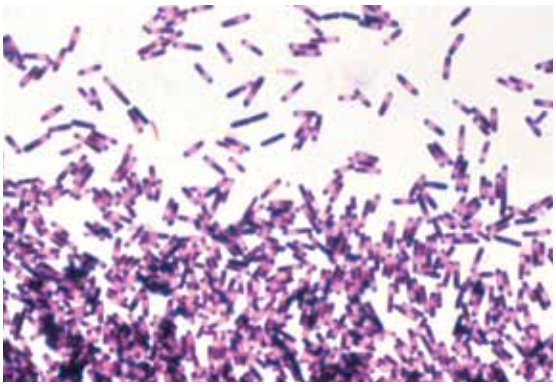
CANADIAN NEEDLE STICK SURVEILLANCE NETWORK

ANALYSIS OF OCCUPATIONAL EXPOSURES TO BLOOD, BODY FLUIDS AND BLOODBORNE PATHOGENS (1 JANUARY 2008 TO 30 JUNE 2012)

FINAL PROGRAM REPORT



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LISTS OF ACRONYMS

BBF: Blood and body fluids

BBP: Blood borne pathogens

CNSSN: Canadian Needle stick Surveillance Network

EPINeT: Exposure Prevention Information Network

HCW: Health Care Worker

HBV: Hepatitis B virus

HCV: Hepatitis C virus

HIV: Human-immuno-deficiency virus

PEP for HIV: Post-exposure HIV prophylaxis

PPE: Personal protective equipment

The Agency: Public Health Agency of Canada

WinSISES: Window Integrated Surveillance System for Exposures and Seroconversions

EXECUTIVE SUMMARY

The Canadian Needle Stick Surveillance Network (CNSSN) was created in 2000 by the Public Health Agency of Canada to track occupational exposures to blood and body fluids (BBF) as well as to monitor HBV, HCV, HIV and seroconversions as a result of these exposures.

Information on health care workers' (HCWs) exposure to BBF, BBP and their follow-up visits were collected by the hospital's employee health services using a standardized questionnaire developed by the CNSSN Program. Data submission and analysis were done online via the VPN secure tunnel where only anonymous cumulative data were transferred to the Agency.

Percutaneous exposures included needle sticks, cuts, scratches, and bites; Mucocutaneous exposures included body fluids in contact with mucous membranes of the nose, eye and mouth or non-intact skin. As of 30 June 2012, a total of 3,038 occupational exposures to blood and body fluids with complete information were received by the Agency for the period 1 January 2008 and 30 June 2012 from 15 collaborating sites. Review of these cases indicated that blood and blood products (78.2%) were the most common body fluids of the exposures. Needle sticks were the main route of percutaneous exposures (accounting for 75.5% of percutaneous exposures or 61.1% of all cases) whereas splashes from patients were the main route of mucocutaneous exposure (accounting for 39.4% of mucocutaneous exposures or 13.3% of all cases). Of 277 cases with information on available safety devices, only 20.2 of the HCWs said they had activated the device's safety mechanism. Furthermore, available data showed that 61.1% of the 525 HCWs with mucocutaneous exposures did not wear any protective equipment at the time of their exposure.

The most common locations for exposures were the operating rooms (21.0%) followed by medical wards (18.8%) and emergency rooms (9.3%).

Nurses were the dominant group among reported exposures to BBF (52.1%) followed by doctors (15.1%), clinical lab technicians (2.9%), and housekeepers (2.7%). However, the exposure rate of nurses per 100 full-time employee equivalent (FTE) or per 10,000 hours worked was three times higher than the rates of non-nurse staff, i.e., 8.30/100 FTE among nursing staff vs. 2.83/100 FTE among non-nurse staff; or 0.48/10,000 hours worked among nursing staff vs. 0.16 /10,000 hours worked among non-nurse staff.

Out of 3,038 exposures, 2,681 source-patients were identified but not all were tested for BBP. Of the more than 2,301 who were tested, only 213 (9.3%) tested positive for blood borne pathogens and 11.7% of them (25/213) were noted to have co-infections (two or three viruses at the same time), which posed a higher risk for health care workers.

These results provide participating sites with a national benchmark for comparisons with their local/ regional levels and may be used for program and policy development.

1. INTRODUCTION

Needle stick exposures are the most common preventable cause of occupational blood borne pathogen exposures. For this reason, the Canadian Needle Stick Surveillance Network (CNSSN) was created in 2000 by the Public Health Agency of Canada (the Agency) to track occupational exposures to HBV, HCV, HIV and seroconversions to these blood borne pathogens (BBP) among exposed health care workers (HCWs).

This report presents descriptive findings of data collected by the web-based CNSSN program between January 2008 and June 2012 at 15 participating sites. The report gives a comprehensive overview of the national data and concludes with a discussion of the data and its limitations. Appendix A gives the back ground information on how the denominators were chosen by the participating sites for this surveillance report, and the provincial legislation on safety devices.

2. METHODS

Prior to 2009, the WinSISES program and/or EPINet program were used to track occupational exposures to HBV, HCV, HIV and seroconversions among exposed HCWs. After 2009, the Agency developed its own CNSSN program software for online data tracking and analysis of occupational exposures. This program was piloted in 11 sites during 2008–2010 and was upgraded during 2010–2012 to reflect the participating sites' suggestions for improvement.

2.1 GOALS OF THE CNSSN PROJECT

- To enhance the Agency's surveillance capacities to monitor communicable diseases caused by blood borne pathogens (BBP) exposures among HCWs.
- To facilitate data collection on the numbers of percutaneous and mucocutaneous exposures to blood borne pathogens among HCWs via electronic data transfer.
- To enhance national-regional collaboration through ongoing technical support for the web-based data submission and analysis software.
- To allow sites to analyze their own data and compare it with the national benchmark.

2.2 CNSSN PROTOCOL

2.2.1 ELIGIBILITY CRITERIA

Exposure to BBF was defined as a reported event where the HCW was known to be exposed to blood or body fluids whether or not the body fluids contained blood.

Exposure to BBP was defined as a reported event where the HCW was known to be exposed to a source-patient testing positive for at least one blood borne pathogen (HBV, HCV, or HIV).

2.2.2 RECRUITMENT

Participation in the CNSSN is voluntary. Sites are recruited through word-of-mouth and through the demo sessions made at the annual CNSSN meetings (2011, 2012) and occupational health nurse association conference (June 2011). Before joining the CNSSN, the interested site was provided with details on the data sharing agreement and conditions/restrictions regarding the release and publication of the CNSSN data.

2.2.3 DATA COLLECTION

Information on HCWs' exposure to BBF and BBP as well as their follow-up visits was collected by the hospital's employee health services using the standardized questionnaire derived from the CNSSN Program. The questionnaire has two input screens: a) the Employee Management Screen for duplicate checking; b) the Incident Data Input Screen for details related to the HCWs' exposure to BBF, BBP and follow-up testing. Online data submission to the Agency and data analysis was done through the VPN application. Functionality was built into the CNSSN program so that any identifiers such as first name and last name of the exposed health care workers, address, etc. although collected, entered, saved at the site level, were not transmitted to the Agency.

2.2.4 DATA MANAGEMENT

The site was responsible for managing its own data (extracting into Excel, data cleaning) while the Agency managed aggregated data at the national level. As of 30 June 2012, the Agency received a total of 3,258 cases from 15 collaborating sites on the web-server. Data were then reviewed by two epidemiologists for completeness and validity. The study period was from 1 January 2008 (when the pilot program started) to 30 June 2012 (when the program ended), so cases reported prior to or after these dates were automatically excluded from analyses. Testing cases, or cases with wrong exposure dates (such as December 2012, 2020), or cases with no identified site ID were excluded.

Followed-up testing results of HCWs exposed to BBP were validated with each site to ensure no errors in data entry or misinterpretation of the HBV, HCV, and HIV testing results. The validation process was carried out as follows:

- From the CNSSN website, tables, graphs, and line listing of HCWs' follow-up testing results were generated using the software's existing functions for data analyses.
- A newly added feature of the CNSSN program allows for extraction of data into an Excel file for further analyses. Using this function, the Agency extracted data and ran statistical analyses using the in-house SAS program.
- Data generated by the SAS program were compared with those generated by the web-page program to see if there were any discrepancies in figures by two methods. Results from the SAS analyses were used as the reference points.
- Each suspected HBV, HCV or HIV seroconversion case was verified individually with each site for data accuracy.
- During the validation process, one site upon review of their database, realized that their 163 cases reported in 2009 and 2010 were missing. This site was not able to trace back the information in order to reproduce these cases that were sent earlier to the Agency. Therefore, it was agreed that the Agency would not include these missing cases in the current analysis.

A total of 3,038 cases were finally included in the national dataset for data analyses. This surveillance report will focus on this number.

2.2.5 DATA SECURITY

At the site, data is stored on a password protected ACCESS-based database stored on a PC. User access is managed by named user identification authorized by the relevant manager or nominated officer at the site and on receipt of a signed security and data protection/confidentiality agreement. The data is backed up on a daily basis and the system is fully recoverable. At the Agency, data is stored in a password protected ACCESS-based database on secure servers. User access is managed by named user identification authorized by the CNSSN manager or delegate.

Data is encrypted and transmitted using a secure method such as Secure Socket Layer (SSL) transmission, Secure Shell (SSH), or Public Key email whichever is most convenient. There is no paper or unencrypted email transfer of data.

By opening the CNSSN website and logging in under the Agency's ID, the Agency performs the following tasks:

- Views national/regional/site-level agreed data.
- Computes data quality control (checking for potential duplicates, deleting duplicates).
- Generates standardized graphs/tables for one specific site, multiple sites, or national data.
- Analyses cases for HBV, HCV or HIV seroconversions.

Through the CNSSN website and site's login ID, the site views immediately all cumulative cases that the site has transferred to the Agency from the earliest date until the present time and makes any necessary corrections. The site could also produce graphs that give both local and national benchmarks. Table 1 summarizes example of options available in the Analyze Module of the CNSSN program for sites or the Agency to choose.

2.2.6 TRAINING

The Agency provided training to participants through Web-Ex session (Online training with teleconference technology). During the training, sites were instructed to install the program on the shared drive so multiple users from one specific site could access the database and enter the information using different computers. As a result, cumulative data could be safeguarded from different data entry ports.

2.2.7 DENOMINATOR

Two denominators were used for rate calculations: the number of hours worked and the number of full-time employee (FTE) equivalents. The consensus of the participating sites at the 2010 and 2012 CNSSN annual meetings was that the worked hours can be used as a surrogate denominator for full-time employee equivalents using a specific formula, i.e. one FTE = 1,725 worked hours per year (46 weeks per year X 37.5 hours per week).

The calendar year (from 1 January to 31 December) was used for yearly calculations. Note that the length of data collection period varied by site (ranging from 1 year to 6 years), therefore, the number of reported exposures is not comparable between years without considering the number of participating sites. Descriptive statistics include the frequency distributions of exposures according to variables listed in Table 1.

TABLE 1: Reported exposures by site and year (1 January 2008 to 30 June 2012)

PROVINCE, SITE ID	2008	2009	2010	2011	JUN–12	TOTAL
	# (%)	# (%)	# (%)	# (%)	# (%)	# (%)
PEI, Site A	5 (10.6)	44 (4.7)	50 (6.1)	32 (3.7)	9 (2.4)	140 (4.6)
NS, Site B	0	34 (3.6)	57 (7.0)	52 (6.0)	20 (5.2)	163 (5.4)
NS, Site C	0	1 (0.1)	209 (23.7)	218 (25.3)	83 (21.8)	511 (16.8)
NS, Site D	31 (66.0)	29 (3.1)	34 (4.2)	47 (5.5)	25 (6.6)	166 (5.5)
NS, Site E	11 (23.4)	10 (1.1)	16 (2.0)	13 (1.5)	6 (1.6)	56 (1.8)
NB, Site F	0	0	71 (8.7)	76 (8.8)	27 (7.1)	174 (5.7)
NB, Site G	0	63 (6.7)	60 (7.4)	91 (10.6)	13 (3.4)	227 (7.5)
NB, Site H	0	0	0	31 (3.6)	9 (2.4)	40 (1.3)
ON, Site I	0	0	7 (1.0)	4 (0.5)	7 (1.8)	18 (0.6)
ON, Site J	0	102 (10.9)	88 (10.8)	85 (9.9)	49 (12.9)	324 (10.7)
ON, Site K	0	54 (5.8)	87 (10.7)	92 (10.7)	45 (11.8)	278 (9.1)
ON, Site L	0	0	0	0	16 (4.2)	16 (0.5)
MB, Site M	0	0	0	108 (12.5)	68 (17.8)	176 (5.8)
SA, Site N	0	1 (0.1)	14 (1.7)	12 (1.4)	4 (1.0)	31 (1.0)
AB, Site O	0	597 (63.8)	121 (14.9)	0	0	718 (23.6)
Total	47	935	814	861	381	3,038 (100)

3. RESULTS

3.1 CHARACTERISTICS OF PARTICIPATING HOSPITALS

Eight sites in Atlantic Canada (1 in Prince Edward Island, 4 in Nova Scotia, 3 in New Brunswick) contributed for 48.6% of the national data. Three sites in Western Canada (1 in Alberta, 1 in Saskatchewan, 1 in Manitoba) contributed 30.4% and four sites in Ontario contributed 20.9% of the national data.

Table 2 demonstrates the number and proportion of cases reported by different sites for each calendar year (January 2008 to June 2012). In the beginning, site O in Alberta was the greatest data contributor (63.8% of the national cases in 2009). However, due to restructuring of the organization in 2010 (occupational health and related issues became the provincial jurisdiction), this site no longer provided data to the Agency. Eventually sites B, C, D and E in Nova Scotia became the biggest data contributor after 2010 (25.7% in 2010, 25.3% in 2011, and 21.8% in 2012).

Not all sites were able to provide denominator data. Table 2 present those with available data (numerator and denominator) for all staff and nursing staff for the rate calculations. Note that the nurses who conducted administrative jobs were also included in the number of FTEs and the number of hours worked; therefore they were included in the rate calculations.

TABLE 2: Summary of denominators used for rate calculations by reporting year, 1 January 2008 to 30 June 2012

	NUMBER OF FTES			NUMBER OF HOURS WORKED		
YEAR	NUMBER OF SITES WITH AVAILABLE DATA	NURSING STAFF	NON-NURSING STAFF	NUMBER OF SITES WITH AVAILABLE DATA	NURSING STAFF	NON-NURSING STAFF
2008	1	707	1,881	1	1,219,575	3,244,725
2009	4	3,902	7,788	4	6,730,950	13,434,300
2010	6	6,975	15,592	8	12,031,875	26,896,200
2011	10	7,808	13,957	10	13,468,800	24,075,825
12–Jun	5	5,533	7,447	5	9,544,425	12,846,075
All Years	26	24,925	46,665	28	42,995,625	80,497,125

**Only 26 sites of 47 participating sites could provide the information on the FTEs and their working hours.

3.2 EXPOSURES TO BLOOD BODY FLUIDS (BBF)

The body fluids involved in 3,038 exposures were mainly blood or blood products (78.2%) followed by saliva 2.9% (table 3).

TABLE 3: Exposures classified by body fluids at 15 sites, 1 January 2008 to 30 June 2012

	ALL EXPOSURES		PERCUTANEOUS		MUCOCUTANEOUS	
	FREQUENCY	(%)	FREQUENCY	(%)	FREQUENCY	(%)
Blood, serum or plasma	2,376	78.2	1,954	80.5	405	70.9
Amniotic fluid	14	0.5	4	0.2	10	1.8
Cerebrospinal fluid	5	0.2	5	0.2	0	0
Pleural fluid	8	0.3	1	0.04	6	1.1
Peritoneal fluid	10	0.3	6	0.2	4	0.7
Synovial fluid	1	0.03	1	0.04	0	0
Saliva	89	2.9	27	1.1	61	10.7
Vaginal secretions	3	0.1	2	0.08	1	0.2
Other fluid or tissue *	107	3.5	45	1.8	59	10.3
Unknown	300	9.9	285	11.7	9	1.6
Missing information	125	4.1	96	3.9	16	2.8
Total	3,038**	100	2,426	100	571	100

* Other fluids include abscess, acid, adipose particle, bile, blood tinged nasal secretion, bone fragment, bone marrow, breast tissue, breast milk, vomitus, emesis, gastric fluid, IV fluid, stool, sputum, stomach fluid, tracheal suction, urine, cord blood, biopsy tissue, stool, dialysis solution, hydrocele, lung tissue, ocular fluid, organs, wound drainage/irrigation, wash fluid.

** 41 cases had no information on type of exposures.

Table 4 illustrates the locations of reported exposures. Most occurred in the operating rooms (21.0%), medical wards (18.8%), emergency rooms (9.3%), intensive care units (7.1%), and surgical wards (7.0%).

TABLE 4: Location of exposures, 15 sites, 1 January 2008 to 30 June 2012

LOCATION DESCRIPTION	EXPOSURES	%
Operating room	639	21
Medical Ward	571	18.8
Emergency room	281	9.3
Intensive care unit	215	7.1
Surgical Ward	214	7
Other	195	6.4
Labour/delivery/birthing room	135	4.4
Outpatient clinic	117	3.9
Clinical laboratory	90	3
Procedure room	76	2.5
Dialysis unit	77	2.5
Mixed Ward	77	2.5
Missing information	68	2.2
Sterilisation unit	60	2
Psychiatry	47	1.6
Obstetrics/Gynaecology	33	1.1
Unknown	26	0.9
Venipuncture centre	14	0.5
Autopsy room	16	0.5
Chronic care	16	0.5
Pediatric care	11	0.4
Home care	11	0.4
Post-op recovery room	9	0.3
Mental health	8	0.3
Physician/dentist office	5	0.2
Laundry room	7	0.2
Community health	6	0.2
Blood bank	4	0.1
Hygiene and safety department	3	0.1
Total	3,038	100

By type of exposures, of the 3,038 reported occupational exposures to blood and body fluids, 2,997 cases had known information on type of exposures. Examining of these cases indicated that needle sticks accounted for 61.1% of the cases followed by splashes from patients (13.3%) and cuts with sharp objects (9.7%). Needle sticks alone accounted for 75.5% (1,831/2,426) of the percutaneous injuries. See table 5a for detailed information.

TABLE 5A: Type of exposures to blood, body fluids, 15 sites, 1 January 2008 to 30 June 2012

PERCUTANEOUS EXPOSURES	FREQUENCY	PERCENT (%)
Needle stick	1,831	61.1
Cut	291	9.7
Stick other than needle	227	7.6
Scratch	41	1.4
Bite with broken skin	36	1.2
Total percutaneous exposures	2,426	80.9
MUCOCUTANEOUS EXPOSURES	**FREQUENCY**	**PERCENT (%)**
Splash from patients	399	13.3
Direct contact on mucous membrane	78	2.6
Direct contact on non-intact skin	64	2.1
Splash on non-intact skin	30	1
Total mucocutaneous exposures	571	19.1
Overall Total	2,997	100

** 41 cases had no information on type of exposures.

With respect to the trend over time, the proportion of needle stick injuries among all reported cases was similar over time. Similar trends were also observed for other types of percutaneous exposures and mucocutaneous exposures (see Table 5b).

TABLE 5B: Type of exposures to blood and body fluids by reporting year, 15 sites, 1 January 2008 to 30 June 2012

PERCUTANEOUS EXPOSURES	2008 N (%)	2009 N (%)	2010 N (%)	2011 N (%)	2012* N (%)
Needle stick	23 -50	555 -60.1	516 -64.3	505 -59.2	232 -62
Cut	4 -8.7	82 -8.9	80 -10	89 -10.4	36 -9.6
Stick other than needle	7 -15.2	56 -6.1	61 -7.6	72 -8.4	31 -8.3
Scratch	0 0	15 -1.6	10 (1.2)	9	7 -1.9
Bite with broken skin	3 -6.4	8 -0.1	8	12 -1.4	5 -1.3
Total percutaneous exposures	37 -80.4	716 -77.6	675 -84.2	687 -80.5	311 -83.2
MUCOCUTANEOUS EXPOSURES	2008 N (%)	2009 N (%)	2010 N (%)	2011 N (%)	2012* N (%)
Splash from patients	3 -6.5	149 -16.1	83 -10.3	117 -13.7	47 -12.6
Direct contact on mucous membrane	3 -6.5	13 -1.4	25 -3.1	27 -3.2	10 -2.7
Direct contact on non-intact skin	2 -4.3	30 -3.2	14 -1.7	15 -1.8	3 -0.8
Splash on non-intact skin	0 0	15 -1.6	5 -0.6	7 -0.8	3 -0.8
Total mucocutaneous exposures	9 -19.6	207 -22.4	127 -15.8	166 -19.5	63 -16.8
All exposures	46 -100	923 -100	802 -100	853 -100	374 -100

Rates of exposures to blood and body fluids among non-nursing and nursing staff by reporting year are summarized in Table 5c. Nurses had three times the risk of a needle stick injury than non-nursing staff (8.30/100FTEs vs. 2.83/100FTEs or 0.48/10,000 hours vs. 0.16/10,000 hours respectively).

TABLE 5C: Rate of exposures to blood and body fluids by reporting year for all staff and nursing staff, 15 sites, 1 January 2008 to 30 June 2012

	NURSING STAFF					NON-NURSING STAFF				
YEAR	N° OF EXPOSURES	FTES	RATE PER 100 FTE	NUMBER OF HOURS WORKED	RATE PER 10,000 HOURS WORKED	RATE PER 10,000 HOURS WORKED	N° OF EXPOSURES	RATE PER 100 FTE	NUMBER OF HOURS WORKED	RATE PER 10,000 HOURS WORKED
2009	562	3,902	14.4	6,730,950	0.83	373	7,788	4.79	13,434,300	0.28
2010	469	6,975	6.72	12,031,875	0.39	346	15,592	2.22	26,896,200	0.13
2011	521	7,808	6.67	13,468,800	0.39	341	13,957	2.44	24,075,825	0.14
All Years	1,552	18,685	8.3	32,231,625	0.48	1,060	37,337	2.83	64,406,325	0.16

N.B. Years 2008 and 2012 were deleted due to small sample size.

Table 6 lists the number and proportion of reported exposures by job title and type of exposure. Nurses reported the highest number of exposures followed by doctors, clinical lab technicians, housekeepers, and phlebotomists.

TABLE 6: Number and proportion of percutaneous and mucocutaneous exposures by job title, 15 sites, 1 January 2008 to 30 June 2012

	ALL EXPOSURES		PERCUTANEOUS		MUCOCUTANEOUS	
JOB TITLE	FREQ.	(%)	FREQ.	(%)	FREQ.	(%)
Nurse (RN. LPN, RPN, NP)	1,585	52.1	1,217	50.1	341	59.7
Nursing assistant	165	5.4	142	5.9	21	3.7
Nursing student	72	2.4	56	2.3	16	2.8
Medical doctors	459	15.1	411	16.9	39	6.8
• *MD resident*	*230*	*7.6*	*208*	*8.6*	*20*	*3.5*
• *MD specialist*	*155*	*5.1*	*138*	*5.7*	*12*	*2.1*
• *MD general practitioner*	*74*	*2.4*	*65*	*2.5*	*7*	*1.2*
Medical student	50	1.6	38	1.6	12	2.1
Clinical lab technician	88	2.9	65	2.7	23	4
Phlebotomist / IV Team	55	1.8	48	2	6	1
Housekeeper	81	2.7	79	3.3	2	0.3
Sterilisation attendant	48	1.6	46	1.9	3	0.5
Other attendant	43	1.4	34	1.4	9	1.5
Respiration therapist	43	1.4	31	1.3	12	2.1
Diagnostic medical imaging	29	1	18	0.7	11	1.9
Other technician	26	0.8	21	0.9	4	0.7
Patient attendant	15	0.5	10	0.4	5	0.9
Ward aid	7	0.2	7	0.3	0	0
Laundry worker	5	0.2	5	0.2	0	0
Dental hygienist	6	0.2	6	0.2	0	0
Dentist	4	0.1	4	0.2	0	0
Radiation therapist	2	0.1	2	0.08	0	0
Security	3	0.1	2	0.08	1	0.2
Other	210	6.9	159	6.5	49	8.6
Missing information	43	1.4	25	1	17	3
Total	3,038	100	2,426	100	571	100

Table 7 shows the results by type of exposures specific to medical doctors (including medical residents, medical specialist, and medical practitioner) and nurses. The proportion of percutaneous injuries among medical doctors was higher than that among nurses (91.3% vs 78.1%). The relative risk ratio is 1.17 (95% CI: 1.13–1.22).

TABLE 7: Differences of percutaneous and mucocutaneous exposures between medical doctors and nurses, 15 sites, 1 January 2008 to 30 June 2012

		OUTCOME		
		PERCUTANEOUS	MUCOCUTANEOUS	TOTAL
Exposures	Medical doctors	411 (91.3%)	39 (8.7%)	450 (100.0%)
	Nurses	1,217 (78.1%)	341 (21.9%)	1,558 (100.0%)
	Total	1,628	380	2,008

3.2.1 PERCUTANEOUS EXPOSURES

Of the 2,426 reported percutaneous injuries, only 2,394 cases had known information on type of devices. As noted in Table 8a and 8b, the most frequently reported devices were hypodermic needles attached to syringes (25.1%) followed by hollow-bore needles used for venous access (16.0%), surgical instruments (14.0%), and suture needles (12.9%). Note that injuries from solid sharp devices (suture needles, scalpels) are less risky than injuries from blood-filled hollow bore needles.

When these results were broken down by selected job categories, nurses/nursing students, medical doctors, lab technicians, nursing assistants, and phlebotomists were those most often injured by these devices (see Table 8b).

TABLE 8A: Devices involved in percutaneous exposures, 15 sites, 1 January 2008 to 30 June 2012, N=2,394*

NEEDLES	EXPOSURES	%
Hypodermic needle attached to disposable syringe	600	25.1
Hollow bore needle used for venous access	383	16
• *Blood-collection needle (Vacutainer type)*	*119*	*5*
• *Winged Needle I.V. set (butterfly type)*	*157*	*6.6*
• *IV Catheter (Jelco type)*	*94*	*3.9*
• *Other venous catheter*	*13*	*0.5*
Suture Needle	310	12.9
Other needle	205	8.6
Unknown Needle type	61	2.5
Needle on I.V. line (Conventional/Piggy-back)	57	2.4
Insulin Injector	56	2.3
Lancet	47	2
Hypodermic needle unattached to disposable syr.	32	1.3
Arterial Catheter	19	0.8
Needle attached to arterial gas syringe	15	0.6
Other catheter	11	0.5
Total	1,796	75
SURGICAL INSTRUMENTS		
Scalpel blade	153	6.4
Disposable scalpel	42	1.8
Metal wire (suture/fixation/guide)	34	1.4
Razor	23	0.9
Scissors	20	0.8
Retractors, skin/bone hooks	17	0.7
Drill bit	12	0.5
Other**	35	1.46
Total	336	14
GLASS		
Total	27	1.1
VARIOUS		
Nails, teeth	34	1.4
Unknown type of object	30	1.3
Vacuum tube (plastic)	8	0.3
Specimen test tube, capillary tube	7	0.3
Vacuum tube (glass)	3	0.1
Other instrument	153	6.4
Total	235	9.8

**Other included: Pin/Staple, electrocautery device, bone cutter, staples/steel structures, bone chip, clamps/hemostats, towel clip.

* 32 percutaneous cases had no information on type of devices.

TABLE 8B: Four top devices involved in percutaneous injuries reported by selected job title, 15 sites, 1 January 2008 to 30 June 2012

DEVICES	NURSES (N=1,218)	NURSING ASSISTANTS (N=142)	NURSING STUDENTS (N=56)	MEDICAL DOCTORS (N=411)	MEDICAL STUDENTS (N=38)	CLINICAL LAB TECHNICIANS (N=65)	PHLEB-OTOMIST/ IV TEAM (N=48)
Hypodermic needle attached to syringe	29.80%		48.20%	16.80%		12.30%	6.20%
Blood collection needle	21.00%	14.10%	10.70%			24.60%	85.40%
Other needle	9.70%	5.60%	16.10%	7.10%	7.90%		
Suture needle	8.40%	7.80%		38.20%	79.00%		
Scalpel blade		6.30%		15.10%	5.30%	15.40%	
Disposable scalpel					5.30%		
Other instrument						16.90%	
Vacuum tube							4.10%
Insulin injector			10.70%				

Stages of the work when the percutaneous injuries occurred are presented in Table 9. About 42.8% of the injuries occurred while using the device and 33.6% occurred after using the device (which can be prevented with the safety implementation/application). Note that 4.5% of the HCWs still recapped a needle after using the device, a practice that has been discouraged for some time.

TABLE 9: Stage of the work when the percutaneous exposure occurred, 15 sites, 1 January 2008 to 30 June 2012

STAGE OF WORK	EXPOSURES	%
Before using the device	11	0.4
While using the device	1,181	48.7
• *Because of the false move*	*855*	*35.2*
• *Because of a defective device*	*47*	*1.9*
• *Because of a collision with patient/colleague*	*136*	*5.6*
• *Because of other reason*	*143*	*5.9*
After using the device	817	33.7
• *While recapping a needle*	*110*	*4.5*
• *While disassembling a device or piece of equipment*	*99*	*4.1*
• *While withdrawing a needle from rubber material*	*12*	*0.5*
• *While sorting, cleaning, disinfecting, sterilising, device*	*90*	*3.7*
• *While carrying device before disposal*	*97*	*4*
• *While discarding device left on or near a sharp container*	*131*	*5.4*
• *Because of a device left on or near a sharp container*	*12*	*0.5*
• *Because of device protruding from a sharp container*	*39*	*1.6*
• *Because of a device piercing through a sharp container*	*13*	*0.5*
• *Because of a device left in an inappropriate place*	*185*	*7.6*
• *Because of a device piercing through garbage bag/ container*	*29*	*1.2*
While restraining a patient	51	2.1
While passing an instrument from hand-to-hand	71	2.9
Other reason	221	9.1
Unknown	61	2.5
Missing	13	0.5
Total	2,426	100

With respect to the depth of percutaneous injuries, 66.2% of the 2,264 cases with known depth of injury involved broken skin with moderate bleeding, and 4.3% involved deep cuts with or without bleeding (see Table 10).

TABLE 10: Depth of percutaneous exposures, 15 sites, 1 January 2008 to 30 June 2012

DEPTH OF INJURY	NUMBER	%
Superficial (scratch without bleeding)	668	29.5
Moderate (broken skin with bleeding)	1,498	66.2
Deep (stick or deep cut with or without bleeding)	98	4.3
Total**	2,264	100

** 162 percutaneous cases had missing information on depth of injury.

3.3.3.1 USE OF SAFETY DEVICES

The question on the use of safety engineered devices was added to the CNSSN program in August 2011 at the request of CNSSN participating sites. However, due to time constraints, many sites were unable to input retrospective data in their database. To date, only 28.0% (512/1,831) of the answers with needle sticks had the answers filled in the value for unknown was blank and therefore not included in the analysis. Based on the collected information from 13 sites, 79.8% of the 277 HCWs said they did not activate the safety mechanism; and 20.2% activated the safety mechanism. The activated rates declined steadily from 2009 to 2012. See Table 11 for details

TABLE 11: Needle stick injuries that had the answers on the use of safety devices

	USE OF SAFETY DEVICES*		
YEAR OF EXPOSURE	ACTIVATED (%)	NOT ACTIVATED (%)	TOTAL
2008 (from 1 site)	0	4 (100.0)	4
2009 (from 4 sites)	12 (31.6)	16 (68.4)	38
2010 (from 4 sites)	6 (20.7)	23 (79.3)	29
2011 (from 11 sites)	20 (20.0)	80 (80.0)	100
2012 (from 14 sites)	18 (15.5)	98 (84.5)	116
All years	56 (20.2)	221 (79.8)	277

*Missing values were not part of this analysis.

3.2.2 MUCOCUTANEOUS EXPOSURES

Mucous membranes exposures (to the eyes, nose or face) accounted for 83.5% of reported mucocutaneous blood exposures (477/571) while non-intact skin accounted for 16.5% (94/571) of the mucocutaneus blood exposures.

A description of personal protective equipment that was worn by the HCWs at the time of exposure for mucous membrane or non-intact skin exposures can be found in Table 12. It is worth noting that for 59.5% of mucous membrane exposure cases, no protective gear was worn and for non-intact skin exposures the percentage was even higher at 68.9%. HCWs failed to wear eye or facial protection in 92.4% of the mucous membrane exposures and failed to wear hand protection in 73.3% of the non-intact skin exposures.

TABLE 12: Protective personal equipment worn by HCWs, 15 sites, 1 January 2008 to 30 June 2012

PROTECTIVE CLOTHING/ EQUIPMENT WORN BY HCWS	ALL MUCOCUTANEOUS EXPOSURES (N=525)		MUCOUS MEMBRANES (N=435)		NON-INTACT SKIN (N=90)	
	FREQ.	(%)	FREQ.	(%)	FREQ.	(%)
None	321	61.1	259	59.5	62	68.9
Clothing protection	26	4.9	24	5.5	2	2.2
Eye protection	2	0.4	2	0.4	nil	Nil
Face & clothing protection	3	0.6	3	0.7	nil	Nil
Face, eye, and clothing protection	12	2.3	12	2.8	nil	Nil
Hand and clothing protection	22	4.2	21	4.8	1	1.1
Hand and eye protection	1	0.2	1	0.2	nil	Nil
Hand and face protection	7	1.3	7	1.6	nil	Nil
Hand protection	112	21.3	88	20.2	24	26.7
Hand, eye and clothing protection	1	0.2	1	0.2	nil	Nil
Hand, face and clothing protection	8	1.5	8	1.8	nil	Nil
Other	10	1.9	9	2.1	1	1.1
Total	525	100	435	100	90	100

When looking at the cause of 571 mucocutaneous exposures, splashes/projections directly from patients and direct contacts with patients accounted for 39.4% and 8.6% of the exposures, respectively. Of interest was the fact that 52.0% of mucocutaneous exposures were not caused by direct patient contact, but involved a medical product which served as a vehicle of exposure. In 14.4% of incidents, specimens or other containers leaked or broke; in 13.1%, an IV tube, bag or pump leaked. These events highlight the need to improve the integrity of fluid specimen equipment and fluid evacuation equipment, which can serve as vehicles of blood and body fluid exposures.

TABLE 13: Cause of the mucocutaneous exposure, 15 sites, 1 January 2008 to 30 June 2012

CAUSE OF MUCOCUTANEOUS EXPOSURES	EXPOSURES	%
Splash/projection directly from patient	225	39.4
Direct contact with patient	49	8.6
Leak/break/disassembly of I.V. line	82	14.4
Leak/break/disassembly of tube other than I.V.	75	13.1
Broken container/glass tube	10	1.7
Contact with contaminated area/sheet/gown	13	2.3
Contact with contaminated equipment or surface	20	3.5
Other	97	17
Total	571	100

3.3 STATUS OF SOURCE PATIENTS

The source person was identified in 88.2% (2,681/3,038) of the exposures, but not all of them were tested for blood borne pathogens (BBP). Among the 2,681 identified source-patients, the proportion of those screened for HBV, HCV and HIV were 95.6%, 95.5% and 95.9% respectively. Testing results for these screenings are summarized in Table 14a and 14b. In summary, 240 positive test results for BBP were found among 213 source-patients as 11.7% (25/213) of them had existing co-infections (two or three viruses at the same time).

TABLE 14A: Positive test results for BBP without accounting for co-infections among identified source-patients by year of exposure, 15 sites, 1 January 2008 to 30 June 2012

RESULTS	ALL YEARS (%)	2008	2009	2010	2011	2012
HBV +	40/2,301 (1.7%)	0/25 0.00%	23/735 -3.10%	4/600 -0.70%	7/655 -1.10%	6/286 (2.1%)
HCV+	151/2,345 (6.4%)	25-Jan -4.00%	54/727 -7.40%	39/609 -6.40%	40/686 -5.80%	17/298 -5.70%
HIV+	49/2,344 (2.1%)	0/26 0.00%	21/737 -2.80%	11/599 -1.80%	13/682 -1.90%	4/300 -1.30%

TABLE 14B: Summary of 240 positive test results among 213 identified source-patients, 15 sites, 1 January 2008 to 30 June 2012

RESULTS	FREQUENCY
HBV positive	30
HCV positive	127
HIV positive	31
HBV-HCV positive	7
HBV-HCV-HIV positive	2
HBV-HIV positive	1
HCV-HIV	15
Total	213

3.4 SEROLOGICAL STATUS OF THE 213 HEALTHCARE WORKERS EXPOSED TO SOURCE PATIENTS TESTED POSITIVE FOR BBP

At least 85.0% (34/40) of HCWs exposed to patients with hepatitis B stated they were already immune (i.e., protected) to HBV virus; only 7.5% (3/40) said they were susceptible and received post-exposure prophylaxis. The remaining three HCWs did not know their immune status.

Among the 49 HCWs exposed to HIV infected source-patients, only 6 (12.2%) were considered as candidates for HIV post-exposre prophylaxis; 5 accepted the treatment while one declined it.

At baseline testing, nine HCWs exposed to positive source-patients were found to be already infected with HBV, none with HCV or HIV. See Tables 15a, 15b, 15c for information.

TABLE 15A: Serological status of HCWs at base line by status of source-patients for HBV, 15 sites, 1 January 2008 to 30 June 2012

SOURCE-PATIENT TESTING RESULTS FOR HBV	HCW TESTING RESULTS FOR HBV		
	BASELINE +	NEGATIVE	TOTAL
Source tested positive	9	31	40
Source tested negative	73	2,188	2,261
Untested source	4	255	259
Source with indeterminate result	0	4	4
Total	86	2,478	2,564

TABLE 15B: Serological status of HCWs at base line by status of source-patients for HCV, 15 sites, 1 January 2008 to 30 June 2012

SOURCE-PATIENT TESTING RESULTS FOR HCV	HCW TESTING RESULTS FOR HCV		
	BASELINE +	NEGATIVE	TOTAL
Source tested positive	0	151	151
Source tested negative	13	2,179	2,192
Untested source	1	211	212
Source refused to be tested	0	2	2
Source with indeterminate result	0	4	4
Total	14	2,547	2,561

TABLE 15C: Serological status of HCWs at base line by status of source-patients for HIV, 15 sites, 1 January 2008 to 30 June 2012

SOURCE-PATIENT TESTING RESULTS FOR HIV	HCW TESTING RESULTS FOR HIV		
	BASELINE +	NEGATIVE	TOTAL
Source tested positive	0	49	49
Source tested negative	7	2,287	2,294
Untested source	4	218	222
Source with indeterminate result	0	4	4
Total	11	2,558	2,569

3.4.1 SEROCONVERSION DATA

Participating sites had different protocols for the follow-up of HCWs exposed to source patients who were unknown or known to be positive for a BBP. In addition, follow-up testing was sometimes done in different laboratories, making it difficult to collate and reconcile longitudinal test results for the same HCW. These and other issues resulted in many incomplete records for HCWs exposed to unknown or BBP-positive sources, and thus only a limited amount of data were available to assess seroconversion rates.

Among the 151 HCWs who were exposed to HCV-positive BBF, there were 95 cases (62.9%) with percutaneous exposure, 49 cases (32.5%) with mucocutaneous exposure and 7 cases (4.6%) with no information on type of exposure. Each case was followed up at least 6 months and there were no HCV-seroconversion cases observed.

Among the 49 HCWs who were exposed to HIV-positive BBF, there were 36 cases (73.5%) with percutaneous exposure, 11 cases (22.4%) with mucocutaneous exposure and 2 cases (4.1%) with no information on type of exposure. Each case was followed up at least 7.5 months, and no HIV-seroconversion cases were observed.

Among the 40 HCWs who were exposed to HBV-positive BBF, there were 33 cases (82.5%) with percutaneous exposure and 7 cases (17.5%) with mucocutaneous exposure. Each case was followed up at least 6 months. Of these 40 HCWs, 24 had previously been vaccinated for HBV and of the 16 who had not been vaccinated, 2 seroconverted for HBV. Both cases of seroconversion resulted from needle stick injuries and other risk factors related to HBV infection were unknown.

4. DISCUSSION

The Agency received a total of 3,214 occupational exposures to blood and body fluids from 15 collaborating sites; 176 cases (or 5.4%) of reported cases were excluded from analyses because of the incorrect information entered into the database and loss of the data by one site during their replacement of an old computer.

The findings are subject to a number of limitations.

- The data are not fully representative of all Canadian hospitals in Canada because all participation sites were voluntary and not randomized; therefore, selection bias existed in this surveillance system.
- Needle-stick injuries may be underreported among the participating hospitals if some injured health care workers feared that they would bear some responsibilities after reporting needle-stick injuries or being discovered positive for BBP; HCWs from private agencies, medical residents, medical students are not considered as hospital staff so they might not be followed-up by the employee health department or occupational health service (anecdotal evidence from site managers who attended the CNSSN annual meetings from 2006 to 2012). Table 15a, 15b, 15c of our data did show that at baseline, nine HCWs were already infected with HBV when they were exposed to source-patients positive for HBV.
- The follow-up completeness rates were quite low due to resources constraints within the participating sites.

Based on the dataset with complete information, the main findings were as follows:

- Among the 3,038 reported occupational exposures to blood and body fluids analyzed, 61.1% were related to needle sticks and this alone accounted for 75.5% of the percutaneous injuries.
- Rates of exposures to BBF were 8.30/100 FTE among nursing staff and 2.83/100 FTE among non-nurse staff.
- Rates of exposures to BBF were 0.48/10,000 hours worked among nursing staff and 0.16/10,000 hours worked among non-nursing staff.

Nurses as the highest personnel group in the hospital, were the dominant group who reported the sharp injuries (50.1%). Nurses were three times higher for risk of exposure for needle stick injuries than non-nursing staff (8.30/100FTEs vs. 2.83/100FTEs or 0.48/10,000 hours vs. 016/10,000 hours, respectively.

- HCWs were at risk of two and multiple blood-borne pathogens exposures as 11.7% (25/213) of positive source-patients were found to have existing co-infections (HBV-HCV, or HCV-HIV, HBV-HIV, HBV-HCV-HIV).
- There were 2 HCWs to contract HBV during this surveillance period with sero-conversion rate of 12.5%. Therefore needle-stick injury was an important route for hepatitis B transmission.

These results may be used as information for public health policy development. It provides the participating sites with a national benchmark for comparisons at their local/regional levels. In addition, the trend of needle stick injuries over time allows tracking for the progress of safety device implementation.

APPENDIX

DENOMINATOR DATA

Around the world, there are lots of debates on choosing suitable denominators for the rate calculations. Massachusetts State in the USA has required the hospitals to report sharps injuries with the following denominators: occupied beds, number of licensed beds, number of full-time employee equivalents (FTEs), number of patients, number of medical procedures and number of devices. Kim and his colleagues (2008) investigated the usefulness of the above 5 denominators by ranking surgical injury (SI) rate results from 68 acute hospitals in 2002. Based on the 3,064 SI reported cases, the overall mean SI rates were: 18/100 licensed beds, 30/100 occupied beds, 56/1,000 FTEs, 11/10,000 patients and 20/10,000 medical procedures. They found that the choice of denominators had a large effect on the relative SI rates when comparing hospitals, and probably for different areas of the same hospital. Thus a common denominator for SI rates is needed so that hospitals can have consistent and reliable measures of relative performance in risk reduction. The authors suggest that the emergency department as a basic observation unit, registered nurses or equivalent as basic subjects and observation period fixed as 1 year.

In Canada, for the CNSSN surveillance system, the Agency found a close link between worked hours and full-time equivalent workers (FTEs) by using the formula agreed by the collaborating sites, i.e., most HCWs work for 46 weeks during one year and 37.5 hours per week, therefore, one full-time employee equivalents (FTEs) = 1,725 working hours / year. The worked hours can be used as a surrogate denominator for full-time employee equivalents. There are several advantages for us to choose worked hours as the most suitable denominator: (1) It is easy for human resource department to obtain this information; (2) It also considers the contributions of non-full time employees, including nurse student, part-time nurses and others, (3) it has the same denominators used for medical errors and fatigue syndrome.

However, the disadvantages of using worked hours are the following: worked hours is the best indicator only when HCWs use sharps devices all the time in their shift. It may be true in certain settings like emergency room but not good in other setting like out-patient or mental clinic where sharp devices are rarely used during the shift.

THE CURRENT PROVINCIAL/ TERRITORIAL LEGISLATION IN REGARDS TO NEEDLE STICK INJURY PREVENTION

Canadian Occupational Health and Safety Regulations have been passed in the provinces listed below regarding the use of safety engineered devices as a primary method of reducing exposure to blood borne pathogens: BC, Alberta, Saskatchewan, Manitoba, Ontario, Nova Scotia. Application of the regulation varies from provinces to provinces and it does not always cover all health care facilities or all types of needles. For example:

- B.C.'s regulations said that as of Oct. 1, 2008, all medical devices used in workplaces must be safety-engineered where workers are performing activities that put them at risk for exposure to blood-borne pathogens. This regulation applies to a wide variety of workplaces, including hospitals, long-term care facilities, ambulances, out-patient services, home care services and tattoo parlors, among others.
- Alberta stipulates that effectively on July 1, 2010, an employer must provide and ensure that any medical sharp is a safety engineered medical sharp. But this does not apply if (a) use of the required safety engineered medical sharp is not clinically appropriate in the particular circumstances, or (b) the required safety engineered sharp is not available in commercial markets.

- Manitoba enacted legislation amending the Occupational Health and Safety Act to make the use of hollow-bore safety-engineered medical devices mandatory. The legislation took effect on January 1, 2006, six months before Saskatchewan's revised regulation.
- Saskatchewan, the first province in Canada to announce that the use of safety-engineered hollow-bore needles would be mandatory (2005). The regulation took effect in January, 2006 and compliance was required by July, 2006.
- The Government of Ontario provided funding to enable a conversion of acute care facilities to safety devices in 2005. This announcement was followed by a new regulation mandating the use of safety-engineered hollow-bore needles in 2007. The regulation came into effect in September, 2008. A consultation process is being considered in 2009 for expansion of the regulation coverage to other health care workplaces.
- Nova Scotia passed into law the mandatory use of safety-engineered needles in June, 2006. The law requires health-care facilities to provide safety-engineered, hollow-bore needles to workers to ensure they are protected against needle-stick injuries and potential exposure to blood-borne pathogens. The law applied to hospitals, long-term care homes and emergency services.

Information from the other provinces (PEI, Newfoundland, New Brunswick, and Quebec), Yukon, Territories, as well as Nunavut on the existing legislation are not available.

When examining CNSSN data from six sites where there is the provincial legislation on safety devices (2 in Ontario, 3 in Nova Scotia, and 1 in Manitoba), 50.9% of the HCWs said they did not activate the safety mechanism in 2011 and 54.6% did not do it in the first six months of 2012 (as shown in Table 13b). This means that despite the safety devices being available and used, half of HCWs still did not used them properly.

According to the Saskatchewan Workers' Compensation Board, there has been a significant decrease in total claims as a result of needle-stick injuries since the new regulation came into effect.

SOURCE	2003	2004	2005	2006	2007	2008	TOTAL
Needles and Syringes	391	429	462	415	348	179	2643

It has been suggested that other measures can include improvement in the following areas: exposure control plan with a surveillance system to identify risk situations and procedures and modify them whenever possible, post exposure procedures and actions, workers' training on safe work practices, proper use of safety devices, availability of protective equipment, health care workers' vaccination against hepatitis B in their early career.

At the present time, uses of safety engineered devices to prevent needle stick injury are not mandatory in Canada. It has been shown in other countries that preventing needle-stick injury and other sharp injuries needs the comprehensive measures. Six Sigma management theory was elicited from other successful hospitals in USA and this management mode needs to be validated by the hospitals and other health care establishments in Canada.

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