those caused by protruding needles) were reduced, but no decrease in overall injury rate was achieved. Injuries due to recapping of used needles did not decrease, in spite of the education program. Straub et al. (1986) reported no significant lasting change in needlestick injury rates following the introduction of a rigid system for needle collection, accompanied by an

education program. Injury rates decreased during the year following implementation of the new program, but this trend did not continue. In this study, nursing units which placed needle disposal containers at each bedside reduced injuries by 49% compared to an 18% decline in other units.

Edmond et al. (1988) and Seto et al. (1990) each studied the effect of an education program and improved needle containers on the frequency of needle recapping. There was no change in observed recapping frequency in Edmond's study, where participants were unaware they were being monitored. Seto, however, found that nurses required to attend a live, in-service presentation were less likely to be recapping needles five weeks later than nurses not exposed to the presentation. Frequency of non-recapping behaviour in this study was measured by anonymous self-reports and by examining discarded needles to determine whether or not they had been recapped. Eighty-five percent of the study group reported no recapping and 57% of their discarded needles were uncapped; 21% of one control group were not recapping and 27% of their discarded needles were uncapped.

Sanborn et al. (1988) described a pilot study which provided point-of-use placement of new contaminated material containers in four nursing units in a university hospital. Educational sessions were provided and staff members were surveyed prior to and during the study. Eighty-six percent of nurses who completed questionnaires before the study began

reported recapping used needles all or some of the time; this was reduced to 61% six months into the study. Fewer needlestick injuries were reported to staff health during this period compared to the previous six months.

Most major published studies of needlestick injuries were designed to describe the needlestick problem in the authors' hospital, rather than report the outcome of a needlestick prevention program (Reed et al., 1980; McCormick and Maki, 1981; Hamory,1983; Jacobson et al, 1983; Ruben et al., 1983; Neuberger et al., 1984). Many conclude by stating that, now that more is known about needlesticks in their facility, interventions are being planned in order to reduce the problem. Reports of the outcomes of these programs have not yet been published.

Critique of CDC guidelines

It can be seen from the previous section that limited data exist to confirm the efficacy of the CDC approach - education, improved disposal containers and no recapping. A brief examination of each aspect may help explain the limitations.

Education: Educational endeavours related to injury prevention "in general have consumed large shares of 'safety' budgets without commensurate benefits" (Baker, 1975). It is

naive to think that simply informing health care workers of new regulations will result in major behaviour changes. Decision-makers must ensure that new equipment and policies truly meet the needs of those who are to use them.

Containers: Disposal containers made of puncture-resistant material (usually a rigid plastic) have replaced flimsier ones used previously. Containers have openings wide enough to accept the needle and attached equipment, such as a disposable syringe, without disassembly. Manufacturers now supply sturdy containers in a range of sizes suitable for wall-mounting or placing on medication trays, trolleys, shelves or nursing stations (Porter, 1990).

Uncapped needles attached to reusable equipment, for example, blood collection vacuum tube holders, cannot usually be detached by hand. Some disposal containers allow the uncapped needle to be separated from the holder or syringe. The needle hub is held in a slot at the top of the container while the holder is rotated, thereby unscrewing the needle, which then falls into the container. These containers can be quite small since they will hold only needles; some blood collectors use a pocket-sized design.

There are limitations to the ability of needle disposal containers to reduce needlestick injuries. Unless disposal units are located very close to the site of needle-use, employees may be forced to carry uncapped needles to the

container, with the inherent risk of pricking themselves or another individual en route. Some will choose instead to recap the needle. Most needle containers work well for receiving syringes, intravenous catheter stylets and other devices which are small in size and easy to manipulate. Cumbersome devices, such as long stylets used for introducing peritoneal dialysis catheters, or needles attached to intravenous tubing, may be more difficult to insert into the container.

Needle disposal containers must have openings which provide for easy deposition of waste materials without exposing the health care worker to contact with needles already inside. Regular replacement of containers is necessary to avoid overfilling, which could cause needles to protrude from the opening or be forced through the sides.

To summarize, new disposal containers offer several safety advantages, but unless they are close at hand, easy to use and replaced before they are full, staff will not benefit from them. Special problems not adequately covered by CDC guidelines, such as how to disconnect vacuum-tube needles and how to dispose of awkward pieces of equipment must be addressed at the hospital level.

<u>"No recapping" policies:</u> The Society of Hospital Epidemiologists of America (SHEA) believes that "it is counterproductive to flatly prohibit recapping of needles"

(Weinstein, 1990). Similar views have been expressed frequently by Jagger and colleagues (1987, 1988, 1989; Anon., 1988a; Anon., 1989), who point out that rather than acting irresponsibly when recapping needles, employees are using the means they judge most appropriate to protect themselves and others. The CDC "no recapping" directive does not cover every type of needle and every situation. Employees who must manipulate equipment or who must carry needles through a room or corridor to reach a disposal container are on their own. Needle recapping has been declared unsafe, but strict compliance with "no recapping" policies also carries risks.

Acceptance of Universal Precautions: Some health care workers believe that use of CDC-recommended blood precautions is necessary only for patients known or suspected of carrying a blood-borne pathogen. These employees would like "high-risk" patients to be identified. Hospitals have customarily used warning labels on patient beds, room doors, requisitions and specimens to alert employees and visitors to the presence of infectious diseases. However, in the case of AIDS, this type of patient identification raises serious concerns; health care workers, by their own admission, may adopt discriminatory practices towards these patients (Gordin et al., 1987; Searle, 1987). Labels now specify the type of precautions needed (e.g., blood and body fluid for HIV infection), rather than

stating which disease is present, but any labelling may jeopardize a patient's right to privacy.

Full implementation of the principles of Universal Precautions means that all patients are treated equally and labelling is discontinued. This has proven to be a controversial issue, with some still in favour of knowing which patients pose a risk to health workers (Godfrey, 1988; Lassen, 1989). According to Leubbert (1990), laboratory technologists who want warning labels for specimens from patients with hepatitis or HIV infection are in one of two categories. When asked what they would do differently with labelled specimens, those in the first category name procedures which should be standard for all patients (e.g., wearing gloves when they have open cuts). Those in the second category would use unnecessary or redundant procedures (e.g., autoclaving leftover samples, when the laboratory already has a policy of incinerating all discarded blood products).

The alleged benefit of divulging patient diagnostic information as a protective measure is disputed by findings that many infected patients have not been diagnosed and that health care workers have not be shown to get fewer needlestick injuries when dealing with known AIDS patients. Kelen et al. (1988a) found that 92 of 119 patients with HIV infection presenting to a hospital emergency room were not known to be seropositive. In one hospital which used "biohazard" warning labels on blood specimens (Hansfield,

1987), a study found that 33% of HIV antibody-positive samples and 72% of those with HBsAg did not carry the hazardous designation. Authors of both studies endorse the use of Universal Precautions for all patients and their specimens.

Published reports documenting needlestick injuries among those treating AIDS patients show that knowledge of infection is no assurance that injury can be prevented (Weiss et al., 1985; Wormser et al., 1984 and 1988; Meltzer, 1989). There are even some who believe that health care workers dealing with known AIDS patients may have an increased likelihood of injury, resulting from heightened anxiety (Sande and Cooke, 1990; Anon., 1988b).

Monitoring and enforcement: While CDC recommends monitoring adherence to their HIV and HBV prevention guidelines, there have been no reports documenting the effect of monitoring on employee compliance. The two studies reported earlier which achieved a measurable reduction in recapping frequency (Sanborn et al., 1988; Seto et al., 1990) are noteworthy for the continued involvement of the investigators with the participants. The requests to complete multiple questionnaires may in themselves have had an impact. Subjects may have felt they were being monitored (though responses were anonymous) and had better act as instructed or, alternatively, they may have simply responded favourably to the attention.

The Occupational Safety and Health Administration in the United States has developed a Proposed Standard for the Protection of Workers from the Hazards of Bloodborne Pathogens (OSHA, 1989), which would mandate infection control measures in hospitals and other workplaces where there is the potential for blood exposure. The onus placed on hospitals to ensure workplace safety will bring a new dimension to efforts to reduce needlestick injuries. Enforcement of safety regulations, rather than just monitoring, is one expected outcome, as employers strive to demonstrate compliance with OSHA demands.

Densmore (1989) reported the case of a Texas nurse fired after she accidentally stuck a co-worker with a needle used in treating an HIV-infected patient. A newspaper story said the nurse was terminated for gross negligence. She was apparently carrying the used needle across an emergency treatment room to place it in a disposal container.

Alternative measures to prevent needlesticks

While the approach taken by the CDC to reduce needlestick injuries has been widely publicized and endorsed, other strategies have also been proposed. Some of these dispute the merit of the CDC guidelines; others offer changes which would obviate the need for some current safety practices.

Safer needle recapping

Recapping used needles with two hands places the hand holding the cap at risk. If the operator misses the cap when attempting to insert the needle, the contaminated needle may puncture the hand holding the cap. Needle recapping may be still be reasonable when disassembly of equipment is required before disposal (for example, needle holders for vacuum tube blood collection sets are reusable, so needles must be detached from the holder and discarded separately). Recapping may also be advisable when disposal containers are not available. Some alternatives to two-handed recapping will be described.

One-handed needle recapping: Needle recapping can be accomplished by a single-handed technique without any special equipment. When the needle cap is removed prior to use, it is laid on its side near the operator. After using the needle, the employee scoops the cap up and back on to the needle by inserting the needle tip into the cap, keeping one hand free. Once the needle tip is covered, the second hand secures the cap in place. The covered needle may then be discarded along with any attached equipment, or it may be detached and discarded separately.

Many devices, both purchased and "homemade", have been proposed for facilitating one-handed needle recapping.

These include wooden stands with holes drilled in the top (Vasant, 1986), polystyrene foam blocks (Dowker, 1987), towel holders (Bailey, 1986), "hedgehog" pencil holders (Vasant,1987), used food cans (Kaufman, 1988) and specially designed needle cap holders (Bessent et al., 1987; Parker, 1987; Sherwood Medical, 1989). All hold the cap while the needle is being used; at the end of the procedure, the needle is inserted back into the cap. These devices allow more convenient positioning of the cap than laying it on the nearest surface. The gadgets are cheap, reusable and portable. While they appear to provide a sensible way to recap needles, their effectiveness has not been studied (Birnbaum, 1988).

Safer two-handed needle recapping: Two-handed needle recapping may be safer if the hand holding the needle is protected. Wider needle-caps have been promoted (Huber and Sumner, 1987), as has a rigid disc-shaped shield which has an opening at its center to enable it to slip over the cap and serve the same function.

Goldwater and colleagues (Goldwater et al., 1987, 1989a, 1989b; Nixon, 1986) have reported a fourfold reduction in needlestick injuries among phlebotomists using their patented "Needle Guard" shield. Most needles used by the subjects were attached to vacuum-tube blood collection equipment. The results would be encouraging if they could be

reproduced elsewhere, but there are some puzzling aspects to the reported findings. The number of venepunctures performed daily by these "full-time venepuncturists" (Goldwater et al., 1989a) appears to be very low, fewer than twenty per person. In contrast, the present study found that many blood collectors used between 60 and 100 needles per shift. The injury frequency for guard users is reported as 30 for 47 persons in 33 months, which converts to an annual rate of 23.2 per 100 full-time employees. Non-users had a rate of 91.7 per 100. Even the rate achieved by using the device (23.2) is higher than the range of 3.9 - 15.8 reported injuries per 100 laboratory employees (Table 2). In another comparison, Goldwater's reduced needlestick rate of 6.2 per 100,000 venepunctures is similar to the 7.4 per 100,000 reported by McCormick and Maki (1981) in a study pre-dating the CDC guidelines.

Guard users in the Goldwater study reported fewer needlestick injuries of all types compared with non-users, though there is no obvious reason why the incidence of procedural or disposal injuries would have been affected by the manner in which the cap was replaced. It may be that those who chose to use the guard were more careful in all aspects of needle-handling than non-users; it might also mean they were less likely to report injuries of any type.

The criteria by which individuals "were regarded as non-users" (Goldwater et al., 1989a) is unclear. Employees

feeling some pressure to support the study may have declared themselves to be users. Reporting a recapping injury may have led to scrutiny of all aspects of an employee's technique, including use or non-use of the guard. Since uninjured persons were not likely to have been interviewed in depth, a comparison of the prevalence of guard usage and an estimation of its potential for reducing risk are not possible.

Redesigned equipment

Long-term approaches to controlling needlestick injuries include major changes in design and use of needles and related equipment. Ideally, a device to prevent needlesticks would exert its protective effect without requiring any deliberate action on the part of the user. Passive measures of injury prevention, for example automatic air bags in automobiles, are more effective than active strategies, such as seat belts, which require compliance of the individual (Haddon, 1974; Robertson, 1975). Non-recapping or safer recapping strategies fail because they require health care workers to take protective action after each and every needle use. A passive safety device would cover the needle tip so that the operator is never exposed to a contaminated needle.

One kind of device meeting these criteria is a needle which, in effect, self-destructs with use. In one model, a solid piston is forced through the hollow needle shaft and out through the end, so that the sharp tip is no linger exposed (Zimmerman, 1988). Other devices require the operator, once the needle is used, to push or release into place a shield which covers the needle tip. A search conducted in January, 1989 in the U.S. disclosed eighteen patents issued in the preceding three years for this type of needle covering device (Imai, 1989). The new products are more expensive than those currently in use; their efficacy in reducing needlesticks has yet to be established.

Reducing the number of needles used when administering drugs has been suggested (Shulman and Gorman, 1988). Kempen (1988 and 1989) described a European cannula which eliminates the use of needles for adding drugs to secondary lines during intravenous therapy. Similarly, laboratory use of needle and syringe to aspirate and dispense samples has been discontinued wherever possible (Collins, 1988). Existing manual and mechanical pipetting devices can replace needles for most laboratory purposes.

Directions for further study

Studies of needlestick injuries published to date include:

1) calculation of needlestick injury rates, most often using hospital-recorded data from a single hospital;
2) descriptive studies of needlestick injury mechanisms and/or factors affecting injury rates; and
3) reports (few in number) of the effect of an intervention on needlestick rates.

To enhance understanding of needlestick injuries, future studies must do more than document injury rates for a single location and time. Published reports show large rate variations without enough information for comparing and explaining differences. Descriptive studies can gather detailed information on normal needle-handling procedures and the circumstances of needlestick injuries. For instance, it is known that most needlestick injuries recorded by staff health departments are reported by nurses. What is less clear is whether nurses experience more needlestick injuries on a per capita basis than others or whether they report injuries more often. If nurses are injured more often than laboratory technologists, phlebotomists or physicians, it should be possible to identify the factors which contribute to this. This study has compared nurses and laboratory employees with

regard to numbers and types of needles used, needle handling and disposal practices and demographics. Other studies are needed to confirm its findings, expand to other occupational groups (e.g., physicians) and examine the effect of additional variables such as workload and prevalence of HIV infection on needlestick injury rate.

Randomized trials of needlestick preventive strategies may be constrained by ethical and legal considerations (staff cannot be required to follow procedures condemned by regulatory agencies), but assessment of the merits of various products and procedures is still possible. Examples of how this may be done include:

1) Comparison of needlestick injury rates in the same facility before and after implementation of preventive programs. Assessing staff compliance with recommended procedures will be necessary in order to properly interpret impact. For example, if few persons comply with a "no recapping" policy, it would be a mistake to attribute changes in needlestick injury rates - positive or negative - to the policy.

2) Assuming that CDC or equivalent infection control recommendations are maintained as the minimum, pilot studies can be used to evaluate the efficacy of any further changes within a hospital.

3) Examination of existing differences in technique between injured and uninjured persons in the same workplace may uncover successful individual protective strategies which can be endorsed for general use.

4) Comparison of needlestick rates in hospitals which use different needle-handling policies, procedures and/or safety equipment may indicate which of these is more effective in needlestick injury prevention.

Data collection in future needlestick studies must take into consideration high rates of under-reporting of needlestick injuries to staff health departments. Those injuries which are reported may not necessarily be representative of all needlesticks. Descriptions of injuries recorded by staff health departments have not been compared with descriptions of injuries disclosed anonymously. Designs for case-control studies must consider the limitations of using staff health data for subject classification. Studies which identify persons who have reported injuries and then use records, interviews or questionnaires to examine their needlesticks are using a self-selected group which may be different from injured persons who did not report. Sampling from the total population and then asking participants to declare whether or not they have been injured may be a more valid way to assign individuals to categories.

The current study has been designed to describe needlestick injuries in three hospitals in the same city. It attempts to identify differences between injured and uninjured employees in nursing and laboratory departments. The data gathered may provide a basis for planning programs to reduce the incidence of needlestick injuries.

CHAPTER 3. METHODS

Target population

Nursing and laboratory personnel at three hospitals were selected for a descriptive study of needlestick injuries. The hospitals chosen were adult tertiary care teaching facilities in St. John's, Newfoundland. Hospital A is a 528-bed hospital, the designated trauma center for the province. It contains 342 acute care beds, including a number of sub-speciality services, and 186 beds dedicated to chronic care and rehabilitation services. Hospital B, with 303 beds, and Hospital C, with 344 beds, provide primary (local) and secondary (regional) hospital care for the region, as well as some speciality services (Canadian Hospital Directory, 1989; Nycum, 1986).

The choice of nursing and laboratory personnel for the study population was based on the following rationale:

1) Both groups have relatively high rates of needle injuries, as reported in published studies cited in Chapter 2.

2) Most members of both groups have completed a post-secondary certification program of at least three years, during which they received formal training in needle use and needle disposal practices.

3) Both nurses and laboratory employees operate in a hierarchical system where they are subject to rules and guidelines established by the hospital and enforced by supervisory staff.

4) The two groups differ in the types of needles they use and in the way they handle used needles; these differences make the study more informative than if a single occupational classification were used.

Information provided by hospitals

Sources of data

Several departments at each hospital assisted in the study. Infection control and staff education departments described current needle-handling and disposal policies, the means (oral and written) by which such policies are made known to staff, types of disposal equipment currently in use, and training and information sessions offered to employees. Staff health units explained injury reporting procedures, needlestick protocols and hepatitis B vaccination programs for employees. They also provided, where available, statistical data on the number of needlestick injuries recorded from 1985 to 1989. Personnel departments supplied staffing figures which were used as denominators when injury rates were calculated.

Recorded needlestick injuries

Needlestick rates for total hospital staff and for nurses were calculated from hospital-supplied data as the number of injuries per 100 full-time equivalent (FTE) employees per year. The number of FTE in an employee group is calculated by dividing the total paid hours by the number of hours worked by one full-time employee. The use of FTE figures permits comparison with previously published reports. A uniform denominator of 100 FTE eliminates differences between employee groups with varying proportions of full- and part-time workers. For example, a full-time nurse in the target population works 37.5 hours per week. Two part-time nurses each working 18.75 hours per week would equal 1.0 FTE. Laboratory employees are in another union and a laboratory FTE is 35 hours per week. Employees in all three study hospitals are unionized and covered by similar collective agreements.

Calculation of hospital-recorded needlestick injury rates per 100 laboratory employees was substituted for the rate per 100 FTE. It was not possible to determine the number of FTE in the target population, because the human resources departments, which compile staffing figures, were unable to distinguish which laboratory employees met the study entrance criteria. Instead, the number of laboratory employees in the target population at the time of the study was used as

denominator. All laboratories indicated that staffing levels had been stable for several years.

Survey sample

Eligibility for inclusion in the survey sample was restricted to:

1) Graduate, non-supervisory, nurses who ordinarily use needles in the course of their work.
2) Laboratory personnel of all job classifications who normally collect blood as part of their work.

Full-time, part-time and casual employees were included. Individuals were asked on initial contact to exclude themselves from the survey if they never used needles in the course of their work. Only one person, a nurse, excluded herself for this reason.

A sample of nurses from all services was selected by random numbers from staff lists provided by each hospital. A separate selection was made for each facility, with 296 nurses chosen from original lists totalling 1308 names. Sample sizes were calculated using the statistical software package, EPISTAT (Appendix B, page 157). Respondents were asked to identify the nursing unit where they worked; units were grouped into the five categories listed in Appendix J, page 176.

Laboratory administrators provided lists of all employees in their departments who ever collected blood. One hundred and three met this criterion, including 47 persons at Hospital A plus 28 at each of hospitals B and C; all were invited to participate in the survey. Laboratory respondents were classified as technologists or phlebotomists using the criteria described in Appendix K, page 177.

Individuals who had ceased employment or who were not scheduled for work within two weeks of the survey distribution date were excluded from the study. This latter group included those on maternity leave, Workers' Compensation leave or long-term sick leave, and casual employees who worked only on a seasonal basis. Replacements for excluded nurses were selected in the same manner as the original sample. Since all eligible laboratory staff members were already included, no replacements were possible.

Ethical considerations

Permission to conduct the study was granted by the Human Investigation Committee of the Faculty of Medicine, Memorial University and the research ethics committee of each participating hospital. A commitment of anonymity was made to all those asked to take part in the survey. Completion of the questionnaire was taken to indicate individual consent.

Questionnaire

The questionnaire (Appendix C, page 159) was organized into the following categories:

1) types and numbers of needles handled by the employee,
2) disposal of used needles,
3) needlestick injuries - number and description,
4) knowledge and beliefs regarding needlestick injuries,
5) demographics, and
6) lifestyle and health practices.

The questionnaire was self-administered and required approximately fifteen minutes to complete.

Pre-test

The questionnaire was pre-tested in June, 1989 by volunteer nurses and laboratory technologists working in the Faculty of Medicine and the School of Nursing at Memorial University of Newfoundland.

Pilot study

In September, 1989, the revised questionnaire was employed in a pilot study at a St. John's hospital which would not be used in the main study. Questionnaires were distributed to all laboratory employees meeting the inclusion criteria and a random sample of fifty nurses. The experience of the pilot study led to some further modifications of the questionnaire and a change in the method of distributing and collecting the questionnaires in nursing units.

Survey method

Questionnaire distribution

A survey package (Appendix D, page 167) containing a questionnaire, covering letter, survey description, participant card and return envelope was hand-delivered to the hospital work area of each subject. Packages were distributed to those initially selected for the study from November 16-24, 1989. Survey materials reached the last of the replacement subjects by December 8, 1989. Questionnaires for employees not at the worksite at the time of delivery were left in the care of a colleague.

Questionnaire return

Subjects were asked to place the completed questionnaire in a pre-addressed return envelope and put the envelope, in turn, into a large manila pouch or cardboard box left in their work areas. To maintain anonymity, names were not requested on the questionnaire form. Instead, a completed participant card was to be placed in a second receptacle provided for the purpose. This made it possible to know who had responded while keeping the questionnaires anonymous. The card had a space for persons whose job did not involve using needles to declare their ineligibility and it invited participants to request a summary of the study results.

Each nursing station had a set of manila pouches to receive questionnaires and participant cards. These were located at the central desk, on a staff bulletin board, in the lounge area or in the supervisor's office, whichever was deemed most suitable after consultation with a senior staff member. A single set of cardboard boxes, located in a readily accessible area, was placed in each laboratory to collect replies.

First follow-up

It was assumed that persons who did not return survey participant cards had not completed questionnaires. Ten days after initial distribution of the materials, a written reminder was sent (Appendix E, page 170). Personal contact was made during hospital visits with as many non-respondents as possible. Some who worked evenings, nights or weekends were telephoned during work shifts.

Second follow-up

During the week of December 18-22, 1989, approximately a month after initial distribution, the return receptacles were removed from the laboratories and nursing units, since it appeared unlikely that many more responses would be received in this way. Nurses who had still not participated were sent a second reminder (Appendix F, page 171) with another copy of the survey materials. They were asked to return the completed card and questionnaire through the hospital/university mail service in separate self-addressed envelopes provided for the purpose.

Additional reminders

A special appeal (Appendix G, page 172) was sent to nurses in one area where the response rate had been particularly slow up to this time. A final written reminder (Appendix H, 173) also went to a small number of laboratory employees who had not been reached in person.

Notices of thanks were delivered to each nursing station and laboratory section for display on bulletin boards. The notice concluded by saying that any outstanding questionnaires would still be welcomed. All questionnaires returned by January 15, 1990 were included in the analysis.

Data entry and analysis

The software package Epi Info, version 3, supplied by the Epidemiology Program Office of the Centers for Disease Control, was utilized for data entry and the preparation of frequency tables, cross-tabulations and univariate analyses. The program reports Chi-square (X^2) tests of association and probability (p) values for statistical significance. Only associations with significance at $p < .05$ have been specifically reported. Results with $p > .05$, have been presented without specifying p-values.

Needlestick injury rates were calculated and reported using 100 FTE or 100 employees as denominator. The proportions of injured persons are reported as percentages. Mean needlesticks per injured person were calculated by dividing the number of injuries in a category of respondents by the number of injured persons in the same category.

CHAPTER 4. RESULTS

Section A: Hospital-recorded needlestick injury rates

Availability of data

The first objective of the study was to calculate the annual rate of needlestick injuries per 100 full-time equivalent positions (FTE) in each hospital for nursing, laboratory and total staff. This objective was modified due to unavailability of some of the requested data. Human resource departments were able to supply FTE figures for nursing staff and hospital totals. However, staffing figures equivalent to the laboratory survey population could not be obtained since the human resources data base does not identify which laboratory employees ordinarily collect blood. Instead, the number of laboratory employees in the target population at the time of the study was used for rate calculation.

Annual needlestick injury data were unavailable from Hospital C. The staff health nurse supplied needle injury statistics for two separate periods between January 1987 and December 1989 which did not correspond to calendar years; annual rates extrapolated from these data must be interpreted with caution.

Calculated hospital-recorded rates for nurses and all staff

None of the hospitals had achieved a decrease in the rate of needlestick injuries per 100 FTE for nurses or for all staff over the years for which data were supplied (Table 5). For the most recent year, 1989, nursing rates showed considerable variation from hospital to hospital, with Hospital B having a much lower rate than A or C. Hospital-wide rates in the three institutions were very similar.

Table 5: Annual needlestick injury rates per 100 FTE

	NURSING DEPARTMENTS			ALL STAFF		
YEAR	A	B	C	A	B	C
1986	27	13	-	8	9	-
1987	28	19	12	9	9	5
1988	23	13	-	8	8	-
1989	24	12	22	7	7	7

Employees in departments other than nursing and the laboratory were not part of this study, but needlesticks they experienced were included in figures referring to all staff (Table 5). Many of them, such as housekeeping, laundry and central supply personnel, do not use needles for patient care. Also excluded from the study were technologists from radiology and nuclear medicine, nursing students, physicians and others

who use needles regularly but account for only small numbers of reported needlestick injuries.

Laboratory data

Raw data for the laboratory (Table 6) show a decrease in reported needlestick injuries for Hospitals A and B over the past four years. Staffing levels were stable during this time. Table 6 also provides needlestick rates per 100 employees calculated using the number of employees in each laboratory who met the study criteria as of November, 1989.

Table 6: Needlestick injuries to laboratory staff, as recorded by staff health departments

	RECORDED NEEDLESTICKS			RATE / 100 EMPLOYEES		
YEAR	A	B	C	A	B	C
1985	29	-	-	62	-	-
1986	19	13	-	40	46	-
1987	16	5	3	34	18	11
1988	16	2	-	34	7	-
1989	11	1	1	23	4	4

Proportionate distribution

The proportions of recorded needle injuries attributable to the nursing and laboratory departments show wide fluctuations from year to year and considerable variation

among hospitals (Table 7). Some of this is to be expected, since even minor changes can cause a large shift in percentages when frequencies are small.

Table 7: Proportionate distribution of recorded needlestick injuries, by department

HOSP.	YEAR	TOTAL (N)	NURSING (%)	LABORATORY (%)	OTHER (%)
A	1985	167	70	17	13
	1986	179	75	11	14
	1987	189	71	8	21
	1988	174	66	9	25
	1989	157	79	7	14
B	1986	70	56	19	25
	1987	81	73	6	21
	1988	65	60	3	37
	1989	58	64	2	34
C	1987-88	71 (15 mo)	56	6	38
	1988-89	78 (9 mo)	78	2	20

Nurses consistently account for the majority of needlestick injuries. The average annual proportion of needlesticks contributed by the nursing department was 72% at Hospital A, 63% at Hospital B and 67% at Hospital C.

A decline in the proportion of recorded needlestick injuries experienced by laboratory employees has occurred at Hospitals A and B; the entire increase in recorded needlesticks apparent at Hospital C between the first and second time periods can be explained by injuries to nurses.

Summary of hospital-recorded injury rates

Hospital-recorded rates of needlesticks per 100 FTE were similar for all three hospitals over the years 1986-1989. No hospital had achieved a reduction in recorded injuries to nurses or total staff during this period. Rates for nursing staff were lowest at Hospital B. Injuries to nurses in the three hospitals ranged from 64% to 79% of all recorded needlesticks, with Hospital A having the highest and Hospital B the lowest proportion.

Laboratory injuries show a decline in both absolute numbers and in the proportion they contribute to all hospital injuries. The rate and proportion of recorded injuries from the laboratory at Hospital A were higher than at the other two hospitals.

Section B: Survey results

Survey results I: Response rate

The survey response rate, shown in Table 8, was 86% overall. The rate of return was highest from Hospital B. The success of the method used for returning questionnaires is discussed in Appendix I, page 174. Non-respondents were distributed across all nursing areas and laboratory work categories and there was no apparent concentration of full-time, part-time or casual employees.

Table 8: Survey response rates

DEPARTMENT	HOSPITAL A	B	C	Total
Nursing:				
Distributed	107	94	95	296
Returned	90 (84%)	86 (91%)	80 (84%)	256 (86%)
Laboratory:				
Distributed	47	28	28	103
Returned	38 (81%)	26 (93%)	22 (79%)	86 (83%)
Totals:				
Distributed	154	122	123	399
Returned	128 (83%)	112 (92%)	102 (83%)	342 (86%)

Survey results II: Profile of participants

Study participants are profiled under the following headings:

1) age and sex,
2) qualifications,
3) area of work,
4) work experience,
5) length of shift, and
6) job status.

Age and sex

Participants were predominantly young females (Table 9). Seventy-eight percent were under age 40 and almost 95% were female. Most of the males were employed in laboratories. Age and sex distributions were similar among the hospitals.

The virtual absence of subjects over 55 years of age is noteworthy. In the case of technologists, the first large class of medical laboratory technologists in this province graduated from the College of Trades and Technology in 1967. These graduates are now in their forties. Prior to this, small numbers were trained on an less formal basis.

Different circumstances apply to the nurses. Many of those practising at the time they enter their forties have moved into supervisory, teaching or administrative positions

and thus would not have been included in the survey group. Others have left the profession because they no longer have the stamina to cope with the physical demands of the job; some have switched from acute care hospital work to other types of nursing, for example positions in nursing homes (Andrews, 1990).

Table 9. Age and sex of survey participants

AGE (Years)	FEMALE	MALE	TOTAL
<25	53	2	55 (16%)
25-39	199	11	210 (62%)
40-54	62	6	68 (20%)
>54	6	0	6 (2%)
Not stated	3	0	3
Total	323 (94%)	19 (6%)	342 (100%)

Qualifications

All nursing participants held the Registered Nurse qualification (R.N.). The vast majority were graduates of diploma schools of nursing, three percent also held a post-graduate speciality certificate, and eight percent had a Bachelor of Nursing (B.N.) degree (Table 10).

Table 10. Qualifications of participants: nursing

Qualification	n	(%)
R.N. only	227	(90%)
R.N. + B.N.	19	(8%)
R.N. + Certificate	7	(3%)
Not Stated	3	
Total	256	(101%)*

* Total exceeds 100% due to rounding.

More than three-quarters of the laboratory employees had Registered Technologist (R.T.) certification (Table 11). This qualification is comparable, in terms of duration of training (three year diploma program), financial remuneration and national recognition, to the R.N.. Of the remainder, most had been trained on-the-job and three of these had completed a part-time study course for phlebotomists. Two were graduates of a one-year laboratory assistant course and one held a science degree.

Table 11. Qualifications of participants: laboratory

Qualification	n	(%)
R.T.	65	(78%)
On-the-job or phlebotomy training	15	(18%)
One year course	2	(2%)
B.Sc.	1	(1%)
Other/not stated	3	
Total	86	(99%)*

* Total is less than 100% due to rounding.

Area of work

The units where nurses worked were categorized into five areas, with three-quarters of nurses working in medical-surgical or critical care (Table 12). Hospital A's distribution of nursing work areas was different from that of B and C. A majority of nurses from Hospital A were employed on medical-surgical units; most of the remainder worked in critical care and only 16% were in other areas. Hospital A has no obstetrical service, while more than one-fifth of nurses in the study from Hospitals B and C work in obstetrics. All but one of the nine geriatrics nurses were employed at Hospital A.

Table 12. Distribution of nurses by work area* and hospital

AREA	HOSPITAL A	B	C	Total
Medical-surgical	45 (52%)	28 (34%)	29 (38%)	102 (42%)
Critical care	28 (32%)	28 (34%)	25 (33%)	81 (33%)
Obstetrics	0 (0%)	18 (22%)	16 (21%)	34 (14%)
Psychiatry	6 (7%)	9 (11%)	5 (7%)	20 (8%)
Geriatrics	8 (9%)	0 (0%)	1 (1%)	9 (4%)
Not stated	3	3	4	10
Total	90 (100%)	86 (101%)**	80 (100%)	256 (101%)

* Appendix J, page 176, lists the units included in each category.
** Total exceeds 100% due to rounding.

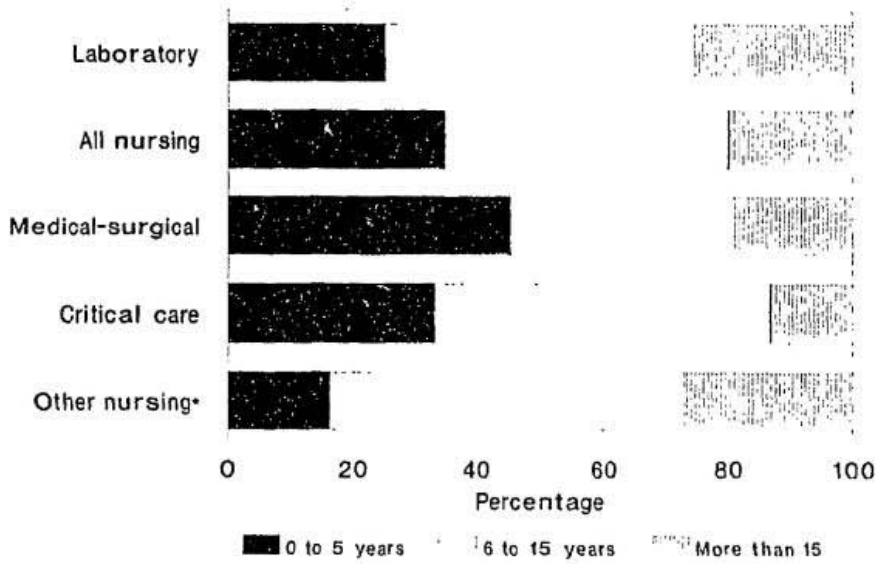
There were two categories of laboratory employees. The larger group are the technologists (mostly R.T.'s) who work in hematology or chemistry laboratories and collect blood early in the morning from hospital in-patients before beginning their analytical work. In hospital C, many people help with daily blood collections. In the other two hospitals, this task is rotated and most technologists take blood only a few days each month. Some people are called upon to collect special specimens, so they may collect blood most working days, but the total number of venepunctures is small.

The other group of laboratory employees consists of the full-time blood collectors or phlebotomists. Most of the non-R.T.'s are phlebotomists. A phlebotomist position may

also be filled by an R.T., often as an entry-level job. Several survey questions were considered to determine laboratory respondents' job classifications. Using the criteria explained in Appendix K, page 177, 26 persons (30%) were categorized as phlebotomists and the remaining 60 (70%) as technologists.

Work experience

Almost 80% of the respondents in all categories reported fewer than sixteen years of working experience. Nurses had lengths of total work experience comparable to that of laboratory personnel, but they had worked fewer years in their present hospital (Figure 1). Nurses in medical and surgical units were least experienced and most likely to be new to the hospital. Nurses employed in obstetric, geriatric and psychiatric units were at the opposite end of the spectrum. At Hospital A, 53% of nurses had fewer than six years of service in that facility, compared with 35% at Hospital B and 43% at C. Only 1% of Hospital A nurses had been employed there for more than fifteen years; 15% of Hospital B nurses had been with the hospital at least that long.



•Obstetrics, Geriatrics, Psychiatry

Figure 1: Working experience of survey respondents in present hospital

Length of shift

All laboratory employees except two part-timers ordinarily worked shifts of between seven and eight hours. Shifts for nurses were usually of eight or twelve hours duration. Twenty-eight percent of nurses reported that a typical shift for them was fewer than ten hours and 72% worked shifts of ten hours or more.

Job status

More than three-quarters of respondents were full-time employees. Compared to laboratory employees, more than twice as many nurses described their jobs as part-time or casual (12% vs. 27%). All hospitals showed a similar job status distribution.

Profile summary

Three hundred forty-two employees of three St. John's hospitals completed questionnaires, including 256 nurses and 86 laboratory employees. Typical participants were young and female, with fewer than sixteen years of working experience. All nursing personnel were Registered Nurses; almost all were graduates of diploma level nursing programs. Three-quarters of nurses worked in either medical-surgical or critical care areas. Most laboratory personnel were Registered Technologists; 30% of them were classified as phlebotomists and 70% as technologists. A large majority of subjects in both departments held full-time positions. Most nurses worked shifts of eleven to twelve hours; laboratory employees and a quarter of the nursing group worked seven to eight hours.

Survey results III: Needle use patterns

Respondents' use of needles is described under these headings:

1) types of equipment,
2) numbers of needles used,
3) handling used needles, and
4) needle disposal.

Types of equipment

Respondents were presented with a list which included six devices to which hollow needles may be attached and two types of blood-sampling lancets. They were asked to indicate for each instrument whether they used it on most of their shifts, some shifts or rarely/never. As Figure 2 illustrates, nurses used a wide variety of needled instruments on most shifts, with disposable syringes and equipment for intravenous (i.v.) infusions used most frequently. Laboratory personnel most commonly used needles in conjunction with vacuum-tube venepuncture equipment.

Figure 2: Types of equipment used by nursing and laboratory personnel

Key to abbreviations:

syringe	disposable syringe
iv tu	intravenous tubing
cath	intravenous catheter
autolct	automatic spring-loaded lancet
vacuum	vacuum-tube blood collection equipment
b'fly	butterfly-type winged needle
lancet	standard blood lancet
cart	pre-filled injection cartridges

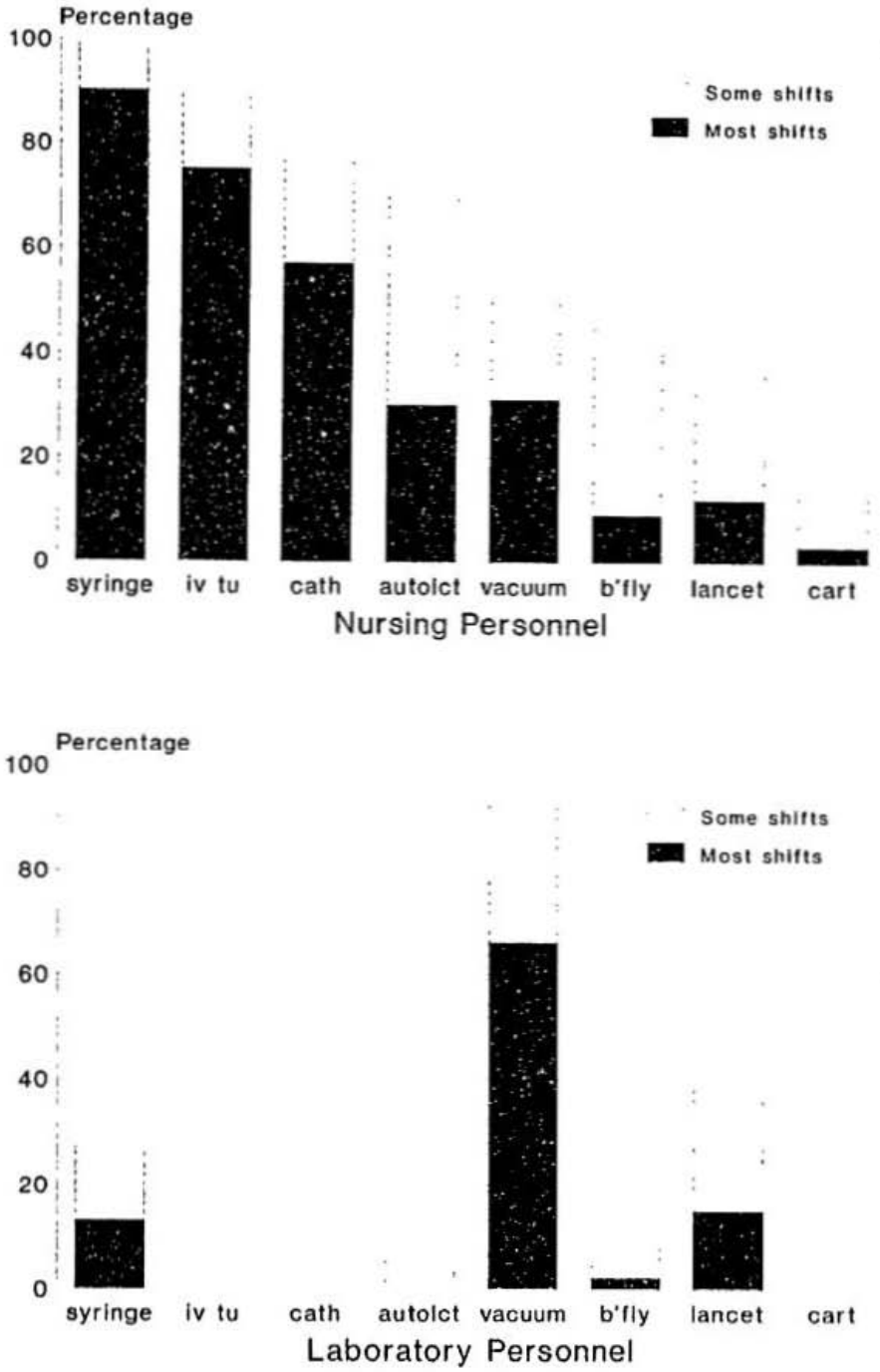


Figure 2. Types of equipment used by nursing and laboratory personnel.

Note: Key to abbreviations on facing page.

Numbers of needles used

Respondents' needle-use frequency was categorized as low (0-5 needles per shift), medium (6-15) or high (>15). The number of needles used by nurses varied among the nursing areas (X^2=76.44 with 8df, p<.00000001), though ranges were similar in the two largest areas, medical-surgical and critical care (Table 13). There was an association between number of needles used and hospital of work (X^2=9.61 with 4df, p<.05); only 10% of nurses in Hospital B were in the high-use category. Half of laboratory employees were high users (Table 14), with several using up to 100 needles per work day.

Table 13. Number of needles used by nurses

		NEEDLES PER SHIFT			
AREA/HOSPITAL	n	0-5	6-15	>15	Total
Medical-surgical	101	19%	55%	26%	100%
Critical care	81	15%	59%	26%	100%
Obstetrics	34	44%	53%	3%	100%
Psychiatry	19	95%	5%	0%	100%
Geriatrics	9	89%	11%	0%	100%
Hospital A	88	27%	49%	24%	100%
Hospital B	86	30%	59%	10%	99%*
Hospital C	79	33%	41%	27%	100%
All nurses	253	30%	50%	20%	100%

* Total is less than 100% due to rounding.

Table 14. Number of needles used, by department

DEPARTMENT	n	NEEDLES PER SHIFT 0-5	6-15	>15	Total
Nursing	253	30%	50%	20%	100%
Laboratory	81	28%	24%	48%	100%
All respondents	334	30%	43%	27%	100%

X^2 = 27.7 with 2 degrees of freedom (df); significant at $p < 0.000001$

Handling used needles

Survey participants were asked to describe how they deal with used needles. Figure 3 illustrates how often seven different courses of action were followed. The seven practices included are not mutually exclusive; two may be needed in sequence in order to dispose of a single needle. It also became clear that many people do not have a single needle-handling protocol which they use at all times. For example, 78% of respondents often or sometimes recapped needles after use, while 68% often or sometimes discarded uncapped needles. The type of needle, availability of disposal containers or recapping devices, and other circumstances may alter the course of action.

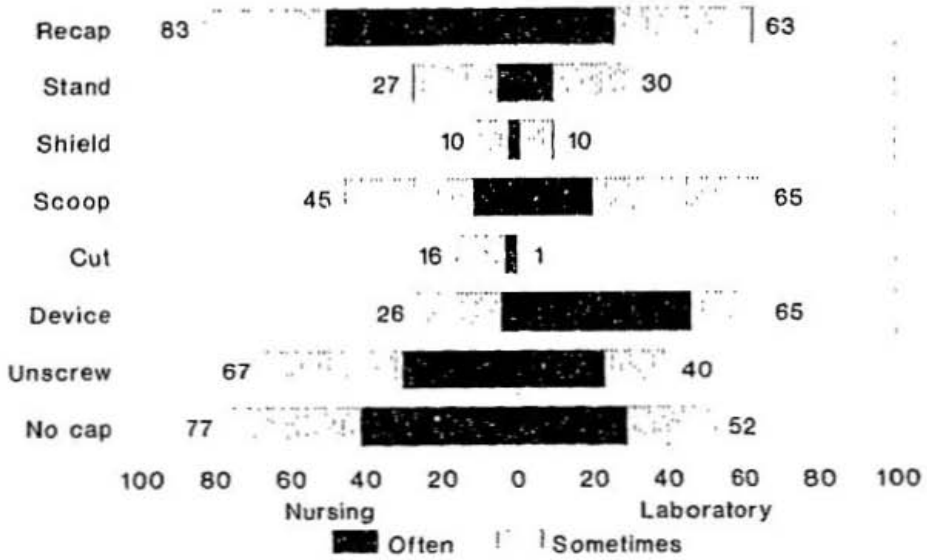


Figure 3. Needle handling practices, by department

Key to abbreviations:

recap	recap used needle using two hands
stand	place cap in stand, insert needle to recap
shield	hold cap in shield, insert needle to recap
scoop	scoop cap off flat surface and on to needle
cut	cut or bend needle
device	separate needle from equipment using device
unscrew	separate needle from equipment by hand
no cap	discard needle without recapping

Three-quarters of the respondents reported that they recap needles using both hands at least some of the time. Two-handed recapping was reported more commonly by nurses than laboratory employees (83% versus 63%), and by staff members at Hospital A, where 87% stated they recap with two hands compared to 71% and 76% at Hospitals B and C (Tables 15 and 16). No significant differences in frequency of two-handed recapping were found among the five nursing areas.

Table 15. Proportion of two-handed recapping, by department

		TWO-HANDED RECAPPING			
DEPARTMENT	n	Often	Sometimes	Never	Total
Nursing	248	50%	33%	17%	100%
Laboratory	84	26%	37%	37%	100%
Total	332	44%	34%	22%	100%

$X^2 = 20.02$ (2 df); significant at $p < .00005$

Table 16. Proportion of two-handed recapping, by hospital

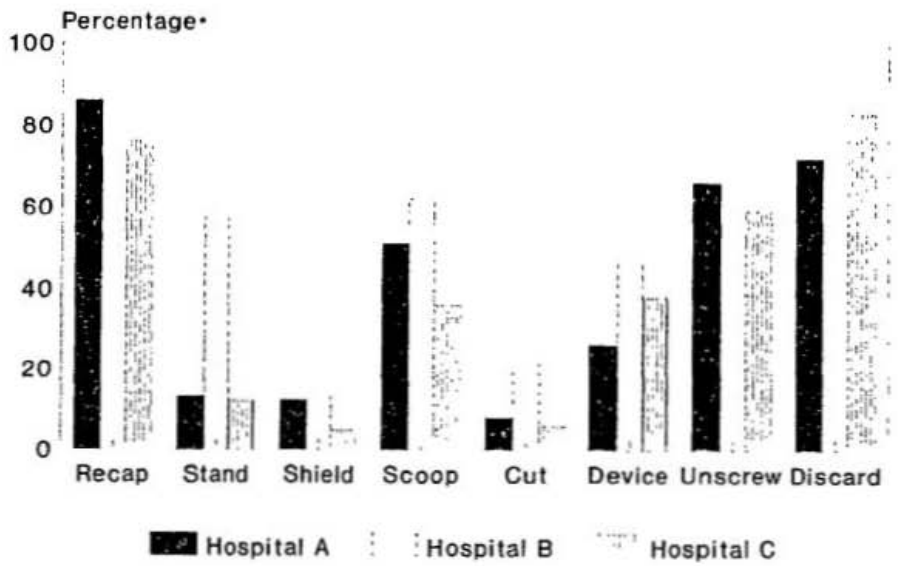
		TWO-HANDED RECAPPING			
HOSPITAL	n	Often	Sometimes	Never	Total
A	122	57%	30%	14%	101%*
B	110	34%	37%	29%	100%
C	100	41%	35%	24%	100%
Total	332	44%	34%	22%	100%

* Total exceeds 100% due to rounding.

$X^2 = 14.62$ (4 df); significant at $p < .01$

Other aspects of needle-handling shown in Figure 3, by department and in Figure 4, by hospital, are:

1) alternatives to two-handed recapping,
2) detaching or cutting needles from equipment, and
3) state of needle at the time of disposal (capped or uncapped).



• Employees using technique often or sometimes.

Figure 4. Needle-handling practices, by hospital

Note: Key to abbreviations is on page 74.

Alternatives to recapping needles using both hands (described in detail in Chapter 2) were reported as follows:

1) A quarter of the survey group said that at least some of the time they used a stand which held the cap while the needle was used and facilitated one-handed recapping after use. More Hospital B personnel reported using a stand to hold needle-caps than their colleagues in the other two hospitals.

2) Ten percent indicated some use of a shield to surround the cap and protect their hands during recapping. (All hospital officials who were asked indicated that no such devices were available in their facilities. The term "shield" may have been interpreted by these respondents as a cap holder or support, a variation of what was referred to in the questionnaire as a stand.)

3) Half of respondents reported that they often (13%) or sometimes (37%) placed the needle cap on a flat surface and used a single-handed motion to scoop it up and back on to the needle. Use of the scooping technique was reported more often by laboratory staff than by nurses and by employees of Hospital B more frequently than in the other hospitals.

Needles must ordinarily be detached from certain types of equipment, e. g., vacuum-tube blood collection devices, and discarded separately. Over half (56%) of the participants removed needles from ancillary equipment by hand and a third used a device to do this. More nurses reported manually detaching needles and more laboratory employees reported use of a device. (Almost half the nursing group rarely used vacuum-tube equipment, so would have fewer occasions when detaching needles was required). Hospital A had the fewest employees using needle-removing devices.

When asked if they ever bent or cut needles, 39 respondents (11%) gave affirmative replies. Officials from all three hospitals had stated that cutting devices used in the past were now banned. Notations by several nurses clarified that what they were cutting was plastic tubing attached to the needle rather than the needle shaft. Some nurses stated that they cut tubing for dialysis or intravenous infusions away from the needle to facilitate needle disposal and this may be the most reasonable explanation of these responses.

If hospital efforts to reduce needle-capping are succeeding, all needles should be discarded without their caps. While 38% of the survey group say they often discard uncapped needles, 28% never do this and a further 32% discard uncapped needles only some of the time. It is obvious that a large number of used needles are still being recapped

routinely in these three hospitals. Seventy-seven percent of nurses discarded uncapped needles at least some of the time, compared with 52% of laboratory employees.

Needle disposal

Two aspects of needle disposal were examined: the availability of suitable containers at the site of needle use and the disposal of needles into inappropriate receptacles.

When asked "Do you ever have to carry needles from the point-of-use into another area to get access to an approved disposal container?", 55% overall said yes, with the proportion carrying needles highest among employees of Hospital A and lowest in Hospital C (Table 17). Laboratory and nursing distributions were similar.

Table 17. Proportion carrying used needles, by hospital

		CARRY USED NEEDLES		
HOSPITAL	n	Yes	No	Total
A	127	75%	25%	100%
B	111	56%	44%	100%
C	102	30%	70%	100%
Total	340	55%	45%	100%

$X^2 = 45.16$ (2 df); significant at $p < .00000001$

In the comment section, 50% of persons who stated they sometimes carried used needles to a disposal container reported going outside the room where the needle had been used and just over one-third said they had to cross the room (for example, a four-bed ward) to reach the single container provided. Some of those who denied ever having to carry used needles made notations on their questionnaires such as "each patient room has a container". Apparently they did not regard crossing the room as going "into another area". For this reason, the calculated proportion of survey respondents transporting used needles is probably an underestimate.

Respondents who had to leave the room where they had used a needle in order to reach a disposal container, explained that they took the needles to a nursing station, another patient room, a treatment room, a utility room or back to the laboratory. Lack of provision of containers was not always the problem - sometimes a container was present, but was already filled. A nurse's need to carry used needles was associated with the area where he or she worked. Of those respondents working in the two largest areas, seventy percent of medical-surgical nurses sometimes had to carry used needles, compared with 44% of critical care nurses (Table 18).

Access to disposal containers appeared to influence whether or not an employee recapped used needles. Half of those who never had to carry used needles to a container often discarded uncapped needles; of those who reported they

sometimes had to carry used needles, only 30% regularly discarded them uncapped (Table 19). Many respondents who did have to carry used needles commented on their reluctance to walk through a ward or hall with an uncapped needle in hand.

Table 18: Proportion carrying used needles, by nursing area

AREA	n	CARRY USED NEEDLES Yes	No	Total
Medical-surgical	102	70%	30%	100%
Critical care	79	44%	56%	100%
Obstetrics	34	38%	62%	100%
Psychiatry	20	80%	20%	100%
Geriatrics	9	67%	33%	100%
Total	244	58%	42%	100%

$X^2 = 21.39$ (4 df); significant at $p < .0005$

Table 19. Association between carrying used needles and disposing of uncapped needles

CARRY USED NEEDLES	n	DISCARD UNCAPPED NEEDLES Often	Sometimes	Never	Total
Yes	185	30%	37%	33%	100%
No	144	49%	27%	24%	100%
Total	329	38%	33%	29%	100%

$X^2 = 11.53$ (2 df); significant at $p < .005$

To evaluate general compliance with safe needle disposal practices, participants were asked if they ever noticed needles discarded into containers not designated for the purpose. In total, 29% said they had seen needles in unsuitable containers, with greater proportions of positive responses from Hospital A and from the laboratories. Nursing-laboratory differences may have a simple explanation since phlebotomists and technologists would visit many areas of the hospital in the course of blood collection rounds. Improper disposal practices in any one area would be reflected in their answer. When asked to comment on why they think needles are placed in inappropriate containers, the most common responses were:

1) non-availability of suitable containers - not preser., already full or container provided not designed for the purpose;
2) staff behaviour - careless, not aware of policy;
3) physician responsibility - ignorance or lack of compliance with proper procedure.

Summary of needle use patterns

Nurses typically used needles in conjunction with three or more types of instruments on each shift, while technologists and phlebotomists used mainly vacuum-tube blood collection equipment. Most nurses handled no more than

fifteen needles on a shift; almost half of laboratory staff used more than fifteen. Seventy-eight percent of the survey participants recap used needles with both hands. A majority of respondents report a need to carry used needles from where they are used into another area for disposal. Both two-handed recapping and having to carry used needles were reported more frequently by respondents from Hospital A. The need to carry used needles was more common on psychiatric and medical-surgical nursing units than in other work areas. There was an association between two needle-handling practices: a smaller proportion of those having to carry used needles reported leaving them uncapped than those with ready access to a disposal container.

Survey results IV: Risk awareness and management

Disease transmission by needlestick injury

The questionnaire presented a list of five infectious diseases for which there have been published reports of needlestick transmission (Collins and Kennedy, 1987) and respondents were asked to select those which, in their opinion, could be transmitted by needlestick. Over 99% of respondents selected AIDS and hepatitis B; only one-quarter chose syphilis, and even fewer (17% and 12%) thought herpes and tuberculosis transmissible by needlestick.

The chance of developing an infection following exposure by needle puncture varies with the disease involved. Seroconversion rates (i.e., evidence of infection provided by antibody production in an exposed individual) have been found to be in the range of 10-25% for hepatitis B virus (HBV) and are estimated currently at less than 1% for HIV.

Survey participants' estimates of infectivity rates were lower than actual for HBV and higher for HIV. The only noteworthy difference found among hospitals and departments was that nurses' estimates of the risk of acquiring HIV infection were greater that those of laboratory personnel. Medical-surgical nurses gave the highest estimates of all.

Respondents held divergent opinions regarding their chance of acquiring <u>any</u> occupationally-related disease now as compared with five years ago. Almost half believed the risk had increased; 41% reported a decreased risk and the remaining 12% saw no change. Employees of Hospital A were most likely to perceive an increased risk and those working in Hospital C most likely to believe risk had decreased. Nurses saw an increased risk more often than laboratory personnel.

Educational activities related to safe needle-handling

During the previous year, 64% of respondents had been exposed to written material related to safe handling of needles, but only a minority had been in attendance at any

live presentation dealing with safe needle-handling. Twenty-seven percent of participants (almost all of those who had recently attended a lecture, seminar or training program) had been to a hospital-sponsored presentation. Fewer employees of Hospital A reported attendance.

Responsibility for reducing needle injuries

A large majority (80%) of subjects believed that the major responsibility for reducing needle injuries should rest with the individual. Many commented on the need for all employees to protect themselves by following safe procedures since it is they who will reap the benefits or suffer the consequences. Others stressed the necessity for hospital administrators and departmental supervisors to provide safety equipment and establish appropriate policies. Very few saw their professional society or union as having responsibility for needle injury prevention.

Hepatitis B vaccine to reduce risk from needlesticks

Since 1985, hepatitis B vaccine has been available in Newfoundland free of charge to laboratory personnel who collect blood and to nurses frequently exposed to blood. Critical care nurses are eligible to receive vaccine at no charge; a minority of nurses in other areas qualify. The

human-source vaccine used for the early years of the program was replaced in 1987 by a recombinant vaccine (Newfoundland Department of Health, 1985, 1987).

Slightly under half (47%) of the survey group stated they had been vaccinated against hepatitis B. The laboratory and critical care areas had the highest rates of vaccination (Table 20). The relatively high number of nurses in some areas, especially medical-surgical, who were unable to state whether or not they had been vaccinated is unexplained.

Table . Hepatitis B vaccination, by work area

WORK AREA	n	HEPATITIS B VACCINE Yes	No	Unknown	Total
Laboratory	84	61%	39%	0%	100%
Medical-surgical	99	37%	47%	16%	100%
Critical care	81	67%	33%	0%	100%
Obstetrics	34	30%	62%	9%	101%*
Psychiatry	18	22%	44%	33%	99%*
Geriatri	9	0%	78%	22%	100%
Total	325	48%	44%	8%	100%

* Total does not equal 100% due to rounding.

Health practices on and off the job

An attempt was made to determine whether frequency of health practices, both at work and in a person's private

life, was associated with an individual's needle-handling practices. It is known that employees do not always comply with safety measures promoted by the hospitals which employ them, but it is not known whether use of job-related safety measures parallels personal preventive health behaviour.

Health practices at work - glove-wearing: The Centers for Disease Control recommend wearing gloves as a barrier to protect health care workers from exposure to blood and body fluids. In response to concerns about the risk of AIDS, many hospitals instituted guidelines for wearing gloves as a part of the same infection control changes which addressed needle-handling procedures.

Respondents were asked to categorize how often they wear gloves when using needles. The majority reported wearing gloves rarely or never (88% of laboratory and 56% of nursing staff). Strong opinions were held on the issue of glove-wearing; 93% offered a comment to explain why they did or did not wear gloves (Table 21). Among the laboratory staff, 42% referred primarily to perceived disadvantages of glove-wearing: discomfort, awkwardness, lack of protection from needle injuries or simply the unnecessary inconvenience. About 30% of nurses had similar complaints.

Many respondents stated that they wore gloves in specified circumstances, for example, when dealing with patients thought to pose an increased risk or for procedures

involving a substantial likelihood of blood exposure. A full one-third of laboratory personnel mentioned wearing gloves for certain "high-risk" patients, but only seven percent of nurses based their decision to wear gloves on patient factors. On the other hand, more than a fifth of nurses cited certain procedures, for instance, those involving exposure to blood, as a reason for wearing gloves. Type of procedure was seldom mentioned by laboratory staff as a factor influencing glove use.

Table 21. Factors affecting decision to wear gloves

DECIDING FACTOR	RESPONDENTS Nursing	Laboratory	Total
Awkward/ no value	29%	42%	33%
Selected procedures	22%	3%	17%
Certain patients	7%	33%	14%
Gloves protect	18%	0%	14%
Policy/training	11%	3%	9%
Other/ multiple	13%	20%	15%
n	238	81	319

Frequent glove-wearing was reported by many more nurses than laboratory employees (44% versus 12%). That many nurses viewed this as routine procedure was evident from the 18% who made comments such as "I wear gloves to protect myself". About one nurse in ten cited hospital policy or

training as justification for when they wore gloves; such views were rarely expressed by laboratory employees. Nurses working in critical care wore gloves most often.

Personal health practices: Survey participants were asked to provide information related to five personal health practices. The questions (31-35, Appendix C, page 166) were adapted from the Canada Health Promotion Survey (Health and Welfare Canada, 1988). Twelve women declined to answer two or more of these questions; six of them worked in a single area and several made comments indicating that since the information requested was personal it was not relevant to the study.

No association was found between frequency of smoking, seat belt usage, exercise or Pap smears and any on the job practice. Frequency of breast self-examination (BSE) was, however, associated with wearing gloves when handling needles (Table 22).

Table 22. Association between BSE and glove-wearing

	WEAR GLOVES HANDLING NEEDLES		
PERFORM BSE	Always/frequently	Sometimes/never	Total
Every 1-3 mo.	91 (78%)	116 (60%)	207 (67%)
Less often	26 (22%)	78 (40%)	104 (33%)
Total	117 (100%)	194 (100%)	311 (100%)

$X^2 = 9.81$; significant at $p < .0025$

Summary of risk awareness and management

Survey respondents under-estimated the risk of acquiring HBV infection from a needlestick and over-estimated the risk of contracting HIV infection. About one quarter had, in the last year, attended a hospital-sponsored live presentation concerning safe needle-handling. A large majority of the survey group believed responsibility for reducing needlestick injuries should rest with the individual employee.

Approximately half had received hepatitis B vaccine; many of those unvaccinated were eligible for free vaccine. A minority wore protective gloves on a regular basis, nurses more often than laboratory employees. Among female respondents, a positive association was found between frequency of wearing gloves and breast self-examination.

Survey results V: Frequency of needlestick injuries

Lifetime injuries

Seventy-eight percent of employees reported having experienced a needle injury at some time in their career, with no difference seen across hospitals or departments or with years of working experience. A greater proportion of employees in the 25-39 year age group had been injured (84%) compared to those younger (71%) or older (70%).

Recent injuries

Participants were asked to state the number of needlestick injuries they had experienced during the preceding twelve months. Data for self-reported injuries have been summarized in three ways:

1) the proportion of persons in a given category who had been injured, expressed as a percentage,
2) the number of needlesticks per employee group, converted to the injury rate per 100 employees, and
3) mean needlesticks per injured employee.

Self-reported data do not permit conversion of number of employees to FTE since to do so would necessitate knowing exactly how many hours each employee had been paid for in the past year. However, distribution of full-time, part-time and casual employees was similar among the study hospitals.

Overall injury rates: Thirty-six percent of respondents had been injured at least once during the last year; 21% had single injuries and 14% reported more than one needlestick incident. The 339 persons who answered this question reported 208 needlesticks for an annual injury rate of 61 per 100 employees. Respondents indicated the number of injuries

experienced in the last year by marking the appropriate response from a range of zero to "6 or more". If some participants had experienced more than six injuries, the actual total would have been greater than 208. Rates per 100 employees may therefore be slightly underestimated .

Nursing injury rates: The proportion of nurses injured during the twelve months prior to the study was 41%; 17% had multiple injuries (Figure 5). The overall nursing injury rate was 74 needlesticks per 100 employees. Examination of injury occurrence patterns within the nursing population revealed several differences among hospitals. More nurses at Hospital A stated they had been injured than at the other two facilities (55% versus 33% and 34%). Hospital A's needlestick rate was also the highest at 108 injuries per 100 nurses, compared to 43 and 68 at Hospitals B and C respectively. The mean number of needlesticks per injured nurse was 2.0 at Hospitals A and C, while injured nurses at B averaged 1.3 needlesticks in the course of the year.

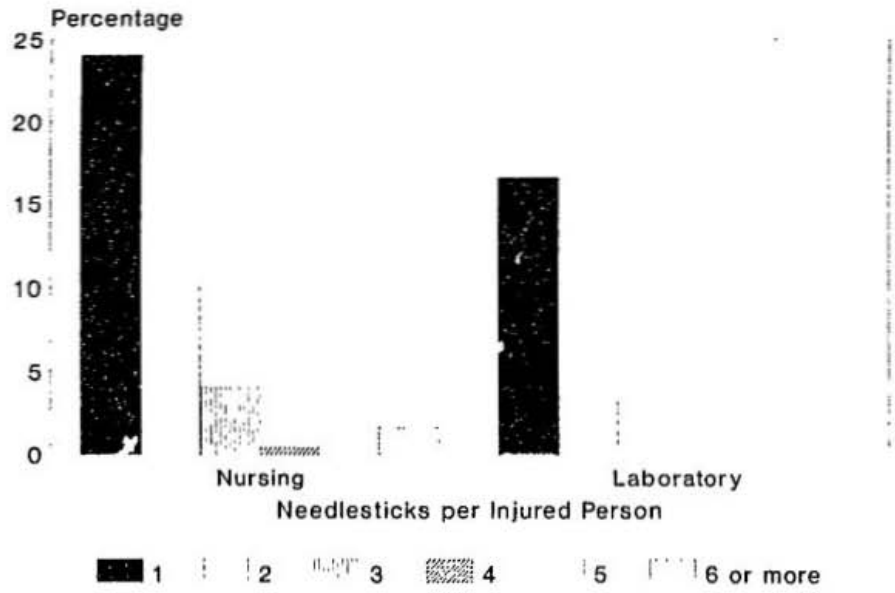


Figure 5. Number of needlestick injuries in last 12 months

Laboratory injury rates: Twenty percent of laboratory employees stated they had been injured at least once in the twelve months preceding the study. Only 3.5% of those injured had two injuries during this period; none had more than two Figure 5). The injury rate was 24 per 100 employees. Injured laboratory employees averaged 1.2 needlesticks during the year. Rates for individual laboratories were not calculated since frequencies were very low. There was no significant variation among the three hospitals, nor was a difference observed between phlebotomists and technologists.

Factors affecting injury occurrence in the study respondents: When respondents stating they had one or more needlesticks in the last twelve months were compared with those claiming no injury, no significant difference was found between the groups for sex, education level, job status, knowledge and beliefs about needlesticks, and personal health practices. As already reported, more nursing respondents than laboratory employees reported having an injury in the last twelve months. Injured and uninjured categories of respondents also differed with regard to their distribution of the following variables:

1) need to carry used needles to a disposal container,
2) recapping used needles using two hands,
3) discarding uncapped needles,
4) work area,
5) working experience, and
6) number of needles used.

The strength of association between each of the variables listed and having experienced a recent needlestick injury was estimated by univariate analysis using the Epi Info Software Package.

1) Carrying used needles

Having to carry used needles into another area to reach a disposal container was associated with being injured, for respondents of both departments (Table 23).

Table 23. Association between carrying used needles and experiencing recent needlestick injury

NEED TO CARRY USED NEEDLES	n	INJURED LAST 12 MO. Yes	No	Total
Yes	187	43%	57%	100%
No	150	26%	74%	100%
Total	337	36%	64%	100%

$X^2 = 10.14$; significant at $p < .0025$

2) Two-handed recapping

Recapping needles using two hands was associated with needlestick injury and with number of injuries in the preceding twelve months (Table 24).

Table 24. Association between two-handed needle recapping and experiencing recent needlestick injury

FREQUENCY OF TWO-HANDED RECAPPING	n	INJURIES LAST 12 MO. 0	1	>1	Total
Often	146	58%	25%	18%	101%*
Sometimes	110	63%	21%	16%	100%
Never	73	80%	18%	3%	101%
Total	329	64%	22%	14%	100%

* Total exceeds 100% due to rounding.

$X^2 = 13.39$ (4 df); significant at $p < .01$

3) Discarding uncapped needles

Forty-eight percent of respondents who said they sometimes discarded needles in an uncapped state had a needlestick injury in the last twelve months compared with 33% of those who often and 28% of those who never discarded uncapped needles (Table 25). Being inconsistent in recapping used needles - by any method - may place individuals at higher risk for injury.

4) Nursing area

Among nursing respondents, the proportion of employees injured was highest (53%) among those working in medical-surgical; only 24% of respondents from obstetric, geriatric and psychiatric units had been injured (Table 26).

Table 25. Association between discarding uncapped needles and experiencing recent needlestick injury

FREQUENCY OF DISCARDING UNCAPPED NEEDLES	n	INJURED LAST 12 MO. Yes	No	Total
Often	126	33%	67%	100%
Sometimes	108	48%	52%	100%
Never	94	28%	72%	100%
Total	328	36%	64%	100%

$X^2 = 10.36$ (2 df); significant at $p < .01$

Table 26: Association between nursing area and experiencing recent needlestick injury

NURSING AREA	n	INJURED LAST 12 MO. Yes	No	Total
Medical-surgical	102	53%	47%	100%
Critical care	80	40%	60%	100%
Other*	63	24%	76%	100%
Total	245	41%	59%	100%

* Obstetrics, psychiatry and geriatrics.

$X^2 = 13.71$ (2df); significant at $p < .0025$

5) Working experience

For nursing respondents, there was an association between having been injured in the last year and age ($X^2=7.92$ with 3df, $p<.05$), total years of working experience ($X^2=11.58$ with 2df, $p<.005$) and length of employment in their present

hospital. Strength of association was greatest between having been injured and number of years with their present employer (Table 27). For laboratory employees, age and working experience were not associated with recent injury.

Table 27. Association for nurses between time with present employer and experiencing recent needlestick injury

YEARS WITH EMPLOYER	n	INJURED LAST 12 MO. Yes	No	Total
<6	109	52%	48%	100%
6-15	118	35%	65%	100%
>15	25	20%	80%	100%
Total	252	59%	41%	100%

$X^2 = 12.22$ (2 df); significant at $p < .0025$

6) Number of needles used

For nursing staff, there was an association between numbers of needles used per shift and having had an injury during the year ($X^2=6.63$ with 2df, $p<.05$); laboratory injury rates were not associated with the numbers of needles used.

Summary of needlestick injury frequencies

More than three-quarters of the survey respondents in all hospitals and both departments reported having a needlestick injury at some time in their careers. In the

twelve months before they completed the questionnaire, 36% had been injured. A greater proportion of nurses had been injured and more reported multiple injuries in this period than laboratory personnel. Higher proportions of injured persons were found among those who had to carry needles to a disposal container after use, who recapped used needles using both hands or who were inconsistent in whether they discarded needles with or without caps. Within the nursing group, more of those working in Hospital A or in medical-surgical units, or who had been employed fewer than six years, or who used many needles per shift reported having been injured in the last year.

Survey results VI: Description of needlestick injuries

All participants who had ever experienced a needle injury were asked to describe their most recent injury, regardless of how long ago it had happened. These injury descriptions were divided into two groups: "recent" (those relating to injuries occurring during the preceding twelve months; n = 119) and "past" (those describing earlier events; n = 147). Laboratory employees made up a greater proportion of past episodes than of recent ones (Table 28).

Table 28. Proportion of past and recent injuries from each department

DEPARTMENT	n	TIME OF INJURY Past	Recent
Nursing	196	63%	86%
Laboratory	70	37%	14%
Total	266	100%	100%

Injury descriptions cover the following areas:

1) type of equipment,
2) needle contamination,
3) activity at the time of needle injury,
4) suggestions for injury prevention, and
5) injury reporting and management.

Type of equipment

The type of needle involved in the needlestick was identified for 128 of 147 past and 106 of 119 recent injuries (Table 29). More than two-thirds of all nursing injuries were associated with disposable syringe and needle assemblies. The second most common type of equipment in recent nursing injuries was the automatic (spring-loaded) lancet. The increased proportion of injuries due to these devices (14% recent vs. 4% past) was the only significant difference ($p<.05$) in proportion of injuries associated with an equipment

type. Automatic lancets are used by nurses for obtaining capillary blood samples for glucose determinations.

Ninety-four percent of laboratory injuries, past and recent, involved vacuum-tube blood collection devices.

Table 29. Equipment associated with past and recent needlestick injuries

EQUIPMENT	NURSING		LABORATORY	
	Past (n=77)	Recent (n=90)	Past (n=51)	Recent (n=16)
syringe	69%	68%	4%	-
vacuum-tube sets	4%	2%	94%	94%
i.v. catheter	14%	7%	-	-
automatic lancet	4%	14%	-	-
i.v. tubing	3%	3%	-	-
other	7%	6%	2%	6%
Total	101%*	100%	100%	100%

* Total exceeds 100% due to rounding.

Needle contamination

When asked to state whether the needle involved in their most recent injury had already been used on a patient or exposed to blood or other body fluids, 59% of those with recent injuries said "yes", compared with 79% of those describing past injuries. An injury with an uncontaminated needle may mean that the procedure had not yet begun or that

the procedure for which the needle was used (for example, drawing up medication) was thought not to involve blood exposure.

Less than half of those injured using syringe needles indicated that the needle was contaminated; a majority of needles attached to other types of equipment had been exposed to patients or their body fluids.

Activity at the time of needle injury

The distribution of activities at the time of needle injury, shown in Table 30, was similar in nursing and laboratory employees. One-quarter of recent injuries occurred before the intended procedure was carried out, accounting for about half of the injuries due to uncontaminated needles. Needle recapping was the most frequently cited activity; the proportion of both past and recent injuries attributable to recapping needles was identical at 42%. Injuries caused by a needle held by someone other than the victim comprise a smaller proportion now (2%) as compared to the past (6%). All of these injuries involved nurses and the person holding the needle was usually a colleague.

Table 30. Stage of procedure at which injury occurred*

STAGE OF PROCEDURE	Past	Recent
Recapping needle	42%	42%
Before procedure**	14%	24%
Holding needle, after use	9%	12%
Loose needle on bed, etc.	8%	6%
Performing procedure	6%	7%
Disposing of needle	6%	7%
Disassembling equipment	6%	5%
Needle held by another	6%	2%
Other	5%	7%
n	145	121

* Total exceeds 100% due to multiple responses.

** $p < .05$

When asked what was different about the episode when the injury occurred, about one-third could offer nothing to explain why the injury happened. Those describing differences from a normal situation most frequently mentioned, in order:

1) working conditions - rushed, tired, inattentive, fault of other staff;
2) equipment not performing as expected - cap loose or too tight, needle piercing cap or protruding from waste container, etc.;
3) patient's behaviour, usually unexpected movement;

4) staff member's own actions described as careless or in other self-blaming terms.

Nurses more often cited working conditions as a factor contributing to their injury; laboratory personnel mentioned patient behaviour much more often. Perceptions of how the injury situation differed from normal were similar in those with past and recent injuries.

Employee suggestions for injury prevention

Survey respondents, when asked how the injury they described could have been prevented mentioned the following (in order of frequency):

1) doing something different themselves,
2) improvements affecting other staff, or
3) equipment changes.

Just over half of all respondents who have ever sustained a needlestick injury (142 of 266) believed that the key to prevention of a similar injury lay in modifying their own behaviour. Fifty-nine percent of nurses and 37% of laboratory employees expressed the view that avoiding unsafe practices, including needle recapping, and "being more careful" would lead to a reduction in the incidence of needle injuries of the type they had experienced.

Thirteen percent cited staffing factors as important. This included calls for more responsible behaviour by other staff members in handling needles when working together, as well as in prompt and safe needle disposal (a nursing problem). Laboratory staff recommended the assistance of another staff member in performing procedures on uncooperative patients. A few respondents said there was a need to hire additional staff so that individuals would not be rushed when performing their jobs.

About twelve percent of those who had needlestick injuries stated that equipment factors needed to be altered to prevent injuries of the type they had experienced. Examples of their suggestions are: needle redesign, changing to single-use barrels for blood collection and greater availability of needle disposal containers.

When asked to choose from a supplied list of areas (Question 24, Appendix C, page 164) where improvements might be made in order to reduce the <u>overall incidence</u> of needle injuries, 51% selected training. Comments on how and where training could be improved included: need for increased access to in-service programs, wider coverage of departments (including medical staff), better training at the initial certification level, more information on risks associated with needlestick injuries and improved training in proper needle-handling techniques. Other proposed ways to reduce needle injuries (improvements to policies, needle design or disposal

containers) were each chosen by between twenty and thirty percent of the survey group.

Injury reporting and management

Respondents were asked to indicate what they did about their most recent injury (Table 31). All hospitals included in this study have policies that require reporting of all needlestick injuries both to the employee's supervisor and to the staff health nurse or, in the absence of the nurse, to the emergency department. Emergency departments, in turn, are expected to refer injured employees to staff health. Staff health departments maintain records of employee injuries, vaccinations and immune status. It is the responsibility of the staff health department to implement the needlestick injury protocol and ensure appropriate follow-up.

Fifty-seven percent of those who had one or more injuries in the last year said they had not reported their latest injury to the staff health department. The 43% who did report was a lower proportion than the reporting rate of 53% for those whose most recent injury occurred more than a year ago. Reporting injuries to supervisors or emergency departments was also less common among those with recent needlesticks. Forty-eight percent of those injured in the

last year said they had taken care of the injury themselves, an increase from 12% of those with past injuries.

Taking care of an injury oneself did not necessarily preclude making an official report and receiving treatment. In some cases it simply meant that the staff member used self-administered first aid as an initial step. However, of all those who described how they had handled a needlestick injury, 36% (n=98) said they took care of it themselves and of this group, three-quarters (n=74) reported their injury to no one.

Table 31. Action following most recent needlestick injury

ACTION	PAST INJURY (%)	RECENT INJURY (%)
Took care of it myself	27	48
Reported to supervisor	62	52
Reported to staff health	53	43
Reported to emergency	33	27

* Totals exceed 100% due to multiple responses.

Reporting one's most recent needle injury to staff health was associated with each the following:

1) being injured with a contaminated needle,
2) having had only one needlestick injury in the twelve months preceding the study, and
3) having received hepatitis B vaccine.

Having been injured with a needle already contaminated by patient contact was associated with reporting the injury to staff health (Table 32).

Table 32. Association between reporting needle injuries to staff health and condition of needle

REPORTED TO STAFF HEALTH	NEEDLE CONTAMINATION Yes	No	Total
Yes	46 (66%)	5 (10%)	51 (43%)
No	24 (34%)	44 (90%)	68 (57%)
Total	70 (100%)	49 (100%)	119 (100%)

X^2 = 34.01; significant at $p < .000000$

Only 28% of persons who had more than one injury in the last year reported the most recent one to staff health compared to 51% of those who had only one needlestick during the year (Table 33). Some respondents commented that they did not consider it necessary to report their latest injury, since they knew their vaccinations were up to date.

In both the laboratory and nursing departments having received hepatitis B vaccine was associated with reporting injuries to staff health (Table 34).

Table 33. Association between reporting needle injuries to staff health and injuries in last 12 months

REPORTED TO STAFF HEALTH	INJURIES IN LAST 12 MO. One	More than one	Total
Yes	38 (51%)	13 (28%)	51 (42%)
No	36 (49%)	34 (72%)	70 (58%)
Total	74 (100%)	47 (100%)	121 (100%)

$X^2 = 5.68$; significant at $p < .025$

Table 34. Association between reporting needle injuries to staff health and HB vaccination status

REPORTED TO STAFF HEALTH	HB VACCINATION Yes	No	Total
Yes	30 (57%)	16 (30%)	46 (43%)
No	23 (43%)	37 (70%)	60 (57%)
Total	53 (100%)	53 (100%)	107 (100%)

$X^2 = 6.49$; significant at $p < .025$

Summary of needlestick injury descriptions

Two hundred sixty-six respondents described their most recent needlestick injury, 121 of which occurred in the twelve months preceding the study. Most nurses were injured while using a needle and syringe and most laboratory staff while using vacuum-tube blood collection devices. Automatic

lancets were involved in a greater proportion of recent injuries to nurses compared with past injuries.

The largest group of injuries occurred while individuals were recapping used needles. Factors cited as contributing to needlestick injuries included working conditions, equipment failure and personal carelessness. Fifty-seven percent of those who had a needlestick injury in the last year said they did not report their latest injury to staff health.

Section C: Summary of results chapter

Rates of recorded needlestick injuries for nurses and for all staff showed no reduction in the years for which staff health departments at the participating hospitals could provide data. Although numbers are small, the frequency of injuries to laboratory staff appears to have declined during this period for at least two hospitals.

Three hundred forty-two persons completed survey questionnaires; three-quarters were nurses and one-quarter laboratory employees. Most participants were females under forty years of age with fewer than sixteen years of working experience.

Nurses used fewer needles, but used them with more types of equipment than laboratory employees. There were

significant differences in needle-handling practices between the two departments and among the three hospitals.

Thirty-six percent of survey respondents had experienced at least one needlestick injury in the last year. Having had a needlestick injury in the last year was associat l with:

1) department of employment (nursing compared to laboratory employees);
2) recapping used needles with two hands, having to carry used needles to reach a disposal container or inconsistently discarding uncapped needles;
3) for nurses: area where employed, length of employment and number of needles used per shift.

The largest proportion of injured persons (42%) reported their injury occurred when they were recapping the needle. Less than half the survey group had reported their most recent injury to the staff health department.

CHAPTER 5. DISCUSSION

The results will be discussed in the context of the three main objectives, which were:

1) to calculate rates for hospital-recorded needlestick injuries in the study hospitals and determine whether they are increasing, decreasing or remaining the same,
2) to measure self-reported needlestick injury rates in employees of the study hospitals through an anonymous questionnaire, and
3) to study the effects of various factors on the likelihood of an employee having a needlestick injury.

Hospital recorded injuries

Employees of the three study hospitals are required to report all on-the-job injuries to staff health departments in order that appropriate management and treatment may be initiated. Injuries serious enough to involve lost time from work may not be covered by Workers' Compensation benefits if they are not documented when they occur. Full disclosure of injuries may assist in identifying workplace hazards so that hospital management can implement suitable preventive measures.

Over the past several years, all study hospitals have attempted to reduce needle injuries through efforts which have included:

1) education and in-service training programs,
2) policies that used needles not be recapped, and
3) provision of improved needle disposal containers.

Hospital-wide rates

No one of the three hospitals showed a decrease in annual needlestick injury rates for all staff over the years for which data were provided. One hospital (C) had an increase in recorded injuries, but there were limited data available and the increase may have been due to improved injury reporting.

The hospital-wide injury rate calculated from staff health data was 7 injuries per 100 FTE per annum for all three hospitals in 1989, the latest year for which data were available. Similar surveys of injuries recorded by staff health services (Table 2, page 15) revealed a needlestick rate of 4.9 to 16 injuries per 100, with most reporting fewer than nine per 100 employees or FTE. Local rates, therefore, are consistent with earlier findings.

Departmental rates

Nursing: Published reports of annual rates of recorded needle injuries for nurses range from 3 per 100 employees (Waldron, 1985) to 28 per 100 FTE per year (Fishman et al., 1985). Hospital B's current needlestick rate for nurses of 12 injuries per 100 FTE would be in the lower half of this range and Hospitals A and C with rates of 24 and 22 are in the upper end. Rates in the study hospitals have fluctuated in the years for which data were provided and display no clear increasing or decreasing trend.

Laboratory: Published annual rates of recorded needlestick injuries for laboratory employees range from 3.9 per 100 employees (Waldron, 1985) to 12 per 100 employees (Ruben et al., 1983). Study rates of recorded needlestick injuries, calculated using as denominator the number of persons identified by the supervisors as collecting blood for each laboratory, were 23 per 100 employees at Hospital A and 4 per 100 found at B and C. It must be noted that these rates are based on very low needlestick frequencies - e.g., only one injury was recorded in 1989 for laboratory employees at Hospitals B and C.

There has been a decline in recorded needlestick injuries for the laboratories at Hospital A between 1985 and 1989 and for Hospital B between 1986 and 1989. Hospital C

provided figures for only two periods and the slight decrease in an already low frequency (from three injuries to one) could not be said to represent a change.

Proportionate distribution: Nursing departments accounted for between 45% and 75% of needlestick injuries in ten published surveys (Table 3, page 18). In hospitals A and C, already noted for their high injury rates, 79% and 78% respectively of all reported injuries were attributable to nursing in 1989. The nursing proportion at Hospital B was 64%.

Laboratory proportions in the published surveys reported in Table 3 (page 18) range from 5% to 16%. In 1989, laboratory employees accounted for 7%, 2% and 2% of recorded needlestick injuries at Hospitals A, B and C respectively. Proportionate rates for laboratory employees at Hospitals A and B show a considerable decline over the past five years.

Usefulness of hospital-recorded injury rates

Needlestick injury rates calculated from staff health records have been used to make comparisons among hospitals and to monitor changes within the same hospital over time. These rates reflect the number of injuries reported to staff health and may not be a good indicator of the number of actual injuries. Factors affecting needlestick reporting must be considered.

Employees may be less inclined to report injuries if the reporting procedure is felt to be cumbersome, time-consuming or likely to lead to punitive actions if recommended techniques have not been followed. Fewer of those in the study who had multiple injuries in the previous year reported their latest injury. They may have believed they understood the needlestick management protocol well enough to decide that no treatment was required for the injury. On the other hand, they may have felt pressured to reduce injuries and were therefore reluctant to report an event they characterised as a failure.

Survey respondents who did not report their most recent injury frequently indicated a report was unnecessary because the injury presented no risk. This assessment of danger posed by needlestick is subjective. Persons injured with a sterile needle may be safe, but those who decide not to report because they "knew the patient's diagnosis" or "my vaccinations were up to date" may be ill-informed about needlestick risk and management.

In order for records of needlestick injuries kept by staff health departments to be complete, there must be cooperation, not only from the injured person, but also from other hospital employees to whom the injury may be reported. An injured employee may report first to a departmental supervisor or to the emergency department, especially if the

injury occurs outside the working hours of the staff health nurse. In all three study hospitals there is a requirement that such injuries be reported in writing to the staff health department, which oversees injury management and maintains employee health records. Because data are unavailable, this study did not determine the proportion of injuries reported elsewhere within a hospital which eventually came to the attention of staff health.

Interventions such as education programs, provision of new equipment and improved employee health services may be doomed to failure if the measure of success is a reduction in the rate of injuries reported to staff health offices. For example, needle injury management programs, by heightening staff awareness of injury consequences, may themselves lead to improved - i.e., increased - rates of injury reporting and offset the hoped-for reduction in recorded injuries.

Caution must be exercised when comparing rates of recorded injuries. Published rate calculations have not been performed in a consistent manner since various studies have used as their denominator full-time equivalents, full-time employees and all employees. Some studies which present findings for hospital-wide rates have excluded low-risk departments, such as medical records, cafeterias and pharmacies from the denominator. Some rates for nursing departments include injuries incurred by students and

ancillary staff in addition to Registered Nurses. Data for comparison were based on groups which conformed as closely as possible to the group definitions used in this survey.

Despite these shortcomings, needlestick injury reports make calculation of recorded injury rates a simple matter. They can be useful to compare with rates found in other hospitals, provided group definitions, denominators and injury recording systems are similar. Monitoring injury rates within a hospital over time may facilitate detection of changes in the frequency and nature of injuries. Providing interpretation of these changes includes careful consideration and awareness of possible confounding factors.

Needle injuries reported by questionnaire

Comparison of recorded and self-reported rates

The second needlestick injury rate calculation made in this study was derived from information reported on questionnaires completed by nursing and laboratory staff at the three study hospitals. When comparing these data with the hospital-derived figures, it is necessary to be aware of the possible impact of the following factors:

1) differences in denominators,
2) inconsistent criteria for inclusion in occupational groups, and

3) survey bias.

Each of these points requires a brief explanation.

Denominator differences: Hospital-derived needlestick rates for nurses were calculated per 100 FTE, while the survey rate denominator of 100 employees includes full-time, part-time and casual staff. The inclusion of respondents working less than full time means that 100 survey respondents would comprise fewer than 100 FTE. In this study, while hospital-recorded and self-reported rates were different, the rank order of the three hospitals was the same for both sets of rates.

Group inclusion criteria: The nursing survey group included all registered non-supervisory nurses who regularly use needles in the course of their work. The nursing categories used by staff health for recording needle injuries and by human resources departments for tabulating FTE may have been broader or narrower than those used in the survey. For example, injuries to nursing supervisors may be recorded in the same category as those to non-supervisory nurses; the number of FTE in the nursing department may include some nurses who never use needles. These categorical differences are believed to be small, similar among the hospitals and unlikely to affect the study conclusions.

The laboratory staff chosen for the study were those who use needles to collect blood. Some needlestick injuries

to laboratory employees recorded by staff health may have involved personnel who do not collect blood, but who use needles within the laboratory for other purposes. The inclusion in staff health frequencies of injuries reported by persons not included in the survey group may account for some of the differences between the two rates, but the effect would be expected to be similar in all three hospitals.

Survey Bias: Just as the accuracy of data gathered by staff health departments is affected by factors such as reporting rates, data collection by survey may be subject to bias.

Recall bias may influence questionnaire-reported data. Survey respondents may over- or underestimate the time since their last needlestick (i.e., did the injury occur within the last twelve months?) and the total number of injuries experienced in the past twelve months. The person who has several injuries each year may have difficulty recalling the exact total, whereas an individual with only one needlestick in a lifetime may remember it very clearly. Recall of the type of equipment or activity associated with an injury may also be affected.

Selection bias may have resulted from the timing of the survey. Some casual and part-time employees were not working during the survey period because of its proximity to Christmas and to the university examination period. Other casual and part-time employees worked extra shifts at that

time. However, this survey did not find an association between injury rates and type of position (full-time, part-time or casual).

"Healthy worker" bias can affect studies of morbidity in occupational groups. Exclusion from a study of those off work due to illness, early retirement or transfer to a non-exposed job category results in a workforce healthier than the general population and an underestimate of the problem being investigated. Although several nurses were on leave due to job-related injuries (most often back injuries), there is no reason to suppose their incidence of needlestick injuries while on the job would be different from those still working. Furthermore, no nurses or laboratory employees were absent from work due to a needlestick-related infection and no health care worker in the province received Worker's Compensation benefits for occupationally-acquired hepatitis B infection in 1989 (Garland, 1990).

Comparison of nursing rates from both sources

Despite differences in their derivation, hospital-recorded nursing injury rates and self-reported rates for similar time periods are consistent in showing Hospital A with the highest number of injuries, followed by B and then C.

At face value, the self-reported rates for nurses are far higher than the hospital-recorded rates (Table 35).

When survey data (rate of self-reported needlesticks and proportion reported to staff health) are used to calculate rates of needlesticks reported to staff health (item c, Table 35), the results for hospitals B and C are very similar to the rates from hospital-recorded data. A large discrepancy remains at Hospital A, implying that either the self-reported rates are falsely high or the hospital-recorded rates are falsely low.

Table 35. Comparison of hospital-recorded and self-reported needlestick rates for nursing departments in 1989

FINDING	HOSPITAL A	B	C
a) Self-reported rate per 100 employees*	108	43	68
b) % reporting last injury to staff health	49%	32%	3[illegible]%
c) Needlesticks declared reported/100 employees (b x a)	53	14	23
d) Needlesticks/100 FTE from staff health records	24	12	22

* These figures are a minimum, since some persons reported "six or more" needlesticks.

Comparison of laboratory figures from both sources

Table 36 presents a comparison of hospital-recorded and self-reported needlestick data for the three hospital

laboratories. Because of the low frequencies in the original data, it may be inappropriate to draw conclusions by comparing survey-derived rates of needlesticks reported to staff health departments with rates of hospital-recorded injuries. Examination of the raw figures (and keeping in mind that Hospital A has about twice as many laboratory employees as B and C), suggests that the higher frequency of recorded needlesticks at Hospital A may be indicative of more complete reporting rather than any actual difference in injury rates.

Table 36. Comparison of hospital-recorded and self-reported needlesticks for laboratories in 1989

FINDING	HOSPITAL A	B	C
a) Self-reported rate per 100 employees	29	20	18
b) % reporting last injury to staff health	67%	50%	33%
c) Needlesticks declared reported/100 employees (b x a)	19	10	6
d) Needlesticks/100 FTE from staff health records	23	4	4
e) Self-reported needlestick frequency	11	5	4
f) Hospital-recorded needlestick frequency	11	1	1

Comparison of self-reported rates with published data

Jackson at al. (1986) found that 33.6% of those who participated in an anonymous survey reported having at least one needlestick injury in the preceding year; 36% of participants in this study reported one or more injuries. In Jackson's survey, 64% of respondents were nurses and 36% were medical staff and students; 75% of respondents in the present survey were nurses and 25% were laboratory employees.

Hamory's study (1983) produced self-reported annual needle injury rates of 61.6 per 100 nurses and 25.5 per 100 laboratory employees. The present survey found a comparable 74 injuries per 100 nurses and 24 per 100 laboratory employees. Hamory's rates were calculated using as denominator the number of persons receiving questionnaires, so he assumed they were lower than actual.

Only 43% of those in this survey who were injured in the last year had reported their most recent needlestick to staff health. The 57% rate of under-reporting is very similar to the 60% rate found by Hamory (1983). Other studies (Jacobson et al., 1983; Jagger et al., 1988) have found under-reporting rates ranging from 39% to 92%.

Factors affecting needle injury rates

Comparison of laboratory and nursing departments

Risk of needle injury varied markedly from one department to another. The proportion of nurses who indicated by questionnaire they had one or more injuries in the last year was double that of the laboratory staff (41% vs. 20%). The needlestick rate for nurses, 74 per 100 employees, was three times the laboratory rate. The study revealed differences between laboratory and nursing personnel in the following areas:

1) numbers and types of needles used,
2) handling used needles before disposal, and
3) association between length of working experience and likelihood of recent injury.

Number and types of needles: There was an association for nurses, but not for laboratory staff, between number of needles used per shift and having been injured in the last year. It is possible that the number of needles used per shift by nurses is a proxy measure for work load or job complexity.

On the other hand, laboratory employees, many of whom use far more needles than any nurse surveyed, may not experience an increased risk corresponding to the number of

needles used since no competing tasks interfere with their blood collection duties. A laboratory employee performing a venepuncture need be concerned with only one patient at a time; a nurse giving care to one patient may be distracted by the urgent request of another.

Technologists who take blood only occasionally were as likely to have experienced at least one needlestick injury during the year as full-time phlebotomists. Because they take blood less often, technologists may be less skilled than phlebotomists at performing venepunctures and in managing their work environment, e.g., ensuring they have access to disposal containers and needle-cap removal devices. Several technologists made it clear that blood collection is a chore they dislike and which they attempt to keep to a minimum. One technologist's approach, as described on the questionnaire, is to "usually change shifts to avoid it". Discomfort with the technique may place them at a greater per-needle risk for needlestick injury.

While a majority of nurses use three to six types of needles per shift, the only needles used regularly by most laboratory employees are those attached to vacuum-tube blood collection devices. The uniformity of equipment handled may confer an advantage.

Handling used needles: Virtually all injuries to laboratory employees involved vacuum-tube blood collection devices, the

equipment they use most often. These devices require disassembly after use; needles must be removed from their non-disposable holders. An uncapped needle is very difficult to detach from its holder by hand and few would attempt such a manoeuvre. Needle removal is usually accomplished in one of two ways. The uncapped needle can be inserted into a specially designed slot,located on the lid of most needle disposal containers, which grips the needle hub while the operator rotates the holder. The needle becomes unscrewed and drops off into the disposal container. Alternatively, the used needle can be recapped, manually detached and discarded.

The low rate of needlestick injuries experienced by laboratory personnel may be accounted for by the following factors:

1) needle-detaching devices, which eliminate recapping, are used by 64% of laboratory employees at least some of the time, almost half use them often;
2) fewer laboratory employees, as compared with nurses, recapped needles with both hands; more recapped with a one-handed scooping technique.

Nurses use phlebotomy equipment less often than laboratory employees, but they use other devices which require special handling. Exceptionally long needles or stylets, and needles attached to equipment such as intravenous tubing may not fit easily into every disposal container, necessitating

carrying the needle to a larger disposal unit or detaching it from the rest of the equipment. When nurses detach needles from equipment, they usually do so manually. Needle-detaching slots on disposal containers are designed for unscrewing needles from vacuum-tube holders; some do not work well with needles that slide or lock into place.

Needle and disposable syringe assemblies, which most nurses use on every shift, were associated with 68% of recent nursing injuries (Table 29, page 101). Although fourth in frequency of use, the second most common needle involved in nursing injuries was the automatic spring-loaded lancet usually used to obtain capillary blood for glucose determinations. About 30% of nurses used these lancets on most of their shifts (Figure 2, page 71). Automatic lancets were the only device associated with a greater proportion of recent compared to past needlesticks. Injuries occurred while removing the lancet from its mechanical holder, while attempting to insert the pointed end into the small plastic disc which comes with the lancet, or when a used, uncovered lancet was encountered in the box holding the new ones. The mechanical triggering device with which these lancets are used comes in a variety of designs; lancets can be attached to and removed from some more easily than others. Injury descriptions suggest that some nurses may not recognize that used lancets should be handled like other needles, i.e. placed uncapped into a proper disposal container.

Length of working experience: Having had a needle injury in the last year was associated with years of experience and length of employment for nurses, but not for laboratory employees. Nurses may require years on the job to develop the skills or strategies needed to protect themselves from needle injury. More particularly, they may require a longer period than currently recognized to fully adapt to new working conditions.

Alternatively, some nurses, as they gain experience, move into areas which happen to require less extensive needle use or which otherwise reduce their risk of needle injury. The large number of newly-employed nurses in the medical-surgical area suggests these are entry level appointments, with employees moving later in their careers to obstetrics, geriatrics or psychiatry.

Comparison of nursing sub-groups

Striking differences in nursing injury frequency exist among the three hospitals. Hospital A had the highest rate of injuries per 100 nurses, while Hospital B had the lowest. Dissimilarities among the hospitals were found in the following areas:

1) distribution of nursing units,
2) length of employment of nurses, and
3) needle-handling procedures.

More than half the nurses at Hospital A worked in medical-surgical units, a higher proportion than the 34% at Hospital B and 38% at C. Proportionately more nurses in medical-surgical units (53%) were injured in the past twelve months than in the nursing group as a whole (41%).

Length of employment in their current hospital was associated with likelihood of a nurse's having been injured in the last twelve months. Hospital A nurses had shorter lengths of service than those from other hospitals; 53% had fewer than six years of working experience in that facility, compared to 35% and 43% at Hospitals B and C.

Two needle-handling practices associated with having had a recent needlestick injury were common at Hospital A; 75% of employees sometimes had to carry used needles to disposal containers and 87% recapped needles using two hands.

Hospital B is remarkable for its low proportion of nurses injured and for a lower rate of injuries per 100 nurses, compared with the other two hospitals. Nurses employed at Hospital B have worked there longer than their counterparts elsewhere (15% for more than fifteen years) and few (10%) report high needle-use.

As well, there are differences between needle-handling practices at Hospital B and the other hospitals. Nurses at Hospital B discard uncapped needles less frequently than nurses at the other two hospitals, they often use one-handed methods of replacing the cap, i.e. placing the cap in

a stand or scooping it off a flat surface. Stands in which to place needle-caps to facilitate recapping were in common use at this hospital for a few years; current official policy is that needles not be recapped, but responses from the survey show that many employees continue to use the blocks.

Nursing units within the three hospitals differ in injury rates, with 53% of medical-surgical nurses, 40% of critical care nurses and only 24% of nurses from obstetrics, psychiatry and geriatrics having one or more needlesticks in the last year. There is an association between the area where a nurse works and the following factors:

1) years of working experience and length of time with present employer,
2) having to carry used needles to a disposal container, and
3) using large numbers of needles per shift.

Medical-surgical nurses have the least years of experience and shortest length of time with their hospital, and most of them have to carry used needles sometimes (70% compared with 58% for all nurses). The combination of few years of experience in their hospital (a risk factor also identified by Hamory, 1983) and lack of ready access to a needle container appears to place medical-surgical nurses at increased risk for a needlestick injury.

The finding that critical care nurses in this study had fewer needlestick injuries than medical-surgical staff, contrasts with a report by Ruben et al. (1983) that operating room and intensive care nurses had higher injury rates than medical-surgical nurses. The units included in the critical care category for this study are all considered high-risk for the purpose of hepatitis B vaccination programs; a minority of medical-surgical units are so designated. Critical care nurses in this study used similar numbers of needles per shift and had only slightly more working experience than medical-surgical nurses.

One advantage critical care nurses may have over their medical-surgical colleagues is how they deal with used needles. Fewer of them (44%) ever have to carry needles to disposal containers; carrying used needles is associated with recapping. The close proximity of disposal containers to critical care beds and treatment sites appears to reduce the risk posed by frequent needle-use. Recognition that these areas have very ill patients, the likelihood of frequent needle-use, and the necessity for the care-giver to remain with the patient has led to the provision of disposal equipment right where it is needed.

Small numbers of nurses worked in each of obstetrics, geriatrics and psychiatry. Grouped together, they comprised a quarter of the nursing survey group. Only 24% had

had a recent injury. They used fewer types of needles and fewer needles in total than medical-surgical or critical care nurses. They were also a more mature and experienced work force.

Activities at the time of needle injury

Injury-associated activities will be discussed under the following categories:

1) injuries prior to planned procedure,
2) procedure related injuries,
3) injuries following use of needle, and
4) injuries involving colleagues.

Injuries prior to planned procedure

The only significant difference between recent (occurring in last twelve months) and past (more than a year ago) needle injuries was in the proportion happening before the needle's intended use - 24% of recent versus 14% of past injuries. There was a similar increase in the number of injuries involving needles which had not been exposed to a patient or to blood or other body fluids; some of these needles had been used, but for purposes such as drawing up medications. It would be encouraging to believe that fewer persons currently experiencing needlesticks are at risk of

acquiring an infection as a result. Hospital employees may be handling contaminated needles more carefully.

On the other hand, these data may not mean that fewer recent injuries involve contaminated needles. Injuries with contaminated needles may be more traumatic events than those involving clean needles and may be remembered for a longer period, thereby artificially increasing their proportion among past injuries. Those with recent injuries, on the other hand, may be more inclined to describe an injury with a clean needle, since such an incident may be considered to carry less blame than an injury with a contaminated needle. Those who reported having more than one needlestick within the last year more frequently described their most recent injury as one involving a clean needle. It is also possible that some respondents are mistaken in their belief that the needle was free of blood contamination. Hein et al. (1987) were able to demonstrate by chemical reaction the presence of blood not visually detectable in intravenous lines.

Procedure related injuries

The small percentage of injuries occurring during a procedure (7%) is lower than other published reports which ranged as high as 61% (see Table 4, page 21). Comparisons are difficult to make between the findings of this study and others which attempt to classify what was happening at the

time of injury. Studies including only contaminated needles would likely have a higher proportion of procedural injuries than this study. Most of the published reports have no category for injuries occurring before the needle's intended use, so these events may have been excluded entirely or considered to be procedure-related. In the current study, respondents were asked to choose from eight specific options when describing their most recent injury, one of which was "performing procedure" (Question 13, Appendix C, page 162). Studies using only staff health records to classify injuries may have placed injuries into fewer and, therefore, broader classifications. Activities such as equipment disassembly, a separate category in this study, were considered by some to be procedure-related (Ribner et al., 1987).

Nurses mentioned heavy workloads and less than ideal physical conditions, i.e. poor lighting, as factors in procedural as well as other types of injuries. Laboratory personnel more often reported patient behaviour as contributing to injury risk. Several reported unpredictable movement of a patient during blood collection as the cause of their injury. Blood collectors often have no knowledge of a patient prior to performing a venepuncture and may be unaware of whether or not the individual would be prone to erratic behaviour.

Injuries following use of needle

Most (72%) of the needlesticks described happened after the needle was used and involved such activities as recapping, holding a used needle, disassembling equipment, being stabbed by a loose needle left unattended and disposing of the needle. Recent and past injuries from used needles had nearly identical distributions of each circumstance.

The 42% of injuries in this survey due to recapping is a higher proportion than the 9-30% range in previously published studies (Table 4, page 21). It is also greater than the proportion of needle injuries attributable to recapping found in HIV exposure surveillance studies. The Federal Centre for AIDS (1990) reported 14% of needlestick exposures were due to recapping and Marcus et al. (1988) found 24% were in this category.

A study which gathered injury descriptions by personal interview after the injury report was filed (Jagger et al., 1988) found a higher proportion of recapping (30%) than the 9-26% range in studies which drew needlestick descriptions from staff health reports (Table 4, page 21). The anonymity provided in this survey may explain the greater proportion of subjects in this study describing recapping as the cause of their injury.

Efforts to reduce needle recapping by hospital employees have had outcomes ranging from no behaviour change

at all (Edmond et al., 1988) to considerable success (Seto et al., 1990). At the present time, a direct association between implementation of non-recapping programs and a reduction in overall rates of needlestick injuries is not evident.

Jagger et al. (1988) reported several reasons why employees recap needles, including:

1) self-protection during disassembly of equipment,
2) protection of self and others when carrying used equipment to disposal containers, and
3) safe storage of syringes destined for multiple uses.

Many of the respondents in this study reiterated these concerns when commenting on why they recapped needles. A nurse who had just begun work in an intensive care unit which has containers at each bedside referred to the medical-surgical unit where she used to work:

> In these rooms where there were four beds I felt more comfortable recapping (carefully) a used needle than walking across the room ... to dispose of it... I was always afraid someone might walk into or accidentally hit the used needle. Often the other patients might be coming in and out of the bathroom, and there was the added traffic of visitors and other hospital staff.

This study confirms that if employees are placed in a position of having to choose between conflicting hazards, non-recapping policies are unlikely to achieve their stated goals of reducing both recapping and needlesticks. If non-recapping simply replaces one recognized risk of a needlestick

injury with the unknown perils of walking around with an uncapped needle, there may be no net safety gain.

The additional 30% of injuries which happen after a needle is used are not directly related to the act of recapping, but point out how essential it is to neutralize the hazard of the exposed needle as soon as it has fulfilled its purpose. Injuries which occur while holding a used needle or when a loose needle is accidentally encountered may be reduced by prompt needle disposal.

Disassembling equipment, such as unscrewing needles from vacuum-tube holders, severing intravenous tubing, and removing automatic lancets from their triggering devices are activities which need to be addressed in needlestick prevention programs. It may be possible to eliminate some such practices entirely with equipment modifications. If disassembly is unavoidable, employees must be protected from the hazards posed by manipulation of uncapped needles.

Injuries involving colleagues

Fewer recent than past needlestick injuries were due to needles held by co-workers, though the low proportions (2% of recent versus 6% of past injuries) preclude any definitive conclusions. It may be that health workers have recognized the risk of passing uncapped needles from one to another (the

cause of several of the past injuries in this category), and are refraining from this practice.

Awareness and attitudes

Respondents seemed to be inadequately informed about some job-related risks. Most overestimated the risk of contracting AIDS from a needle contaminated with the blood of an infected individual; most underestimated the risk for Hepatitis B.

A large majority of survey participants accept ultimate responsibility for their own safety, but look to hospital administrators and supervisors for more training, better guidance through appropriate policies, and enforcement of proper procedure, so that others do not place them at risk. Neither assessment of job-related infection risk, beliefs about reducing needlestick injuries or any of the health practices surveyed showed an association with having had a recent needlestick injury.

Although neither was associated with frequency of needlestick injury, it was interesting to find that two health practices, one job-related and one personal, were associated. Women who frequently wear protective gloves on the job more often reported examining their own breasts regularly, compared with non-wearers. Breast self-examination and glove-wearing both address long-term health preservation and both require

personal commitment. Both activities are promoted by official recommendations, but non-compliance is unlikely to have any immediate consequences. Similar mechanisms may affect individual decision-making in both cases.

Summary

Nurses reported more recent needlestick injuries than laboratory staff at the same hospitals. This finding was consistent for injuries recorded by staff health departments and those self-reported on an anonymous questionnaire. Survey data showed that, compared to laboratory staff, nurses used fewer but more varied kinds of needles, recapped needles using both hands more often, and had fewer years of working experience.

Risk factors associated with injuries in nursing sub-groups were fewer years of experience in the present hospital, need to carry used needles to disposal containers and frequent use of needles.

CHAPTER 6. CONCLUSIONS AND IMPLICATIONS

Conclusions

Needlestick prevention measures currently in place in the three study hospitals have not changed the needle-handling practices of nursing and laboratory employees as intended, nor have they reduced needlestick injury rates for the hospitals as a whole. Analysis of the data gathered by questionnaire has led to several conclusions. Categories of respondents reporting more injuries were:

1) nurses, as compared to technologists and phlebotomists, and
2) nurses working on medical-surgical units and in hospital A.

Risk factors associated with belonging to higher-risk groups were as follows:

1) recapping used needles using both hands,
2) carrying used needles to disposal containers,
3) being a younger, less experienced nurse.

Most needlestick injuries described by survey participants occurred after the needle was used and before it could be deposited in a puncture-resistant container. Persons in this study who recapped needles using both hands or who carried used needles to a disposal container more often stated

they had been injured by needlestick in the past year than those not engaging in these practices.

Implications of the study

The present study provides insight into factors contributing to the occurrence of needlestick injuries which may be used to improve hospital practice and staff education and to design research aimed at decreasing the incidence of needlesticks.

Practice

Changes in needle-handling practices should concentrate on the most common causes of injuries. Most injuries described by study participants involved activities preparatory to needle disposal, such as recapping, holding or disassembling needles. The majority of such injuries could be eliminated if needles were placed into a disposal container immediately after use, with no intermediary steps. For this to happen, suitable containers must always be within reach of the needle-user and needles should not be detached from the equipment with which they are used.

Hospitals not presently doing so should consider providing point-of-use placement of needle disposal units. Current concerns about this system relate to costs and

security. In areas of frequent needle-use, costs will not be increased when multiple containers per room are supplied, since containers will normally be filled at the time of disposal and the number of containers used should not increase. On the other hand, areas using few needles may replace containers on a regular schedule so that partially-filled containers are not left in place for long periods. Costs for low-use areas could be contained by using smaller containers or affixing containers to treatment trays or medication carts which are brought into patient rooms whenever needles are used.

A second concern related to placement of needle disposal containers in patient rooms is that patients or visitors might injure themselves or remove needles and syringes to use for injecting illegal substances. Wall-mounted containers with locking devices may help alleviate these concerns. The number of injectable drug abusers and the availability of hypodermic equipment in the local community should be considered when making policy.

Point-of-use provision of disposal containers eliminates the need to recap used needles for safe transport to containers and removes an impediment to compliance with non-recapping policies. Employees also recap needles to protect themselves during disassembly or other manipulation of equipment. Policies and disposal containers designed with small disposal syringes in mind are inadequate for handling

other devices frequently associated with needlestick injuries, such as phlebotomy equipment and automatic lancets.

Vacuum-tube blood collection devices presently employ reusable holders from which needles are detached before disposal; needles are either recapped and unscrewed by hand or detached with a needle removal device. Hospitals which forbid recapping must ensure that all employees who collect blood have access to and know how to use needle removal devices. Detaching needles could be eliminated by discarding needle holders after a single use, but this would increase costs and increase the volume of material deposited in needle containers.

Handling of cumbersome types of equipment which do not easily fit into standard disposal containers should be addressed specifically when policy is formulated and containers are selected. Automatic, spring-loaded lancets are a non-standard type of needle requiring special procedures for disassembly; triggering devices with which they are used should be chosen with ease of lancet removal and safety of the operator in mind.

Legitimate questions have been raised about the advisability of an outright ban on needle recapping. Some believe that, if people are going to recap needles anyway (as many in the present study are doing), they should be taught to recap safely and given devices which facilitate recapping. Infection control officers should discuss with staff why

recapping continues and whether everything possible has been done to make recapping unnecessary. Policy-makers should give guidance to employees regarding what to do when disposal containers are filled or otherwise unavailable.

Education and training

Education on the risks of needlesticks and training in appropriate safety techniques must begin during initial certification courses and be updated continuously. In-service progr. should reach all employees who handle needles, since the careless actions of any individual may expose a colleague to risk of injury. Some study participants expressed particular concern that physicians were uninformed about needle disposal practices in their hospital. Programs should be accessible to staff on all shifts and attendance should be compulsory. Employee input and feedback should be encouraged.

Education programs should stress the importance of reporting all injuries and emphasize that the purpose of such reports is to protect the injured person and assist the hospital in planning infection control interventions, not to determine whether hospital policy is being followed.

Education and training programs should give special attention to those who are at greatest risk. More newly-employed nurses in this study and in published reports experienced a needlestick injury during the survey period.

Orientation for new nurses may need to be evaluated to determine whether needle-handling is addressed adequately.

Research

Areas of research into needlestick prevention may involve evaluation of current programs or assessment of entirely new policies, techniques, needles or disposal equipment. Hospitals need to know whether their strategies to reduce needle injuries are effective. Under-reporting of needlestick injuries may hamper investigations based on data gathered by staff health departments. Recorded injury rates may take years to show the effect of an intervention. What can be measured more quickly is change in employee knowledge and behaviour following education and training programs or policy changes. Questionnaires, direct observation of practice and indirect assessment (for example, checking discarded needles to determine whether they have been recapped) may be employed for program evaluation.

Further research is needed to assess how employee perceptions that injury reporting is time-consuming, inconvenient and may lead to reprisals may act as deterrents to injury reporting. Alternative reporting systems need to be designed and evaluated.

Summary

Study findings have identified employee groups with high rates of needlestick injury and needle-handling practices associated with injury risk. Policies and education programs should be specially targeted to newly-employed nurses and those working on medical-surgical floors. Recapping used needles with two hands remains a common practice and the most frequent cause of needlestick injury. To reduce the need to recap, this report recommends point-of-use placement of needle disposal containers. Policy and equipment changes should be evaluated for employee acceptance and for efficacy.

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Appendix A. Needlestick Protocol for Hepatitis B Prevention

Staff health departments in the study hospitals use a needlestick management protocol endorsed by the provincial Department of Health for the prevention of hepatitis B (Newfoundland Department of Health, 1989). When a needlestick injury occurs, the patient-source (the person to whom the needle was exposed), if identified, should be tested for hepatitis B surface antigen (HBsAg). Prophylactic measures to be undertaken (Table 37), will depend on the outcome of this test and whether or not the exposed employee has already been vaccinated for hepatitis B.

Table 37. Post-exposure immunoprophylaxis

	EMPLOYEE	
SOURCE	Unvaccinated	Vaccinated
HBsAg positive	Hepatitis B immune globulin (HBIg) given immediately. Vaccine series initiated within 7 days.	Test for anti-HBsAg, if not tested in last 12 months. If adequate antibody - no treatment. If inadequate antibody - HBIg plus booster dose of vaccine.
HBsAg negative	No treatment.	No treatment.
Unidentified	Immune serum globulin (ISG). Vaccine series initiated, if in eligible category.	No treatment.

Appendix B. Calculation of Nursing Sample Size

Lists of registered, non-supervisory nurses were supplied by the personnel departments in two hospitals (A and B) and by the nursing office in the third (C). Staff providing the lists identified nursing positions which did not involve patient care, e.g. research coordinators, and these were excluded.

Sample size was calculated by the EPISTAT# Statistical Package for IBM computers, using the formula:

$$n = [z(\alpha) * SQR(pi*(1-pi))/d] \text{ squared}$$

$$N = n/(1+n/TP)$$

where TP = total population

pi = estimated population rate of the study characteristic

d = maximum acceptable error in the study population

α = level of statistical significance

$z(\alpha)$ = standard normal deviation for alpha

values chosen were pi = .50
d = .10
α = .05
$z(\alpha)$ = 1.96

Written by Tracy L. Gustafson, 1705 Gattis School Road, Round Rock, Texas 78664

Sample size was calculated for each hospital. Since the anticipated response rate for the survey was 80%, the calculated sample sizes were divided by .8 to determine how many questionnaires to distribute to obtain participant groups of the calculated size (Table 38).

Table 38. Nursing sample size calculations

	HOSPITAL		
	A	B	C
Total population of eligible nurses	636	340	332
Calculated sample size	87	75	74
N/.8 = questionnaires to be distributed	109	94	93

Appendix C. Questionnaire

Thank you for taking part in this survey. Completion of the questionnaire should take only ten or fifteen minutes.
Please answer questions by marking the appropriate space.

SECTION 1 of the questionnaire concerns the types and numbers of needles you use in performing or assisting at procedures such as medication injections, intravenous therapy and blood collection.

---

1. In the past year, how often have you used each of the following types of equipment? Please check a response for each piece of equipment.

Type of equipment	Used on most shifts	Used on some shifts	Used rarely or never
Vacutainer or equivalent	[]	[]	[]
blood lancet - manual	[]	[]	[]
Autolet-type lancet	[]	[]	[]
disposable needle & syringe	[]	[]	[]
needle and i.v. tubing	[]	[]	[]
butterfly-type needle	[]	[]	[]
i.v. catheter/ angiocath.	[]	[]	[]
prefilled cartridges, such as Tubex or Carpuject	[]	[]	[]
other (specify)_____	[]	[]	[]

With reference to the last shift which you worked:

2. How many hours did you work? _____

3. Approximately how many needles did you use on this shift?

[] 0 [] 1-5 [] 6-15 [] 16-30 [] 30+ (Number=____)

2

Thinking back over the last year, with reference to typical or average shifts:

4. How many hours did you usually work per shift? _____

5. What would be the average number of needles you used per shift?

[] 0 [] 1-5 [] 6-15 [] 16-30 [] 30+ (Number=_____)

SECTION 2 concerns how you handle used needles.

---

6. Listed below are several different ways people handle needles after completing clinical procedures. Please read each choice and indicate how frequently each is part of your technique.

Often	Some-times	Never	
[]	[]	[]	hold needle and attached equipment (syringe/holder/tubing) in one hand, replace cap with the other
[]	[]	[]	place cap in a stand, insert needle to recap
[]	[]	[]	hold cap in a shield, insert needle to recap
[]	[]	[]	use one-handed technique to "scoop" needle cap from flat surface
[]	[]	[]	bend or cut needle
[]	[]	[]	use device to separate needle from rest of equipment
[]	[]	[]	separate needle from rest of equipment by hand
[]	[]	[]	discard needle without recapping
[]	[]	[]	other (specify) _____

7. Do you sometimes have to carry used needles from the point-of-use into another area to get access to an approved disposal container?

[] yes [] no

Please explain._____

8. In your hospital, do you ever notice needles discarded into containers not designated for that purpose?

[] yes [] no

If yes, why do you think this happens?_____

_____

9(a). When performing procedures involving the use of needles, do you wear gloves

[] almost always [] frequently [] rarely [] never

9(b). Please state the reasons why you do or do not wear gloves:

_____

_____

_____

SECTION 3 deals with needlestick injuries, that is, any injury caused by a needle, lancet or stylet used for collecting blood, giving a medication or other patient procedure.

10. Have you <u>at any time</u> ever experienced a needlestick injury?

[] Yes [] No <u>If no, go to question 17.</u>

11. How many needlestick injuries have you experienced <u>during the past twelve months?</u>

[] 0 [] 1 [] 2 [] 3 [] 4 [] 5 [] 6 or more

4

Please answer these questions regarding your most recent needle-stick. (If you had no injury in the past year, I would still like you to describe the last one you can recall.)

12(a). What type of needle and related equipment was involved?

_____

12(b). At the time of the injury, had the needle already been used on a patient or in contact with blood or body fluids?

[] yes [] no

13. Which situation best describes what was happening when you received the injury?

[] before procedure
[] performing procedure
[] holding the needle, after procedure completed
[] recapping the needle
[] disassembling equipment
[] disposing of the needle
[] loose needle on bed, tray, table or other location
[] needle held by another person
[] other (specify) _____

14. What would you say made this situation different from normal?

_____

_____

15. How do you think this injury could have been prevented?

_____

_____

16.(a) What did you do about this injury? Check all that apply.

[] took care of it myself
[] reported to supervisor
[] reported to staff health
[] reported to emergency room
[] other (specify) _____

(b) If you were to have another injury, would you handle it the same way with regard to reporting? []yes []no

Comments:_____

SECTION 4 is concerned with your opinions on the hazards of needlestick injuries.

---

17. In your opinion, which of these diseases can be transmitted by needlestick? Check all that apply.

A. [ ] herpes
B. [ ] hepatitis B
C. [ ] syphilis
D. [ ] tuberculosis
E. [ ] acquired immune deficiency syndrome (AIDS)

18. Which of the diseases named in Q. 17 do you believe to be most common among the population served by your hospital? Write the corresponding letter in the space provided.

Answer: _____

19. **Not everybody injured with a needle used on a patient who has a blood borne disease actually develops an infection.**

(a) In your opinion, what percentage of persons injured with a needle used on a patient with hepatitis B will go on to develop hepatitis?

[ ] <1% [ ] 1-10% [ ] 11-30% [ ] 31-50% [ ] >50%

(b) In your opinion, what percentage of persons injured with a needle used on a person with AIDS will develop evidence of infection with the human immunodeficiency virus (i.e. positive HIV test)?

[ ] <1% [ ] 1-10% [ ] 11-30% [ ] 31-50% [ ] >50%

20. During the past year, did you do any of the following which related to safe handling of needles? Please check all that apply.

[ ] read a journal article or other published document
[ ] attended a hospital-sponsored lecture or seminar
[ ] attended a seminar or lecture sponsored by a professional society
[ ] attended a seminar or lecture sponsored by a union

[ ] other (specify) _____

6

21.(a) Compared to five years ago, which phrase do you think best describes the present risk of contracting an occupationally-related disease in your hospital?

[] increased a lot [] increased somewhat [] no change

[] decreased somewhat [] decreased a lot

(b) What would you say has been the major reason for this change?

_____

22. Have you received Hepatitis B vaccine?

[] Yes [] No [] Don't remember

23(a). Who do you think should bear the major responsibility for reducing the incidence of needlesticks? Check only one.

[] the individual employee
[] hospital administration
[] departmental supervisors
[] professional societies
[] unions
[] other (specify)_____

23(b). Why do you think the responsibility should rest here?

_____

24. To reduce needlestick injuries, which of the following would need to be improved? Please explain.

[] Policies:_____

[] Needle design:_____

[] Disposal containers:_____

[] Training:_____

[] Other:_____

SECTION 5. Now that you have completed the specialized questions, would you please provide some information of a more general nature about yourself?

---

25. Age group: [] <25 [] 25-39 [] 40-54 [] >54

26. Sex: [] Female [] Male

27(a) Nurses: Please indicate your qualifications.

[] R.N. [] B.N. [] other (specify) _____

In which area are you presently employed (e.g. surgery, obstetrics) _____

(b) Technologists/technicians: Please indicate your qualifications.

[] R.T. [] A.R.T. [] C.L.A. or other 1 year course

[] on-the-job [] other (specify) _____

Is blood collection the major part of your job? []yes []no

If no, how many days per month do you take blood? _____

28. Total number of years related working experience:

[] 1 or less [] 2-5 [] 6-15 [] >15

29. How many years have you worked in this hospital?

[] 1 or less [] 2-5 [] 6-15 [] >15

30. Is your position [] full-time [] part-time [] casual

8

SECTION 6. Some believe that our attitudes and practices regarding the protection of our health are similar both on and off the job. The last few questions are intended to gain a general overview of some lifestyle habits.

31.(a) Are you a smoker?

[] Yes [] Former smoker [] No, never did

(b) If you presently smoke, please indicate how many cigarettes you smoke per day, on average.

[] <15 [] 15-24 [] 25-34 [] 35 or more

32. How often do you use seat belts when you ride in a car?

[] always [] most of the time [] sometimes [] never

33. How many times per week do you exercise vigorously for at least fifteen minutes?

[] daily [] 3-6 times [] twice or less [] never

Questions 34 and 35 apply to women only.

34. How often do you examine your own breasts?

[] every month [] every 2-3 months [] less often [] never

35. When was the last time you had a Pap smear?

[] within past year [] 2-3 yr. ago [] >3 yr. ago [] never

Please use the space below for any additional comments on any part of the survey.

Thank you for your interest in this study.

Memorial
University of Newfoundland

Division of Community Medicine & Behavioural Sciences
Faculty of Medicine
The Health Sciences Centre

Date: November 14, 1989

To: Nursing staff,
Hospital

From: Bonnie James

I am asking for your help in a project which is examining needlestick injuries in nursing and laboratory personnel in St. John's hospitals. This study will form the basis of my thesis for a master's degree in community medicine.

The objectives of the study include (1) ascertaining the annual incidence rate of needlesticks and (2) examining factors which may influence the likelihood of a person having a needle injury. The attached outline provides further details.

Would you please help by completing the enclosed questionnaire? Your name was chosen at random from the list of staff nurses at your hospital. You are not asked to identify yourself on the survey and it takes only ten or fifteen minutes to complete. To return the questionnaire, please seal it in the envelope provided. Complete the participant card but do not attach it to the envelope. The card and questionnaire should then be deposited separately in the envelope located at your nursing unit at your earliest convenience. Remember, there are no names requested on the questionnaire, but I would like to know when people have responded so that I need not send reminders. Also, you may indicate on the participant card whether or not you would like a summary of the study's findings.

If you have any questions regarding any aspect of the study, please telephone me at 737-7230 during working hours or at 364-2001 or 579-9888 evenings and weekends. Your participation in this study is greatly appreciated.

Thank you.

P.S. If you never use needles in your work, please complete the participant card only and indicate this in the appropriate space on the card.

St. John's, Newfoundland, Canada A1B 3V6 • Telex: 016-4101 • Tel.: (709) 737-6300 • Fax: (709) 737-6598

Memorial
University of Newfoundland

Division of Community Medicine & Behavioural Sciences
Faculty of Medicine
The Health Sciences Centre

NEEDLESTICK INJURY STUDY

Investigator: Bonnie James, M.Sc. student
Division of Community Medicine and
Behavioural Sciences
Faculty of Medicine
Memorial University of Newfoundland
Telephone: 737-7230

Supervisory Committee: Dr. Sharon Buehler (737-6693)
Dr. Jorge Segovia
Division of Community Medicine and
Behavioural Sciences

Dr. Doreen Neville
Director of Research and Development
Waterford Hospital

Dr. Kevin Hogan
Assistant Deputy Minister, Department of Health

Description of the Study:

Needlestick injuries are one of the most common occupational injuries experienced by hospital employees. It has been estimated that, among hospital employees who routinely use needles, many, perhaps even the majority, will have a needle injury in any given twelve-month period.

This study will use an anonymous questionnaire to gather information on the numbers of needle injuries experienced by nurses and technologists, the circumstances surrounding those injuries and various factors which may affect the likelihood of an individual having an injury. Participants will also be asked to give their opinions on ways to reduce needle injuries, since the changes in equipment and policies introduced in recent years have not succeeded in eliminating all the risks.

Survey results will be analysed with the intention of seeking appropriate ways to reduce needle injuries. Results will be reported in the aggregate only, so that no identification of individual responses will be possible.

Approval for this study has been given by the Human Investigation Committee of Memorial University's Faculty of Medicine and the ethics committees of all participating hospitals.

Division of Community Medicine & Behavioural Sciences
Faculty of Medicine
The Health Sciences Centre

NEEDLESTICK STUDY

Participant's Name _____
(please print)

Hospital _____

Check department: [] *Nursing* [] *Laboratory*

Indicate here if you never use needles in your work []

Would you like a summary of the study results?

[] *Yes* [] *No*

Appendix E. First reminder

MEMORIAL UNIVERSITY OF NEWFOUNDLAND
St. John's, Newfoundland, Canada A1B 3V6

Faculty of Medicine
The Health Sciences Centre

November 28, 1989

Telex 016 4101
Tel (709) 737-6300

Dear

Have you had a chance to return your questionnaire yet?

A short time ago I left a request for you to take part in a survey examining the factors which affect the chances of a person having a needlestick injury. My reasons for doing the study are several. The best estimates available indicate that 10-25% of laboratory technologists experience a needle injury in any given year (and the figures are likely much higher in full-time blood collectors). The problem is not only common, it is expensive and dangerous.

Many people are trying to find ways to make needle-handling safer, but much is left to be learned. Janine Jagger of the University of Virginia, an acknowledged authority in this area, has this to say of needles used in hospitals:

> "it is...necessary to determine how they are normally handled in clinical settings and the various circumstances leading to unintentional needlestick injury after use. Unfortunately, current data do not provide sufficient detail to lead to improved design..."

One of Dr. Jagger's major findings is that some kinds of equipment to which needles are attached seem to be associated with more frequent injuries. For example, blood collection devices may be three or more times as likely to result in injury than a needle attached to a disposable syringe -- but most safety devices and policies are concerned with syringes!

I am hoping that the St. John's study will be able to shed new light on the causes of needlesticks. I would really appreciate it if you would complete the questionnaire within the next few days. Over half the technologists and technicians at your hospital who were asked to participate have already done so, but a higher response rate is needed in order to be sure the results accurately represent your lab.

If you would like to talk to me about any aspect of the study, or if your questionnaire has been mislaid, please leave a message for me at 737-7230. I will come by your laboratory early next week to collect questionnaires again.

If you have already completed your questionnaire, please accept my sincere thanks and I will look forward to sharing the findings of the survey with you next spring.

Sincerely yours,

Bonnie James

Appendix F. Second reminder to nurses

MEMORIAL UNIVERSITY OF NEWFOUNDLAND
St. John's, Newfoundland, Canada A1B 3V6

Faculty of Medicine
The Health Sciences Centre

Telex: 016-4101
Tel: (709) 737-6929

Date: December 20, 1989

To:

From: Bonnie James

Re: Needle use/injury survey

I have noticed as I near the end of my survey that I do not seem to have received your completed questionnaire and I wanted to let you know how important your participation in this study is. Your name was one of a minority of nurses from Hospital selected at random, using a computer-generated list, to take part in this study. If you do not submit your questionnaire, no one else can replace you and your hospital and nursing unit may be under-represented.

The information and opinions you can provide are of great value - **no matter what your experience with needles has been.** To give a reliable account, my sample of nurses must contain some using very few needles as well as those in high-use areas. I need to hear from nurses who have experienced recent injuries and from those who have never had one. Only by getting the full range of responses can I draw reliable conclusions.

Remember, no individual questionnaire will ever be identified.

This is a busy time of year, but I am asking for ten or fifteen minutes of your time. A copy of the questionnaire is attached. When completed, you may simply place it in the self-addressed envelope and return it via the internal mail. (The Medical School is serviced by the hospital mail shuttle.) The participant card may be returned separately in the second envelope, or, if you wish to have complete anonymity, you need not send it at all.

Thank you for considering this request. You may call me at 737-7230 (days) or 579-9888 (nights) with any questions or comments. Kindest regards of the season.

P.S. If you have already returned your questionnaire, many thanks.

Appendix G. Reminder to special care nurses, Hospital A

Memorial
University of Newfoundland

Division of Community Medicine
Faculty of Medicine
The Health Sciences Centre

Date: December 20, 1989

To:

From: Bonnie James

Re: Needle use/injury survey

I have noticed as I near the end of my survey that I do not seem to have received your completed questionnaire and I wanted to let you know how important your participation in this study is. Your name was one of a minority of nurses from . Hospital selected at random, using a computer-generated list, to take part in this study. If you do not submit your questionnaire, no one else can replace you and your hospital and nursing unit may be under-represented. Returns from the Critical Care area in particular have been coming in slowly (no doubt related to the nature of your work) and more are needed to ensure an adequate participation rate is reached.

The information and opinions you can provide are of great value **no matter what your experience with needles has been.** To give a reliable account, my sample of nurses must contain some using very few needles as well as those in high-use areas. I need to hear from nurses who have experienced recent injuries and from those who have never had one. Only by getting the full range of responses can I draw reliable conclusions.

Remember, no individual questionnaire will ever be identified.

This is a busy time of year, but I am asking for ten or fifteen minutes of your time. A copy of the questionnaire is attached. When completed, you may simply place it in the self-addressed envelope and return it via the internal mail. (The Medical School is serviced by the hospital mail shuttle.) The participant card may be returned separately in the second envelope, or, if you wish to have complete anonymity, you need not send it at all.

Thank you for considering this request. You may call me at 737-7230 (days) or 579-9888 (nights) with any questions or comments. Kindest regards of the season.

P.S. If you have already returned your questionnaire, many thanks.

Appendix H. Second reminder to laboratory employees

Memorial
University of Newfoundland

Division of Community Medicine
Faculty of Medicine
The Health Sciences Centre

Date: December 19, 1989

To:

From: Bonnie James

Re: Needle use/injury survey

I have noticed as I near the end of my survey that I do not seem to have received your completed questionnaire and I wanted to let you know how important your participation in this study is. The return rate from ' laboratory has been a little lower than hoped for and just a couple of more responses would make a lot of difference.

The information and opinions you can provide are of great value - **no matter what your experience with needles has been.** To give a reliable account, my sample must contain some who seldom collect blood as well as full-time blood collectors. I need to hear from those who have experienced recent injuries and from those who have never had one. Only by getting the full range of responses can I draw reliable conclusions.

Remember, no individual questionnaire will ever be identified.

This is a busy time of year, but I am asking for ten or fifteen minutes of your time. A copy of the questionnaire is attached. When completed, you may simply place it in the self-addressed envelope and return it via the internal mail. (The Medical School is serviced by the hospital mail shuttle.) The participant card may be returned separately in the second envelope, or, if you wish to have complete anonymity, you need not send it at all.

Thank you for considering this request. You may call me at 737-7230 (days) or 579-9888 (nights) with any questions or comments. Kindest regards of the season.

P.S. If you have already returned your questionnaire, many thanks.

St. John's, Newfoundland, Canada A1B 3V6 • Tel.: (709) 737 6719/6691 • Telex: 016-4101 • Fax: (709) 737-6598

Appendix I. Outcome of Questionnaire Return Method

Questionnaires were returned without identification. To identify respondents and facilitate follow-up, participants were asked to complete a file card and placing it in an separate return receptacle when they submitted their questionnaires. The file cards (Appendix D, page 168) had spaces for the participant's name, hospital and department, and asked whether the respondent ordinarily used needles and whether he or she would like a summary of the survey results.

Cards were the principal means of participant identification. In addition, a small number of questionnaire respondents did not complete cards but they, or another staff member speaking on their behalf, told the investigator that they had completed a questionnaire. Some of these individuals indicated that cards had not been completed because of concern for anonymity, misunderstanding of how the cards were to be returned, or belief that the sole function of the cards was for requesting a summary of the study results.

Table 37 shows the outcome of the return method. Participant cards identified 305 (89%) of 342 respondents. Verbal indications identified an additional 25 respondents (7%). Thirteen respondents did not identify themselves in any way. One person who was identified as having returned a questionnaire apparently did not submit one.

Table 39. Questionnaire return and participant identification

NURSING	HOSPITAL A	B	C
Total sent	107	94	95
Questionnaires returned	90	86	80
Cards completed	75	83	74
Verbal identification	7	2	6
Unidentified	8	1	0
LABORATORY			
Total sent	47	28	28
Questionnaires returned	38*	26	22
Cards completed	35	17	21
Verbal identification	4	5	5
Unidentified	0	4	0

* One questionnaire not received.

Appendix J. Categories of Nursing Units

Nurses' work areas, as stated in answer to Question 27 a, Appendix C, page 165, were grouped into five categories.

Table 40. Categories of nursing units

CODE #	AREA NAME	NURSING UNITS INCLUDED
1	Critical Care	Emergency/outpatients Intensive care unit Coronary care unit Operating room Dialysis Neonatal intensive care
2	Medical-Surgical	Surgery Gynecology Medicine Neurology Hematology Cardiology Respiratory Infectious diseases Orthopedics Oncology Radiotherapy Diagnostic imaging Cardiopulmonary testing Palliative care Nephrology/urology Rehabilitation Outpatient clinics Day surgery Recovery room
3	Obstetrics	Prenatal Case room Post-natal Mother and baby care Nursery
4	Geriatrics	
5	Psychiatry	

Appendix K. Method for Classifying Laboratory Personnel

Question 27 (b) of the survey, "Is blood collection the major part of your job?", was included so that laboratory employees could be classified into one of the two categories which follow:

1) "phlebotomist", a full-time blood collector, or
2) "technologist", an employee whose principal job is analytical, but who does some blood collection.

It was not possible to make the classification solely on the answers to question 27 (b), since the question was misunderstood by several respondents and not answered by others. Some of those stating that blood collection was the major part of their work gave contradictory information elsewhere on their questionnaire. As an example, some indicated in answers to other questions that they used blood collection equipment on only some of their work shifts or that they used very few needles on a typical shift. Neither of these responses is consistent with the job of a phlebotomist. It appeared that people were stating that blood collection was a major part of their work, but not the major part.

For the purpose of this study, "phlebotomist" has been defined as a laboratory staff member who meets all the following criteria:

1) Question 27 (b)

"Is blood collection the major part of your work?"

Inclusion criteria: "Yes" or not stated.

2) Question 27 (b)

"If no [to previous question], how many days per month do you take blood?"

Inclusion criteria: Fifteen or more days, or not stated.

3) Question 1

"In the past year, how often have you used ... vacutainer or equivalent" [i.e., vacuum-tube blood collection equipment]

Inclusion criteria: "Used on most shifts".

4) Question 5

"Thinking back over the past year, with reference to typical or average shifts: what would be the average number of needles used per shift?"

Inclusion criteria: "16-30" or "30+"

Twenty-six laboratory respondents met these criteria and were classified as phlebotomists. A review of all 26 questionnaires found no answers inconsistent with the classification of phlebotomist. The remaining 60 laboratory employees were considered to be technologists.

Notes regarding appendices:

1) Single examples of the covering letter and the various reminder letters are included; minor modifications were made for each hospital and department. All reminder letters were individually addressed.

2) Two changes were made in reproducing the survey materials in order to conform to thesis format requirements. The questionnaire, information sheet and letters have been reduced to 94% of original size. The questionnaire has been copied in single-sided format; it was printed on both sides of the page when distributed for the survey.