Characteristics of persons and jobs with needlestick injuries in a national data set

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Background: Physicians, nurses, and others are at risk of needlesticks, yet little national information is available regarding incidence across demographic and occupational categories.
Methods: Analysis was conducted on national data on occupational injuries for 1992-2003 from the Bureau of Labor Statistics (BLS). Because BLS data were limited to cases with 1 or more days of work loss, and reasons related to reporting of incidents, the data only reflected a subset of all needlesticks. Nevertheless, the data were internally consistent across categories so that relative magnitudes were reliable. Statistical tests for differences in proportions were conducted that compared needlesticks with all other occupational injuries and employment.
Results: Cases with 1 or more days of work loss numbered 903 per year, on average, from 1992 through 2003. Women comprised 73.3% (95% CI: 72.5%-74.2%) of persons injured. For those reporting race, white, non-Hispanic comprised 69.3% of the total (95% CI: 68.1%-70.4%); black, non-Hispanic, 14.8% (95% CI: 13.9%-15.6%); and Hispanic, 13.8% (95% CI: 12.9%-14.6%). The age bracket 35 to 44 years had the highest percentage of injuries at 34.0% (95% CI: 33.1%-34.9%). Ages over 54 years reported smaller percentages of needlestick injuries than either all other injuries or employment. Occupations with greatest frequencies included registered nurses, nursing aides and orderlies, janitors and cleaners, licensed practical nurses, and maids and housemen. Occupations with greatest risks included biologic technicians, janitors and cleaners, and maids and housemen. Almost 20% (95% CI: 18.88%-20.49%) of needlesticks occurred outside the services industry. Seven percent (95% CI: 6.56%-7.53%) of needlesticks resulted in 31 or more days of work loss in contrast to 20.46% (95% CI: 20.44%-20.48%) of all other injuries.
Conclusion: In this nationally representative sample, the most frequent demographic and occupational categories were women; white, non-Hispanic; ages 35 to 44 years; and registered nurses. (Am J Infect Control 2008;36:414-20.)

Fear of needlestick injuries is widespread among physicians, nurses, and other health care workers.[1-8] However, research on demographic characteristics of persons and jobs associated with needlesticks is limited. The authors are aware of only 1 study that uses national data.[9] Most studies provide information only on occupations and only in hospitals.[1-20] For example, Gillen et al[17] find this order of occupations: nurses (45% of all needlesticks); technicians (20%); physicians (20%); housekeeping and maintenance (5%); and students (3%). Information on characteristics other than occupation is rare. Gillen et al[17] provide mean age (38 years) and age range (18-72 years), as well as percent female (77%). Our study summarizes information on gender, race, age, occupation, length of time on the job, days away from work, and industries using nationally representative data from inside and outside hospitals. This study may help target interventions for prevention. Because the data are collected annually, this study provides baseline estimates to judge future interventions.

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METHODS

The Occupational Safety and Health Act (OSH Act) requires most private employers with 11 or more employees to keep logs of occupational injuries and illnesses. The Bureau of Labor Statistics (BLS) annually surveys a scientifically selected probability sample of these establishments and others not required to maintain records except in the survey year (roughly 250,000 firms in 1992 and 183,700 in 2003). The BLS assembles the data and publishes results in its annual Survey of

Occupational Injuries and Illnesses.[21] Our needlestick study analyzed a subset of data from 1992 through 2003 for most categories. However, data on race, occupation, and industry categories changed from 2002 to 2003; therefore, 2003 data for those categories were not analyzed. Information on characteristics of injuries and demographics was available only on cases involving days away from work, a subset that typically comprised one third of all cases.

To classify injuries, the BLS used a scheme similar to coding in the American National Standards Institute. Classifications included Source, Event, and Nature. The Source identified the object creating the injury; Event described the motion or energy causing the injury; Nature described the physical characteristics of harm. The key variable was Source code 751 (''needles and syringes''), which included both clean and contaminated needles, from which numbers of contaminated injuries could not be estimated.

Also analyzed was Event code 3431: ''injections, stings, venomous bites, needlesticks.'' Results were similar to Source code 751 and therefore not reported but available from authors. Event data implied exposure to harmful substances, including medicine. Source data did not have this restriction. Source data were preferred over Event data because the former likely included more of the majority of needlesticks for which no harmful exposures occurred. Source data were roughly 4 times as numerous as Event data and were more likely to be represented in demographic and job categories.

Employment data were drawn from different BLS surveys, the Occupational Employment Statistics program for over 800 occupations, and the Current Population Survey. Because of changes in categorical definitions after 2001, however, employment data for only 1999-2001 were used. This study used employment data from only the health services industry. Employment occupation categories did not always perfectly match injury occupation categories. For example, a group of 7 physician subsets was combined into 1 category, ''physicians.'' Estimates for employment for all 11 years were derived by multiplying 1999-2001 employment figures by the ratio 11/3 and 1999-2000 employment figures by the ratio 11/2. Consistent 2000 data were unavailable for physicians, dentists, and laundry operators.

Statistics involved construction of 95% confidence intervals (95% CI), tests for differences in proportions, and linear regression. Percentages were assumed to be distributed as binomials. Because of large samples, most differences were statistically significant even after Bonferroni adjustments. Clinical judgment was used to distinguish between statistical and clinical significance.[22] No CIs for numbers of cases were constructed since BLS did not release data on individuals because of confidentially restrictions.

RESULTS

On average, over 12 years, there were 903 needlestick cases out of an average of 1,830,155 days away from work cases for all recordable BLS injuries and illnesses. Needlesticks comprised 0.05% of all BLS cases. No statistically significant time trend was apparent for either numbers of needlesticks or the ratio of needlesticks to employment in health services.

Table 1 presents data on demographic characteristics, needlesticks, all other BLS occupational injury and illness cases, and employment within the health services industry. The differences in percent men versus women for needlesticks (26% vs 73%), for all other BLS cases (66% vs 33%), and for health services employment (22% vs 78%) were statistically significant ($P < .0001$ for all 3). The differences in percent of either gender's needlesticks and either gender's all other BLS cases were significant ($P < .0001$). The differences in percent of either gender's needlesticks and either gender's employment were also significant ($P < .0001$ for both genders). Clinical significance suggested that men and women percentages for needlesticks were more similar to those for employment than to those for all other injuries. By contrast, 33% of all other injuries occurred among women.

Thirty-three percent of needlestick cases did not report race. This was consistent with all other injuries but not with employment data. The percentages for race in Table 1 applied only to cases for which race was reported. The percentage differences between needlesticks and all other injuries were statistically significant ($P < .0001$) for white and black non-Hispanic but not for Hispanics or ''other'' races. The percentage differences between needlesticks and employment were statistically significant for white, non-Hispanic ($P < .001$), Hispanics ($P < .0001$), and ''other'' races ($P < .001$) but not for black, non-Hispanic.

The age patterns revealed that needlesticks were more frequent in 25 to 34 year olds ($P < .0001$) and less frequent in 20 to 24 ($P < .0001$) and 55 to 64 year olds ($P < .0001$) than all other BLS cases for the same age brackets. Needlestick injuries were higher for ages 14 to 19 years ($P < .001$), 20 to 24 years ($P < .001$), and 25 to 34 years ($P < .001$) and lower for 45 to 54 years ($P < .001$), 55 to 64 years ($P < .001$), and 65+ years ($P < .001$) than employment percentages for these same groups.

Table 2 ranks occupations with the greatest number of cases. Information was available for 43 occupations. Table 2 contains information on only 23 occupations for which the contribution to all needlesticks was 0.5% or more. Occupations were divided into 4 categories depending on clinical, dental, and health care status. Combining all categories, the occupations with

Table 1. Demographic characteristics of persons with needlesticks and employment

	Needlesticks (1992-2003)		All other BLS injuries, percent (1992-2003)	Employment in health services (1999-2001)	Bonferroni *P* values	
Demographic variable	**Number of cases**	**Percent within category (95% CI)**	**Percent within category (95% CI)**	**Percent within category (95% CI)**	**Needle vs BLS**	**Needle vs employment**
Sex						
Male	2857	26.5 (25.7%-27.3%)	65.9 (65.9%-65.9%)	21.8 (21.7%-21.8%)	<.0001	<.0001
Female	7909	73.3 (72.5%-74.2%)	33.2 (33.1%-33.2%)	78.3 (78.2%-78.3%)	<.0001	<.0001
Not reported	22	0.2 (0.1%-0.3%)	0.9 (0.9%-0.9%)	0.0 (0.0%-0.0%)	<.0001	<.0001
Race and ethnicity*						
White, non-Hispanic*	4496	69.3 (68.1%-70.4%)	71.8 (71.7%-71.8%)	77.0 (77.0%-77.0%)	<.0001	<.0001
Black, non-Hispanic*	958	14.8 (13.9%-15.6%)	12.0 (12.0%-12.0%)	15.8 (15.8%-15.8%)	<.0001	.2159
Hispanic*	894	13.8 (12.9%-14.1%)	13.6 (13.6%-13.6%)	7.2 (7.2%-7.2%)	.9999	<.0001
All other*	143	2.2 (1.9%-2.6%)	2.6 (2.6%-2.6%)	na	.3900	na
Not reported*	3172	na*	na*	na*	na*	na*
Age, yr						
14-19	386	3.6 (3.3%-4.0%)	3.7 (3.7%-3.7%)	2.3 (2.3%-2.3%)	.9999	<.0001
20-24	979	9.2 (8.7%-9.8%)	12.4 (12.4%-12.4%)	7.3 (7.3%-7.4%)	<.0001	<.0001
25-34	3307	31.2 (30.3%-32.1%)	28.9 (28.8%-28.9%)	22.9 (22.9%-22.9%)	<.0001	<.0001
35-44	3607	34.0 (33.1%-34.9%)	27.0 (27.0%-27.0%)	29.5 (29.4%-29.5%)	<.0001	<.0001
45-54	1812	17.1 (16.4%-17.8%)	17.1 (17.1%-17.1%)	24.8 (24.8%-24.9%)	.9999	<.0001
55-64	407	3.8 (3.5%-4.2%)	7.8 (7.7%-7.8%)	10.7 (10.7%-10.7%)	<.0001	<.0001
65+	0	0 (0.0%-0.0%)	1.2 (1.2%-1.2%)	2.5 (2.5%-2.5%)	<.0001	<.0001
Not reported	106	1.0 (0.8%-1.2%)	2.0 (2.0%-2.0%)	0.0 (0.0%-0.0%)	<.0001	<.0001

*Percents for race ignored "not reported"; they applied only to cases for which race or ethnicity could be assigned.

greatest frequencies of needlesticks included registered nurses, nursing aides and orderlies, janitors and cleaners, licensed practical nurses, and maids and housemen. There was breadth in the nonhealth care occupations including farm workers, laborers, and garbage collectors.

Table 2 also includes data on employment within the health services industry and ratios of number of needlestick cases divided by an estimate of employment for 1992-2002, measuring risk. The rankings with greatest to least risk were as follows: biologic technicians, janitors and cleaners, maids and housemen, clinical laboratory technologists and technicians, licensed practical nurses, physician assistants, registered nurses, dental assistants, laundry and dry cleaning machine operators, nursing aides and orderlies, dentists, and physicians.

Table 3, upper panel, presents data on length of service on the job for needlesticks and all BLS injuries. Needlesticks were more likely to occur in the ''less than 3 months'' category and less likely to occur in the ''greater than 5 years'' category when compared with all other injuries ($P < 0001$). Table 3, lower panel, presents data on 3 measures of workdays lost with all other injuries appearing more serious by typical measures of severity.

Fingers (54%) and hands and wrists (17%) were the most frequent injured body part. Less than 1% of all other BLS cases involved fingers. Eighty percent of needlesticks occurred in the services sector compared with 23.59% of all other injuries (Table 4).

DISCUSSION

Most results were consistent with expectations and literature. First, from a clinical (not statistically significant) perspective, needlestick patterns were expected to follow employment patterns. For example, in categories in which needlestick percentages were high (women, white, non-Hispanic, ages 35 to 44 years) employment percentages were also high. Second, prior literature found that high percentages of body parts involved fingers and hands.[12,15,17] Third, the great majority of cases were in the health services industry.

Whereas the exclusively health care literature suggested that nurse (registered nurses and licensed practical nurses combined) was the most frequent occupation, this literature differed on estimates of the percentage contribution of nurses to all needlesticks. Estimated percentages from the literature were as follows: 45%,[10] 46%,[12] 58%[13] (including aides), 39%,[14] 40% to 44%,[15] 29%[16] (outside hospitals), 45%[16] (inside hospitals), 45%,[17] 42% to 74%,[18] and 44%.[19] Estimates in this study were not directly comparable because workers outside health services were included. If this study temporarily assumed that nurses only work in health services and that health services accounted for 80% of all needlesticks and that both

Table 2. Needlesticks by occupation*

Occupation		Needlesticks		Employment in health services, 1999-2001 combined†	Ratio, number in needlesticks divided by estimate of employment 1992-2002‡ times 100,000
Code #	Description	Number of cases combining years 1992-2002	Percent contribution of this occupation to all cases§ (95% CI)	Number and percent (95% CI)	Ratio (95% CI)
I. Health care workers, clinical, nondental					
1. 095	Registered nurses	1804	22.27 (21.36%-23.18%)	5,490,650; 15.60 (15.59%-15.62%)	8.96 (8.55-9.37)
2. 447	Nursing aides, orderlies, attendants	915	11.29 (10.60%-11.98%)	3,232,890; 9.19 (9.18%-9.20%)	7.72 (7.22-8.22)
3. 207	Licensed practical nurses	838	10.34 (9.68%-11.00%)	1,662,660; 4.72 (4.72%-4.73%)	13.75 (12.82-14.68)
4. 208	Health technologists and technicians, n.e.c.	617	7.62 (7.04%-8.20%)	na	na
5. 203	Clinical laboratory technologists and technicians	475	5.86 (5.35%-6.37%)	759,300; 2.16 (2.15%-2.16%)	17.06 (15.53-18.60)
6. 106	Physicians assistants	68	0.84 (0.64%-1.04%)	151,100; 0.43 (0.43%-0.43%)	12.27 (9.36-15.19)
7. 223	Biological technicians	62	0.77 (0.58%-0.96%)	11,860; 0.03 (0.03%-0.03%)	142.57 (107.11-178.04)
8. 446	Health aides, exc. nursing	51	0.63 (0.46%-0.80%)	na	na
9. 084	Physicians	45	0.56 (0.40%-0.72%)	542,290; 1.54 (1.54%-1.55%)	1.51 (1.07-1.95)
II. Health care workers, clinical, dental					
1. 445	Dental assistants	204	2.52 (2.18%-2.86%)	666,110; 1.89 (1.89%-1.90%)	8.35 (7.21-9.50)
2. 085	Dentists	62	0.77 (0.58%-0.96%)	149,440; 0.42 (0.42%-0.43%)	7.54 (5.67-9.42)
III. Health care workers, nonclinical					
1. 453	Janitors and cleaners	901	11.12 (10.44%-11.80%)	282,770; 0.80 (0.80%-0.81%)	86.9 (81.23-92.57)
2. 449	Maids and housemen	779	9.62 (8.98%-10.26%)	712,450; 2.02 (2.02%-2.03%)	29.82 (27.73-31.91)
3. 444	Miscellaneous food preparation occupations	156	1.93 (1.63%-2.23%)	na‖	na‖
4. 438	Food counter, fountain and related occupations	90	1.11 (0.88%-1.34%)	na‖	na‖
5. 748	Laundering and dry cleaning machine operators	50	0.62 (0.45%-0.79%)	109,320; 0.31 (0.31%-0.31%)	8.32 (6.01-10.62)
IV. Nonhealth care workers					
1. 479	Farm workers	270	3.33 (2.94%-3.72%)	na‖	na‖
2. 021	Managers, service occupations, n.e.c.	81	1.00 (0.78%-1.22%)	na‖	na‖
3. 475	Managers, farms, exc. horticultural	68	0.84 (0.64%-1.04%)	na‖	na‖
4. 518	Industrial machinery repairers	66	0.81 (0.64%-1.01%)	na‖	na‖
5. 889	Laborers, nonconstruction	63	0.78 (0.61%-0.97%)	na‖	na‖
6. 628	Supervisors, production occupations	52	0.64 (0.47%-0.81%)	na‖	na‖
7. 376	Investigators and adjusters, exc. insurance	51	0.63 (0.46%-0.80%)	na‖	na‖

exc., excluding; *n.e.c.*, not elsewhere classified.

*Data from 20 additional occupations with less than 0.5% contribution to all needlesticks available from authors. Some of these 20 included grounds keepers, animal caretakers, textile sewing machine operators, garbage collectors, purchasing agents, truck drivers, secretaries, stock handlers, hairdressers, cashiers, baggage porters, and forestry scientists.

†All Bonferroni *P* values to compare needlesticks with employment were $<.0001$.

‡Several occupations were eliminated based on authors' judgment that the few number employed within health services compared with outside health services would render any risk ratio irrelevant. Eliminated occupations included industrial machinery repairs, grounds keepers and gardeners, animal caretakers, garbage collectors, hairdressers and cosmetologists, cashiers, and file clerks.

§This percent applied to the contribution of a particular occupation to all cases. It does not mean, for example, that 22% of registered nurses experienced needlesticks.

‖Occupations not relevant for exclusively health services.

registered nurses and licensed practical nurses were in the nurse category, then results from this study implied that 41.25% of all needlesticks in health services was experienced by nurses. In the one study not restricted to only health care, registered nurses and licensed practical nurses accounted for 36% and 1%,

Table 3. Length of service and days away from work

	Needlestick	All other BLS injuries	
	Percent of cases (95% CI) 1992-2003	Percent of cases (95% CI) 1992-2003	Bonferroni *P* value
Length of service at job			
Less than 3 mo	14.58 (13.92%-15.25%)	12.72 (12.70%-12.73%)	<.0001
3-11 mo	20.43 (19.67%-21.18%)	18.61 (18.60%-18.63%)	<.0001
1-5 yr	34.63 (33.73%-35.53%)	32.81 (32.79%-32.83%)	.0003
Greater than 5 yr	19.19 (18.44%_19.33%)	26.29 (26.27%-26.31%)	<.0001
Not reported	11.17 (10.58%-11.77%)	9.58 (9.56%-9.59%)	<.0001
Days away from work			
Percent of cases eporting exactly 1 day lost	30.63 (29.76%-31.49%)	15.96 (15.94%-15.98%)	<.0001
Percent of cases reporting 31 or more days lost	7.04 (6.56%-7.53%)	20.46 (20.44%-20.48%)	<.0001
Median number of days lost	3 days	5 days	na

respectively.[9] This last study, while nationally representative, was limited to a sample of the roughly 10% of incidents reported to emergency departments and did not separate needlesticks from other work-related bloodborne pathogens exposures.

No literature consensus exists beyond nurses. A number of studies listed ''clinical laboratory technicians,'' or ''technicians,'' or ''lab technicians'' and ''technologists'' as high on the list of occupations sustaining needlesticks. Estimates included 15%,[10] 9% to 15%,[13] 20%,[14] and 15%.[19] Again, assuming that 80% of needlesticks occurred within health services and assuming that all health and clinical laboratory technologists and technicians worked in the health services sector and combining with clinical laboratory technologists and technicians, this study estimated that 17% of needlesticks were attributed to technologists and technicians within the health services industry. Finally, physicians and housekeepers were frequently mentioned in the literature. Estimates for physicians[9,14,15,18-20] included a low range of 0% to 26%[18] and a high of 32%.[14] Estimates for housekeepers included 17%,[10] 11% to 18%,[13] and 3%.[15,19] Shiao et al addressed the special needs of housekeepers and other support personnel.[23] Even without adjustment for needlesticks in health services, this study's results suggested a lower percentage contribution for physicians (1%) and a higher contribution for housekeepers (janitors and cleaners, maids, and housemen) (20%).

This study had some unique demographic findings. Prior literature on race could not be found. Whereas some studies reported median or mean ages, only one[9] reported age brackets. Our study was the first to report that smaller percentages of needlesticks occurred among persons over age 54 years than either all other BLS injuries or employment in health services.

This study had unique findings on occupation. Only 2 published studies[9,24] presented data on dental professionals. The literature was frequently ambiguous regarding whether nursing aides, orderlies, and attendants were included in the ''nurses'' category or were ignored altogether. This study explicitly included aides, orderlies, and attendants. This study also added to the sparse literature on risks by occupation.[9,13]

Additional unique occupational findings related to nonhealth care workers seldom mentioned in the needlestick literature: laborers, garbage collectors, secretaries, stock handlers, clerks, food preparers,

Table 4. Industry

	Needlestick	All other BLS injuries*
Category	Percent of cases for 11 years 1992-2002, (95% CI)	Percent of cases for 11 years 1992-2002, (95% CI)
Agriculture	5.13 (4.68%-5.57%)	2.13 (2.12%-2.13%)
Mining	0 (0%-0%)	0.87 (0.86%-0.87%)
Construction	0.16 (0.08%-0.24%)	10.23 (10.22%-10.25%)
Manufacturing	3.04 (2.69%-3.39%)	24.39 (24.38%-24.41%)
Transportation and public utilities	2.38 (2.07%-2.68%)	11.34 (11.32%-11.35%)
Wholesale trade	1.58 (1.33%-1.84%)	7.56 (7.55%-7.57%)
Retail trade	3.78 (3.39%-4.16%)	17.49 (17.47%-17.50%)
Finance, insurance, real estate	3.63 (3.25%-4.01%)	2.41 (2.41%-2.42%)
Services	80.31 (79.51%-81.12%)	23.59 (23.57%-23.61%)

*All Bonferroni *P* values comparing needlesticks with all other BLS injuries were <.0001.

cashiers, and farm workers (''animal handlers'' in Sepkowitz[11]). This study found that 20% of needlesticks occurred outside the health services industry. An estimated 600,000 to 800,000 needlesticks occurred within the health services industry each year for an annual cost of $188 million.[25,26] This study suggested that, nationwide, 25% (25%=20%/80%) or roughly 150,000 to 200,000 needlesticks occurred outside the health services industry for a cost of $38 million.

Some unique occupational findings were the result of rigorous BLS data collection efforts that classified over 800 census occupation codes. Census codes are useful because social science researchers frequently analyze them.[27,28] Future researchers should consider using census codes.

Given new needlestick laws and new safety syringes from 1992 to 2003, a downward trend in injuries or ratios of injuries to employment was expected. The fact that neither was found was attributed to sampling variation and other limitations (below) and underscored the importance of combining many years of data. However, the only other study with national data found a 15%, but statistically insignificant, increase in work-related pathogens exposures from 1998 to 2000.[9]

There were limitations. The majority of needlesticks likely did not require 1 or more days of lost work time and were therefore unavailable. Our lost work time data were likely to be serious injuries. BLS acknowledged the exclusion of the following groups: self-employed individuals; farms with fewer than 11 employees; all private household workers; and federal, state, and local government workers. These were significant exclusions. During 1992-2003, 15% of employed people were federal, state, or local government workers, and 7% were self-employed.[29] This study's results on physicians might be due to the fact that 57% of physicians were self-employed.[30] There also might have been issues involving employee and employer reporting of needlestick incidents.[1,31-33] This study counted from 674 to 1532 annual needlesticks during 1992-2003, whereas the Centers for Disease Control and Prevention estimated that annual needlesticks were 600,000 to 800,000.[25]

A limitation involved data record keeping. As with all survey data, nonsampling error might have occurred because of the large number of firms that provided data despite BLS efforts to minimize error. This study analyzed data from both Source and Event codes and data from 1992 through 2003 that relied on large samples to minimize error. It was reassuring that data from both codes were similar regarding relative magnitudes.

Whereas employment data covered private sector and government employees, injury data did not include government employees. This might have resulted in bias, given that some hospitals are government institutions. Statistical tests for differences between needlesticks and employment percentages were somewhat problematic because employment data included, but injury data excluded, government workers, and 20% of needlesticks occurred outside the health services industry. Finally, BLS record-keeping changes occurred in 2001, but the changes had minimal effects on recorded needlesticks.

The limitations above are important. However, the Annual Survey is a national database with consistent, ongoing, data collection techniques covering many years. If the biases that affected these data were present in the demographic and job categories considered, then this study was justified in comparing statistics across these same categories. Moreover, the BLS data have been used in highly regarded medical studies.[34-36] Finally, the BLS data are widely used in social science research, particularly in analyzing relative magnitudes across demographic and occupational categories.[27,28]

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