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Infection Risk from "Sharps" Injuries for Non-healthcare Workers

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Executive Summary

The legislature requested that the Commission on Health and Safety and Workers' Compensation review whether provisions of current law offered sufficient protection against sharps injuries for workers outside healthcare occupations. Federal and state bloodborne pathogen statutes closely regulate aspects of "sharps" (needles and other sharp objects that can become contaminated with blood and other infectious materials) in healthcare settings. The legislature has considered extending the regulations in some form to both home-health generated sharps and non-healthcare occupational settings. This report examines the risk that sharps in non-healthcare occupational settings will result in HIV, HBV, or HCV infections.

Findings:

- A review of research literature on non-healthcare, occupational sharps injuries found an extremely small number of confirmed cases of either HIV or HCV being transmitted by needlestick injuries outside healthcare settings. The combined number in developed, western countries appears to be less than 10 total for all countries from the onset of the AIDS epidemic through 2008.
- An analysis of the research on the mechanism of transmission was consistent with the findings of very few cases. We estimate that the risk of HIV from a work related needlestick injury converting to an HIV infection was 1/1 million to 75/1 million when the needle was from an intravenous (IV) drug user. For home-health sourced waste, the risk of infection may be as small as 1/100 million needlesticks.
- A review of data from the Division of Workers' Compensation Information System found that needlestick injuries were uncommon. In non-healthcare settings, approximately 1/10,000 workers will experience a needlestick injury in any year. These numbers are higher in specific industries and occupations, but still in the area of 1/1,000 workers per year.
- When needlestick injuries occur, the workers' compensation claim costs are very low and the presence of temporary and permanent disability is also very low. Needlesticks are almost all very low cost medical-only claims. We found no evidence of seroconversion to any of the

three major infections for any non-healthcare occupational cases in California between 2010 and 2012

- Prophylactic treatment after needlesticks, a measure of the risk perceived by healthcare providers and patients, is also infrequent. Only 1.2% of these injuries received prophylactic treatment.

Needlestick injuries in non-healthcare settings are uncommon and the risk from any needlestick resulting in chronic disease is very small. HIV remains the primary concern because there is no vaccine or cure. But the risk of HIV transmission for non-healthcare workers, from work-related needlesticks is very small. Hepatitis B is much more infectious than HIV, but has an effective vaccine and virtually all workers under 35 were vaccinated as children. Older workers in high risk professions have the vaccine available. The vaccine is thought to be an effective prophylactic measure even when administered after a sharps injury. Hepatitis C (Hep C), while less infectious than Hepatitis B (Hep B) is more infectious than HIV. However, recently, highly effective treatments for Hepatitis C, with fewer side effects than traditional therapy, have been developed.

We find no evidence that additional statutory and regulatory action covering home-health sharps waste or sharps injuries to non-healthcare workers is warranted.



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The legislature requested that the Commission on Health and Safety and Workers' Compensation (CHSWC) review whether provisions of current law offer sufficient protection for workers outside healthcare occupations.

- Existing law requires all sharps waste generated in health care settings to be placed in a sharps container, taped closed, and labeled with the words "sharps waste" or with the international biohazard symbol and the word "BIOHAZARD."
- Existing law specifically excludes home-generated sharps waste from the definition of medical waste for purposes of the statute.
- Existing law only prohibits a person from knowingly placing home-generated sharps waste in certain types of containers and requires that home-generated sharps waste be transported only in sharps containers, as defined, or other containers approved by the State Department of Public Health or the local enforcement agency.

In connection with a proposed bill (AB-1893, Stone and Eggman, 2013-2014) and a related hearing, the Legislature requested additional information from the CHSWC to help the legislature understand the scope of the issue of needlesticks in non-healthcare settings. The legislature requested information on the incidence of needlesticks, the cost to employers, and the cost (if any) and risk faced by workers.

Issue

Concerns about bloodborne infections became a key occupational safety issue in the 1980s & 1990s, coincident with the recognition of the HIV/AIDS epidemic and the transmission mechanism. California adopted a bloodborne pathogen safety standard in 1992. At the same time, the Federal government, mirroring the regulatory language being developed in California adopt regulations covering high-risk situations in the healthcare setting (29 CFR 1910.1030).

More recently, the California legislature has considered expanding the statutory reach of these provisions to include non-healthcare settings where workers may come into contact with potentially infected items that can cause injury and transmission of disease. The legislature is concerned with both household waste (legitimate medical use) and needles from illegal, intravenous (IV) drug use.

This report evaluates the risk of occupational exposure to infection from discarded needles for workers in non-healthcare settings.

We used three approaches to assessing the risk posed by sharps to workers in non-healthcare occupations:

- A review of research literature to identify estimates of the frequency of sharps injuries resulting in infections to non-healthcare workers,
- An evaluation of the risk to non-healthcare workers based on assembling estimates of the risk at each stage of the process that leads from an infected person to disease in an injured worker, and
- A thorough review of sharps injuries in California workers' compensation data was performed.

Diseases considered

There are three diseases of primary concern for the risk of needlestick injuries.

- Human immunosuppressive virus (HIV)--Most of the discussions of needlestick risk coincided with the rise of HIV/AIDS in the early 1980s. This was the immediate concern leading to California's adoption of blood-borne pathogen regulations. California became the model for the national push and eventual adoption of regulations covering high-risk situations in the healthcare setting (29 CFR 1910.1030). HIV remains the primary concern among the three key diseases because there is no vaccine and no cure.
- Hepatitis B virus (HBV)-- Hep B is a common infection, especially in specific subpopulations. The main concern is chronic HBV. Many Hep B infections clear up on their own. Chronic infections occur in 5% of cases and 25% of chronic infections result in serious liver disease (CDC, 2012). Hep B is much more infectious than HIV. However, the risk of Hep B has been greatly reduced since the introduction of a vaccine in the early 1980s. Children in developed countries are routinely vaccinated in infancy. Adult workers in professions with risk for Hep B infection, not previously vaccinated, are routinely offered the vaccination as a prophylactic measure. The vaccine is highly effective.

- Hepatitis C virus (HCV) -- Chronic infections occur in the majority of those infected with Hep C, 60%-85% (NIH, 2002). Chronic infections can result in serious liver disease. While prevalence of chronic Hep C in the general population is much lower than Hep B, the prevalence is quite high among illegal, IV drug users and some other subpopulations. Recently, new drugs (Olysio and Sovaldi) have resulted in a high cure rate for HCV with fewer side-effects than past treatments.

HIV remains the major concern for occupation-related, infection transmission from sharps injuries, primarily because, while there are effective treatments that can reduce or delay the transition from HIV to AIDS, there is no vaccination (like Hep B) or cure (like Hep C).

Description of "Sharps" in non-healthcare settings

Sharps is a term used in healthcare settings to describe any object that can result in an injury involving a piercing of the skin that may result in infection. In medical settings, sharps typically include not only needles but glass and metal objects that can be contaminated and cause subcutaneous injury. In a non-healthcare setting, sharps refer almost exclusively to needles, primarily because needles may contain infectious material (specifically HIV, HBV or HCV). Other objects, glass, metal or sharp plastic, etc, are very unlikely to be perceived as potentially infected.¹ Consequently, when we speak of the risk of sharps in a non-healthcare setting, we are exclusively referencing needles.

Sources of needles in non-healthcare settings

There are two important sources of needles outside healthcare settings:

- Legal, home-sourced waste
- Illegal drug use sourced waste

Legal, home-sourced waste is the result of maintenance regimes of drugs that require injection, most commonly insulin for diabetes, but also including other chronic diseases requiring regular injections. Intravenous (IV) drug users are the second source and are also the dominant source for needles discarded in public spaces.

¹ The exception is medical waste when not properly handled. This waste may contain sharp objects that could have been contaminated during their medical use. The handling of healthcare industry medical waste is the subject of other statutory and regulatory restrictions and will not be examined here. In any case, regulatory controls and industry practices have been successful at controlling this risk in the common waste stream.

The "source" distinction is important for two reasons. First, as we will see below, legal users of needles are rarely infected with the key viruses, but IV drug users are very commonly infected. Second, the legislative request for review of this issue is partly generated by interested parties urging adoption of legislation requiring products particularly designed for needles used in home healthcare situations. While these products could also be used by IV drug users, it is unlikely that legislated requirements will be effective in this segment of the population.²

Summarizing the risk posed by discarded needles in non-healthcare settings

We did a review of literature on needlestick injuries with the aim of identifying cases where work-related needlestick injuries to non-healthcare workers resulted in an infection. We find that needles discarded in household waste or by IV drug users pose minimal risk of infection in community settings. We reviewed the literature on the surveillance and epidemiology of needlestick injuries and found evidence of concerns in the healthcare settings, where a couple of hundred infections with HIV, HBV and HCV, world-wide had been identified. However in the non-healthcare settings, only 3 cases had been attributed to needlestick injuries in all available research we reviewed from Europe, North America, and Australia & New Zealand.

A CDC research panel, reporting in 2005, identified no, non-healthcare setting HIV infections due to discarded needles (Smith, et al., 2005). A review of all needlestick injuries to children at two hospitals in Montreal over 19 years identified no resulting infections (Papenburg, et al., 2008). A Spanish study identified a single needlestick resulting in a HCV infection (Libois, et al., 2005). A 2007 study (Haber, et al., 2007) was able to identify two cases of discarded needles that were considered likely to have resulted in HCV infections. However one victim, while testing negative for HCV immediately after the needlestick had a long history of heroin use and other risky behaviors. A case of a police officer being infected by a needlestick was also identified, but in that case the perpetrator intentionally stabbed the policeman. More recent surveys of cases do not appear in the literature, possibly because the very, very low risk has been established.

² An important exception is the success of needle exchange programs in encouraging IV drug users to transport used needles in FDA approved containers.

The reason for the very low risk and very low incidence of infection with discarded needles is a function of the combination of multiple steps in the chain of events that leads to infection, each step of which may have a small or very small probability of resulting in infection. Since the overall probability of infection is the product of multiplying this chain of conditional probabilities together, the fact that each individual probability is small means the product of the probabilities is very small.

The path to disease

The risk posed by sharps to workers in the workplace can be described as the risk over a series of events. When several conditional probabilities are small, the overall probability of the whole chain of events occurring is very small, sometimes diminishingly so. This is the case when considering the risk of infection posed by discarded needles in non-healthcare settings.

The occupational risk we are interested in with sharps in a non-healthcare setting is the risk that a worker will contract HBV, HCV, or HIV after a needlestick injury.. This risk is determined by a series of steps, from the probability that the original user of the needle was infected through whether the worker is infected and if the infection leads to clinical disease. For each step we can make an estimate (sometimes only a rough estimate) of the conditional probability for that particular event. From the series of probabilities, we can then construct the risk of a worker contracting HBV, HCV, or HIV from a sharps injury.

A challenge to this estimation is that we have to consider three diseases with different transmission risks and two different populations of needle users with different prevalence rates of infection. We will make some simplifications. But the simplifications will not change the fact that risk of disease from a needlestick injury in a worker is very small, even when the worst case assumptions are made.

We will focus primarily on the transmission of HIV. The risk of HIV transmission has been more closely studied and is better understood. HIV is transmitted less readily than HBV and HCV

under identical conditions. However, HBV has better prognoses with prophylactic treatment than HIV. HBV also has an effective vaccine. There are several medications available that are effective in curing HCV, including new treatments that appear to be more effective and have fewer side effects than previous options. Consequently, the ultimate risk of serious health consequences as a result of a needlestick injury is likely of similar magnitude for each of the three diseases.

Steps

We can start by describing the risk of infection under the highest risk set of conditions. When a hospital worker is stuck by a needle just withdrawn after a blood draw from an HIV positive hospital patient, the risk of infection is about 3/1000 needlesticks (Bell, 1997). If instead the patient was HCV positive, the risk is higher about 1/100 (Puro, et al., 1995). The conditions for transferring infection in these cases are "ideal" in the following respects:

- The patient is known to be HIV or HCV positive, that is, infected 100% of the time.
- The patient in a hospital setting and is more likely to have a high viral load in their blood. Viral load is a measure of the active infectious agent present in the patient's blood.
- The needle size commonly used in hospital procedures will, on average, be large.
- The amount of time between blood draw from the patient and needlestick in the worker is short.

Infection rated among original user of needle

A needlestick poses no risk of infection with HIV, HBV or HCV if the initial user was not infected with the disease. Consequently, the first conditional risk factor is the probability that the original user was infected. This issue can be bifurcated along the lines of the population of original users:

- legitimate medical use
- Illegal injection drug use

And can be calculated separately for each of the three sentinel diseases. This offers a 2x3 table of population infection rates.

Percent of Population Infected		
	All	IV Drug user
HIV	0.3% ¹	11.0% ⁶
HBV	0.4% ²	65.7% ⁴
HCV	1.0% ⁵	76.9% ^{3,4}

¹Hall, HI, et al., 2008

²Shepard, CW, et al., 2006

³Armstrong, GI, et al., 2006

⁴Garfein, RF, et al., 1996

⁵Denniston, MD et al., 2014

⁶Spiller, et al., 2015.

Infection rates are low in the overall population. Needles for in-home, medical maintenance use are rarely linked to an infected person because HBV, HCV, and HIV infections are uncommon among this population. On the other hand, needles from IV drug use are more likely to be from an infected person. Infection rates are quite high among IV drug users.

Consequently, the risk of HIV infection from a needlestick in a non-healthcare setting relative to the "ideal risk" above, all else equal, will be 1/300th for home-health used needles and 1/5th for IV drug use needles. This represents the risk that the user is HIV positive versus the hospital setting where 100% of patients were known to be HIV positive.

Viral load

The risk of infection from a needlestick also depends upon the viral load of the needle-user (patient, IV drug user, etc). Viral load is a measure of the active infectious agent present in the patient's blood. The measure is virus particles (RNA copies) per milliliter of blood. The viral load for HIV infected persons varies widely. During the initial, acute phase of infection, usually before the individual has been identified as HIV-positive, the viral load is high - in the millions of copies per milliliter (Hollingsworth, TD, et al., 2008). After the acute stage, viral loads may measure in the 10,000 to 150,000 parts when untreated and increase over time (Fraser, C., et al., 2007). Infected persons adhering to antiretroviral therapy (ART) usually maintain viral loads

consider undetectable or less than 40 copies per milliliter.³

Viral load has been shown to be an important determinant of the risk of sexual transmission of HIV. Several studies have found near zero risk of HIV transmission per sexual encounter when the viral load of the infected partner is below 1500 parts (Quinn, et al., 2000), 400 parts (Attia, et al., 2009) or at undetectable levels due to adherence to ART (Wilson, et al., 2008).

There are a number of factors we do not know about viral load and the risk of occupation-related transmission.

- The impact of viral load in types of transmission other than sexual transmission has not been well examined. Most observers suggest that the viral load matters for all forms of transmission, including needlesticks.
- There is no exact formula that translates viral load to relative risk. Sufficient data is not available to establish a usable formula, or whether the relationship between viral load and relative risk is linear, multiplicative, or exponential.
- How viral load is different among users of in-home medical management needles, IV-drug users, and patients in studies of HIV patients in healthcare settings is unknown. The research focused on healthcare settings did not offer any information on the viral load. However, much of the research reflected data collected from a period prior to the development of effective treatments to control the viral load of those infected HIV. Before effective treatment for HIV, if a patient was in the hospital because they were, their viral load would likely be very high. However if they were being treated after the development of ART and being treated for a completely unrelated medical condition, they might have had low viral load levels. Similarly, IV drug users may be otherwise healthy and maintaining consistent ART, may be in poor health and/or be inconsistent in maintaining the ART regime.

Volume of blood transferred

An important factor in the risk of transmission from a needlestick is the volume of blood transferred (Cardo, et al., 1997). Blood volume in a needlestick is directly affected by the size and characteristics of the needle involved. Needles are hollow-bore, like those used to draw in

³ AIDS.gov, <https://www.aids.gov/hiv-aids-basics/just-diagnosed-with-hiv-aids/understand-your-test-results/viral-load/> Accessed, March 18, 2015.

blood, or solid, like those used to suture wounds. There are no identified cases in healthcare settings where solid needles resulted in infection to a healthcare worker (Bell, 1997; Ippolito, et al., 1999). Only hollow-bore needles have a documented association with infection transfer.

Hollow-bore needles come in different sizes, called gauges, that are a key factor in the amount of blood potentially transferred. Gauge is a measure of the size of the hollow-bore in a needle. A lower number indicates a larger internal diameter, which in turn affects the amount of blood that is available to transfer infection to another party. Roughly speaking, the relative volume of residual blood remaining in the tip of the needle, when comparing two different needle gauges, will be the ratio of the cubes of the internal diameters. The table below compares the relative volumes of common hospital use needles and common home/IV drug user needles. Here "volume" refers to the residual blood that may remain in the tip of the needle after use, not the capacity of the needle cartridge where the medicine is loaded.

Gauge	Diameter (mm)	Volume (mm ³)
Hospital setting		
16	1.194	1.702
23	0.337	0.038
Home/IV drug use		
27	0.210	0.009
31	0.133	0.002

At the midpoint of each range of gauges, the volume of infected blood present in the bore of the needle used will be about 100-150 times higher in a hospital setting than with the same needle in a home/IV drug use setting. While consensus is that the volume of blood is a factor in the risk of infection, we do not know exactly how an increase in volume affects the level of risk. However, the differences in volume are quite large and the impact on risk is likely to be substantial.

Larger-bore needles are common in hospital procedures. Gauges 16-23 are typical of hospital blood draws. Larger gauge (lower number) needles are necessary in phlebotomy procedures to avoid damaging the blood cells (WHO, 2010). IV infusions, involving moving large volumes of

liquid, also require larger gauges.

Home medical maintenance and IV drug use requires much smaller-bore needles. The San Francisco AIDS Foundation (SFAF) needle exchange program distributes needles with gauges ranging from 27-31.⁴ These same gauges are the common size for home medical use, particularly insulin injection.

Viability of virus outside the body

HIV degrades quickly outside the human body. Under ideal conditions for worker infection following a needlestick, the transfer of blood from an infected patient to worker is almost immediate. Consequently, the virus will have little opportunity to degrade. However, discarded needles in the waste stream or in public places can be encountered days, weeks, or months after use.

The rate of degradation of the HIV virus outside the human body is dependent on a number of factors including volume, temperature, humidity and exposure to sunlight. 10-fold reductions in virus levels were found at <5 days in larger volumes at room temperature (McDougal, et al., 1985). Virus was undetectable at 7 days in 16-17 gauge needles (Thompson, et al., 2003). These needles have about 100 times the volume of residual blood as IV drug use needles.

HBV and HCV are more robust outside the human body, degrading more slowly, particularly HBV (Thompson, 2003).

We cannot know the average time from use of a needle to a needlestick injury in a non-healthcare setting. In many cases a virus, if originally present, will be completely degraded, posing no risk. Other needles may have been recently used, contained substantial volumes of blood and been subject to low temperature, no sunlight and high humidity. A reasonable range for the average risk reduction, considering the small volume of blood, poor environmental conditions and frequent long delays between use and contact, could be from

⁴ It is worth noting that the SFAF program also distributes FDA approved needle containers for safe transport of used needles.

90% - 99%.

Comparing the risk of infection from discarded, community-setting needles to known risk in healthcare setting

Comparison of relative risk of infection between healthcare and non-healthcare settings (HIV as the example)			
	Healthcare	Home	IV drug use
Risk of infection under "ideal conditions"	0.003	0.003	0.003
Infection rate of patient/user	1.00	0.003	0.2
Viral load (per milliliter)	40,000-1,000,000 ¹	40-150 ²	40-40,000 ³
Blood volume (mm ³)	0.038 - 1.702	0.002 - 0.009	0.002 - 0.009
Degradation (fraction residual infections agent)	N/A	0.05 - 0.25	0.01 - 0.10

¹ Assumes acute or end state of disease
² . Assumes well maintained ART consistent with maintaining other maintenance drug regime requiring legal injection drug regime.
³ . Assumes sub-acute phase, with or without ART.

As we discussed, the exact relationship between higher and lower values of three of the four characteristics and the risk of infection through needlestick is not well understood. Below some threshold, the risk is at or near zero. But above that threshold, the risk does not necessarily increase linearly with the change in the factor.

We can calculate the risk of a single needlestick resulting in seroconversion to disease by starting with the known risk from the "ideal" conditions (3/1000) as follows:

$$(Risk\ under\ ideal\ conditions) * (relative\ prevalence\ of\ infection\ in\ specific\ subpopulation) * (relative\ risk\ from\ viral\ load) * (relative\ risk\ from\ blood\ volume) * (relative\ risk\ due\ to\ degradation\ over\ time)$$

We know the risk that the patient is infected and that is directly related to the relative risk. If we assume as a simplification that each of the other three risk factors reduces the risk by a factor of 10, then the risk of HIV infection is:

Risk from a home-sourced needlestick:

$$.003 * .003 * .1 * .1 * .1 < 1/(100\ million)$$

The risk of HIV infection from a IV-drug-user-sourced needlestick is:

$$.003 * .1 * .1 * .1 * .1 < 3/(10\ million)$$

Even estimating that each of the three factors only reduced the risk of infection in a community setting relative to a healthcare setting by 1/2 (an extremely conservative estimate) would still mean that a home-source needlestick would result in infection in 1/(1 million) sticks and IV-drug-use sourced risk of 40/(1 million) sticks.

The risk for HBV and HCV are higher because both viruses are more infectious, increasing the first factor (infection under ideal conditions), The prevalence of infected persons in the population (in-home medical users and IV drug users) is higher, increasing the second factor. Both viruses are more robust outside the body than HIV, increasing the last factor. This higher risk is mitigated by the availability of an effective vaccine (HBV) and an effective treatment (HCV). Prophylactic treatment after exposure to HIV is available, but the effectiveness of the treatment is uncertain.

The California Experience: Examining the incidence and cost of needlestick injuries to non-healthcare workers in California

The Department of Industrial Relations (DIR) Research Unit did an extensive review of electronic data collected by the Division, taking advantage of efforts previously undertaken by other researchers, to assemble a picture of occupational needlestick injuries in non-healthcare settings. These data are reviewed here with an emphasis on the risk that needlesticks present to workers and the cost to employers. and. These data were supplemented with data on all needlestick injuries treated in California emergency departments, made available by the Office of Statewide Health Planning and Development (OSHPD).

Data and Methods

The Workers' Compensation Information System (WCIS), maintained by the DIR, collects data on all workers' compensation claims reported in California. These data include information about the injury that allowed the Department to identify claims involving needles sticks. The WCIS data are generally of good quality, but some fraction of claims administrators do not comply with reporting. Therefore, the number of reported claims in WCIS should be interpreted as a lower bound.

Identifying non-healthcare workers and needlesticks

DIR, working with external researchers at the California Department of Public Health and UC San Francisco, has developed a methodology to identify healthcare and non-healthcare workers using both WCIS electronic claims data and paper reports of injury as well as industry classification, occupation description, and employer name to segregate claims into healthcare and non-healthcare jobs.

Needlesticks were identified in WCIS records through a combination of the injury description, a free form text field that describes how the injury occurred, and coded values on the cause and nature of the injury. These were then supplemented with information on medical ICD-9-E code E920.5 in the WCIS medical transaction data that indicates a needlestick as the source of injury.

DWC first searched the injury description text field for the words "needle" or "syringe", including variations in spelling. They then excluded injuries caused by sewing needles, pine needles, cacti, needle-nosed tools and tagging guns.

For inclusion, all cases had to have a:

- "Cause of injury" that included one of the following
 - cut, puncture, or scrape injuries,
 - striking against or stepping on a sharp object,
 - struck or injured by, not otherwise classified.

or

- "Nature of injury" that included one of the following
 - laceration
 - puncture
 - infection
 - contagious diseases
 - no physical injury

The Office of Statewide Health Planning and Development (OSHPD) tracks all emergency department visits in California. These data include ICD9-E codes, which allow us to identify treatment related to needlestick injuries (E920.5). OSHPD also identifies the payer, including a category for workers' compensation. These data are of very high quality. However, they only identify needlesticks that are handled through emergency rooms. A substantial fraction of occupational needlesticks will be treated in other settings. For example, needlesticks in hospitals and other healthcare settings may be treated on-site without directly moving through an emergency department and being identified in OSHPD data. This is consistent with about 80% more occupational needlesticks being reported in WCIS than work-related needlesticks being treated through emergency departments.

OSHPD data does allow us to look at trends across time and the number of needlestick injuries and the distribution between occupational and non-occupational cause.

Needlestick Reports (California)				
Workers' Comp Information System (WCIS)	2010	2011	2012	Total
Total Occupational Needlesticks Identified	4,955	4,996	5,168	15,119
Non-healthcare Worker Claims	1,061	1,134	1,143	3,338
Percent Non-healthcare	21.4%	22.7%	22.1%	22.1%
California Emergency Department (OSHPD)				
Needlesticks--All payers	5,177	5,141	5,250	5,074
Needlesticks--Workers' Compensation	2,727	2,624	2,946	2,718
Percent Occupational	52.6%	51.0%	56.1%	53.6%

Almost 4/5ths of work-related needlesticks are reported to workers in the healthcare sector, a sector which employs 12% of California workers. The total number of reported needlestick injuries has been constant, rising only slightly between 2010 and 2012, consistent with a rise in overall employment.

Needlesticks treated through emergency rooms are flat or slightly declining in number, both total cases and those paid by workers' compensation.

Needlestick injuries by industry

Outside the healthcare sector, the risk of needlestick injuries is quite small. Workers in the healthcare industry have a risk of needlestick injuries of about 1.8 needlesticks per 1,000 workers per year. That is about 14 times higher than the average for all other industrial sectors (0.13/1,000 workers).

Occupational Needlestick Injuries 2010-12 by 2-Digit Industry Sector (NAICS)^a

Sector	Frequency	Percent of all needlesticks in sector	per 1,000 employees per year ^b
Health Care & Social Assistance	9,446	62.5%	1.80
Public Administration	1,089	7.2%	0.15*
Accommodation and Food Services	729	4.8%	0.19
Educational Services	700	4.6%	0.73**
Administrative, Support and Waste Management	698	4.6%	0.27
Retail Trade	374	2.5%	0.08
Manufacturing	344	2.3%	0.09
Professional, Scientific & Technical	326	2.2%	0.11
Other Services (Except Public Admin)	145	1.0%	0.10
Transportation and Warehousing	140	0.9%	0.10
Wholesale Trade	135	0.9%	0.07
Real Estate, Rental and Leasing	115	0.8%	0.15
Agriculture, Forestry, Fishing and	63	0.4%	0.05
Construction	59	0.4%	0.04
Arts, Entertainment & Recreation	49	0.3%	0.07
Finance and Insurance	20	0.1%	0.01
Information	17	0.1%	0.01
Other Sectors	8	0.1%	N/A
Missing/Unknown	661	4.4%	N/A

^a Industry Sector used NAICS if present. If not present, used class code to NAICS crosswalk

^b Industry employment was obtained from Bureau of Labor Statistics, US Dept. of Labor, 2013.

* Includes both police and fire as well as other government workers.

** The high number for educational services may be an error in defining the number of workers in the sector. That is, public education workers may be included as "Public Administration" instead of in the education sector.

The lower risk over all non-healthcare sectors does mask some sectors with higher risk. Food service & accommodations, education, and waste management are areas where the risk is substantially and significantly above the average for non-healthcare workers. As we will see below, public safety is an area where the risk may be higher than for the average sector. Because a large fraction of public administration jobs have little risk of exposure to needlesticks, this could obscure the risk to some public safety occupations when all public sector workers are pooled together.

Education stands out in these data as a sector with relatively high risk. This may be somewhat overstated because segregating injuries and employment into each sector is quite difficult. The government is the major employer in the education sector thus much of the employment may be reported as "Public administration" whereas the injury data is likely accurate at defining the sector more specifically as education, both public and private.

In the healthcare and waste management industries, a broad range of workers and occupations may be exposed to needlestick injuries. Outside these two sectors, industry may be a poor way to define the relative risk of needlestick injuries to different workers. Occupation is likely a much more specific determinant of risk. For example in education and food service & accommodations, the risk is likely highly concentrated in custodial and cleaning services. The same is almost certainly true for the real estate, rental and leasing sector.

Needlestick injuries by occupation

The DWC also broke out the data by occupation and the concentration of risk by occupation that we expected is visible in these data. Excluding healthcare occupations, only "custodial & grounds keeping" and "protective services" exhibit elevated risk for sharps injuries. No other broad occupational category showed any substantial risk. Some observers have raised concerns about waste management workers. The occupational categories group waste handlers with other related occupations and may obscure higher risk for this more narrow group of workers.

Occupational Needlestick Injuries 2010-12 by Occupation

Occupation	Frequency	per 1,000 employees per year ^a
Building and Grounds Cleaning and Maintenance	1,209	0.92
Protective Services	395	0.36
Production	235	0.10
Transportation and Materials Moving	81	0.03
Sales and Related	65	0.02
Office and Administrative Support	65	0.01
Food Preparation and Serving Related	63	0.02
Personal Care and Service	35	0.03
Education, Training, and Library	34	0.01
Construction and Extraction	17	0.01
Installation, maintenance and Repair	16	0.01
Other	56	N/A
Unknown	780	N/A

Incidence by occupation was derived from WCIS claims level data.

^a Data on employment by occupation are from the Bureau of Labor Statistics, US Dept. of Labor, 2013.

TD and medical cost

A concern of the legislature was the degree to which non-healthcare, work-related needlestick injuries might impose significant costs on employers and workers. The direct cost to employers is represented by the workers' compensation costs and includes medical, temporary disability and permanent disability. These can be estimated from data in the WCIS system.

First, a word of caution about the medical and indemnity payment data. These data can be incomplete because claims administrators are not completely compliant with reporting.

Virtually all reported claims will have some medical treatment costs. Needlestick injuries may be a special case where the injury is frequently so minor that only first aid is given in an important fraction of claims. However, because claims with \$0 in medical are very often errors due to incomplete reporting (rather than first-aid-only cases), we calculate average costs across all reported claims and separately for those claims with >\$0 medical reported.

In addition, some of these claims may still be open and future medical treatment could increase the total medical and indemnity costs. Given that the vast majority of these claims are "medical-only" which tend to close quickly, the majority of these claims will be closed as of the date of data extraction. Any future medical cost development will likely be small.

Consequently, the cost reported in WCIS for these claims is likely to be very close to the final cost, especially for more mature injury years like 2010 and 2011.

Finally, needlesticks can occur as part of a broader occupational injury event. For example, a needlestick may occur in the course of public safety personnel subduing a violent IV drug user where the police officer suffers multiple injuries, one of which involves a needlestick. Because of the way we set up the analysis, we identify all medical and disability payments associated with a claim that involves a needlestick and, by association, attribute those costs to the needlestick injury. While this approach is likely appropriate in a large majority of these claims,

this approach may somewhat over state the costs associated with just needlesticks.

The first observation is that this type of claim almost never results in temporary or permanent disability payments. Across all workers' compensation claims for all types of injuries, about 30% of claims receive indemnity payments. For needlesticks, only 1% of claims received any indemnity payments. This is consistent with the expectation for this type of claim. The actual injury is almost always minor.

When indemnity payments are present, they are also very low. When indemnity is reported, the average amount is about \$3,000/claim. For all indemnity claims at insured employers, the WCIRB reports an average indemnity amount of about \$26,000.⁵

Second, average medical cost for claims ranges from \$419, if we consider the average across all reported claims, to \$747, if calculate the average using only claims with >\$0 medical reported. These averages are consistent with typical medical-only claims. As a comparison, the average medical cost on indemnity claims at insured employers is approximately \$42,000/claim.

Finally, very few of these claims resulted in any permanent disability (PD), and then only small amounts. These small PD payments are most likely related to either a psychiatric condition arising out of the original injury (see below) or a second condition connected with the same claim (like the physical injury from subduing a suspect described above) but not directly arising from the needlestick. The small indemnity amounts do not seem consistent with a needlestick resulting in seroconversion to an actual disease.⁶

The cost of needlestick injuries is a function of their frequency and average cost. Frequency, as we saw above, is low. About 0.1% of workers' compensation claims are for needlestick injuries, or about 1/1,000. Needlestick injuries are also very low cost claims. The low cost is apparent in all three primary areas, temporary disability, medical, and permanent disability.

Consequently, the overall cost of these injuries is very low. Over the observation period, 2010-12, the total cost (medical + indemnity) was approximately \$1.5 million in a system with total

⁵ WCIRB Report on Insurer Experience. September, 2014

⁶ In discussions with the Disability Evaluation Unit, they were not aware of any permanent disability ratings done by the unit in recent years that were related to HIV.

employer cost for the period of \$46.5 billion, or less than 1/100th of 1%.

Claim Costs related to Occupational Needlestick Injuries (Non-healthcare workers)				
	2010	2011	2012	Total
Claims Among Non-HCW Claims	1061	1134	1143	3338
Claims with any benefit amount	597	639	635	1,871
Claims with any TD	13	9	14	36
TD Amount (non-compromised)	\$13,961	\$21,840	\$24,991	\$60,792
Claims with any PD				6
PD Amount (non-compromised)				\$16,200
Claims with Medical treatment cost	564	609	613	1768
Total Medical Treatment Cost	\$406,239	\$471,538	\$423,114	\$1,300,891
Including claims with compromise settlements				
Claims with any TD	14	10	15	39
TD Amount (incl. compromised)	\$22,905	\$23,012	\$40,965	\$86,882
Claims with any PD				10
PD Amount (incl. compromised)				\$34,169
Claims with Medical treatment cost	594	638	634	1,866
Total Medical Treatment Cost	\$429,830	\$536,035	\$433,594	\$1,399,459

Data on indemnity and medical costs were derived from claims level data reported to WCIS

Prophylactic measures

As we observed above, the risk of getting any of the three diseases (HIV, HBV, or HCV) from a needlestick injury outside the healthcare setting is very small. However, the actual risk and the perceived risk may differ. That is, an injured worker may be affected by the concern that they will become infected, even if the risk is very low. The fraction of cases treated with prophylactic measures is one indication of the perceived risk, both by medical personnel treating the condition and injured worker.⁷

⁷ One reviewer suggested several additional codes that could identify additional testing:

86703 - HIV-1/HIV-2, SINGLE ASSAY

86706 - HEP B SURFACE ANTIBODY

86803 - HEPATITIS C AB TEST

This would be an area for future research.

We identified five ICD-9-V codes that indicate prophylactic measures:

- V65.44 HIV Counseling
- V04.89 Need for prophylactic vaccination or inoculation against other viral disease
- V05.3 Need for prophylactic vaccination against hepatitis
- V05.8 Need for prophylactic vaccination or inoculation against other specific disease
- V05.9 Need for prophylactic vaccination or inoculation against other unspecified individual disease

There were 41 claims with V05.3 (vaccination against hepatitis) among the 3,338 needlestick claims for non-healthcare workers. That is, about 1.2% of non-healthcare workers with needlesticks were given prophylactic treatment against hepatitis. All other prophylactic measures appeared only 4 times, or in about 0.1% of needlestick injuries.

We examined prophylactic treatments in the OSHPD Emergency Department Data and the results were similar. For the 10,324 needlestick injuries (both occupational and non-occupational) treated in emergency departments in 2012 and 2013, only 86 (0.8%) received any of the prophylactic treatments identified above. 79 of the treatments were prophylactic vaccination against hepatitis. The pattern was similar for occupational and non-occupational cases treated in emergency departments.

The use of prophylaxis is quite low. This is consistent with the low risk from needlesticks and the efficacy of prophylactic measures.⁸ Hepatitis B is the most infectious of the three conditions and prophylactic measures are considered effective and safe. However, the risk of infection is still very low and many persons are already vaccinated against Hep B. HCV has no proven effective prophylaxis. HIV has a recommended prophylactic regime, but, because of potential side effects, the regime is recommended only when specific elevated risk conditions are met.⁹

⁸ Current CDC guidelines call for the administration of [hepatitis B immune globulin](#) (HBIG) and/or [hepatitis B vaccine](#). While the efficacy of the combination has not been evaluated in the needlestick injury setting, it has been shown to be the most efficacious approach in the perinatal setting. The approach has no contraindications during pregnancy and lactation.

⁹ CDC guidelines generally recommend a PEP protocol with 3 or more antiviral drugs, when it is known that the donor was HIV positive; however, when the viral load was low and none of the above noted risk factors are met, the CDC protocol utilizes 2 antiviral drugs. Such a 2 drug protocol should also be considered when the donor status cannot be determined (e.g. injury by a random needle in a used sharps container), but there is an increased risk that

Psychiatric treatment

Even when the risk of infection is very low, the severity of possible outcomes can result in real concern about the possible consequences. We measure the psychological impact by analyzing what fraction of needlestick claims included medical treatment related to a psychological diagnosis. The diagnostic codes for psychological conditions are the range from ICD-9s 290.0 to 319.9 and were available from the WCIS medical transaction database. These data may underestimate the frequency of psychological treatment to the extent that the medical transaction data reporting is incomplete. On the other hand, this may too high an estimate of the frequency of psych treatment related to needlesticks because we are ignoring the possibility that the event may have involved additional injuries unrelated to the needlestick. In any case, the incidence of psych treatment is very low. On needlestick claims, at least one treatment with an ICD-9 code in the psychological range was observed on 94 of the 3,338 non-healthcare worker claims or about 2.8% of these claims. We cannot be sure that the psych counseling is directly related to the needlestick and not some other aspect of the claim.

Discussion

The WCIS data give us a particularly detailed picture of occupational needlestick injuries in California. The DWC put considerable effort into accurately identifying the number of sharps injuries and the financial and disability burdens that the injuries imposed on workers and employers. The WCIS data are consistent with our expectations concerning the risks related to sharps that we developed from reviewing the research literature.

Needlestick injuries, outside the healthcare setting are uncommon. About 1-in-10,000 workers outside healthcare will experience a needlestick in a given year. For specific industries (education, food & hospitality, and waste management) and occupations (custodial services and protective services), this risk is substantially higher. However, even in these specific industries and occupations, the risk of a sharps injury is less than 1/1000 workers/year.

the source was from a risk group for HIV.^[18] PEP drugs for prevention of HIV infection are given for 4 weeks and may include nucleoside [reverse transcriptase inhibitors](#) (NRTIs), nucleotide reverse transcriptase inhibitors (NtRTIs), nonnucleoside reverse transcriptase inhibitors (NNRTIs), [protease inhibitors](#) (PIs), and a single [fusion inhibitor](#). PEP anti-HIV regimens are accompanied by significant [side effects](#) and their utilization is not indicated

When needlesticks occur, the consequences appear to be minor. Again, this is our expectation from the review of the literature. Only 1% of needlestick injury claims involve disability indemnity payments. And the medical costs and disability costs associated with this particular injury are very low compared to the average workers' compensation claim.

Prophylactic treatment following a needlestick is rare. Only about 1% of sharps claims in non-healthcare settings involve prophylactic measures, and then almost always for possible Hepatitis B infection.

Psychiatric counseling after a sharps injury is more common than prophylaxis, but is still only present in a small fraction (2.8%) of claims.

Finally, we find no indication that needlestick injuries are substantially under-reported. There is no effective way to know what fraction of claims may go unreported. However, if an occupational sharps injury that is treated outside the workers' compensation system would be expected to be treated through an emergency department, we do not observe a suspiciously high number of ED visits being paid by payers other than workers' compensation. The risk of sharps injuries from discarded needles is widely distributed across the population, working and not, but over half of emergency department sharps injuries are paid by workers' comp. One might expect high compliance with reporting given that 1) the cost of sharps-related claims is very low, and 2) when indicated, prophylactic measures, taken early, may substantially reduce the medical treatment cost and the psychological stress.

when there is evidence that HIV transmission is not involved; also, initiated protocols can be stopped when data appear indicating that the source-person is HIV-negative.

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