

Epidemiology of needlesticks and other sharps injuries and injection safety practices in the Dominican Republic

Pedro L. Moro, MD, MPH,^a Arelis Moore, MD,^b Patricia Balcacer, MD,^c Alex Montero, MD,^c Delissa Diaz, MD,^c Virgen Gómez, MD,^d Zacarias Garib, MD,^b and Bruce G. Weniger, MD, MPH^a
Atlanta, Georgia, and Santo Domingo, Dominican Republic

Background: Contaminated sharps, such as needles, lancets, scalpels, broken glass, specimen tubes, and other instruments, can transmit bloodborne pathogens such as HIV, hepatitis B (HBV), and hepatitis C viruses (HCV).

Methods: Observation of facilities and injections and questionnaire-guided interviews were conducted in 2005 among health care workers (HCWs) in 2 public hospitals in Santo Domingo and 136 public immunization clinics (IC) in the Dominican Republic. Injection practices and sharps injuries (SIs) in health care facilities in the Dominican Republic were assessed in cross-sectional surveys to identify areas in which preventive efforts might be directed to make injection practices safer.

Results: Of the 304 hospital HCWs and 136 ICs HCWs interviewed, 98 (22.3%) reported ≥ 1 SIs during the previous 12 months. ICs had a lower incidence (13 per 100 per person-years [p-y]) of SIs than hospitals (65 per 100 p-y) ($P < .0001$). Unsafe needle recapping was observed in 98% of all injections observed at hospitals but in only 12% of injections at ICs ($P < .0001$). Sharps were observed improperly disposed in regular waste containers in 24 (92%) of 26 areas at which injections are prepared at the hospitals but in only 11 (8%) of 136 ICs ($P < .0001$). Training in injection safety was received by 4% of HCWs in hospitals but by 77% in ICs ($P < .001$). Of 425 HCWs, 247 (58%) were fully immunized against hepatitis B. There was a higher risk of SIs among staff dentists (adjusted relative risks [aRR], 5.9; 95% confidence interval [CI]: 2.8-12.6), resident physicians (aRR, 3.5; 95% CI: 1.8-6.9), and those who gave ≥ 11 therapeutic injections per day (aRR, 1.6; 95% CI: 1.1-2.4).

Conclusion: Injection practices at ICs were safer than those found at public hospitals. Preventive strategies to lower SIs in public hospitals should include regular training of hospital staff to minimize needle recapping and improper disposal, among other interventions to reduce the dangers of needles. (Am J Infect Control 2007;35:552-9.)

Contaminated sharps, such as needles, lancets, scalpels, broken glass, specimen tubes, and other instruments, can transmit bloodborne pathogens such as human immunodeficiency virus (HIV), hepatitis B virus (HBV), and hepatitis C virus (HCV). Transmission of bloodborne pathogens to patients, health care workers (HCWs), and community members can occur from non-sterile injections, accidental needlesticks, and improper

“recycling” of needles and syringes.¹⁻³ It has been estimated that 66,000 HBV, 16,000 HCV, and 1000 HIV infections attributable to contaminated sharps injuries among HCWs may occur annually worldwide.⁴ Several epidemiologic studies have described the risks and circumstances of needlestick and other sharps injuries (SI) among health care personnel but mostly in developed countries.^{5,6} Few such studies are from the Americas, and none are from the Caribbean.

The Expanded Program for Immunization (EPI) in the Dominican Republic has developed guidelines for safe injections that include proper injection technique (eg, no recapping of used needles before disposal in safety boxes), use of sharps boxes or other puncture-proof containers, and proper final disposal of sharps waste, similar to those recommended by the World Health Organization.⁷ However, anecdotal reports suggest universal precautions on injection practices may not be followed regularly in the Dominican Republic. A high prevalence of HBV infection has been reported there, with 4.1% chronic carriers among adult blood donors.⁸ The prevalence of HCV infection was reported to be 2.6% in males and 2.2% in females.⁹ HIV/AIDS is also a problem, with a seroprevalence in 2002 of 1.0% of the population.¹⁰ With this prevalence of bloodborne pathogens, the potential exists for their transmission to HCWs workers as a result of unsafe injection practices.

From the Immunization Safety Office,^a Centers for Disease Control and Prevention, Atlanta, GA; Programa Ampliado de Inmunización,^b Secretaría de Estado de Salud Pública y Asistencia Social (SESPAS), Santo Domingo; Facultad de Ciencias de la Salud,^c Escuela de Medicina, Universidad Nacional Pedro Henríquez Ureña (UNPHU), Santo Domingo; and Departamento de Enfermedades Infecciosas,^d Hospital Infantil Dr. Robert Reid Cabral, Av Abraham Lincoln No 2, Santo Domingo, República Dominicana.

Address correspondence to Pedro L. Moro, MD, MPH, Immunization Safety Office, Centers for Disease Control and Prevention, 1600 Clifton Rd, MS-D26, Atlanta, GA 30333. E-mail: psm9@cdc.gov.

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Given the paucity of data on needlestick injuries and the absence of a surveillance system to monitor needlesticks and sharps injuries in the Dominican Republic, we surveyed HCWs and injection safety practices in facilities in which injections occur to understand better the epidemiology of SI and to identify areas in which preventive efforts can be targeted.

MATERIALS AND METHODS

Study sites

Hospitals in Santo Domingo. A random sample among 1098 HCWs who provide direct patient care in general public hospital A (260 beds) and pediatric public hospital B (350 beds), both in the capital, Santo Domingo, were asked to participate in the study during October through December 2005. These hospitals were deemed representative of other public general and pediatric hospitals in Santo Domingo but were selected for convenience, not randomly. Santo Domingo has 6 other public hospitals and several private hospitals.

Immunization clinics in the Dominican Republic. This part of the study took advantage of planned supervisory visits at public immunization clinics (ICs) throughout the country by the EPI of the Dominican Republic Ministry of Health. Questions were added to a routine programmatic data collection instrument. A total of 136 ICs in the 8 health regions of the country were surveyed. These were located within 59 primary health centers, 42 municipal hospitals, 25 provincial hospitals, and 10 regional hospitals. Primary health clinics are staffed by 1 to 3 HCWs and provide basic health care services, generally in rural areas. Municipal hospitals provide a broader range of health services and are located in urban areas. Provincial and regional hospitals provide more sophisticated services. ICs at primary health centers (59/720) and municipal hospitals (42/112) were selected by convenience sampling. All of the 10 ICs at regional hospitals and 81% of the 31 ICs at provincial hospitals were included.

Injection safety questionnaire in Santo Domingo

A questionnaire to assess injection safety and sharps disposal practices in the 2 hospitals was prepared based on standardized tools developed by the World Health Organization (WHO),^{11,12} with additional questions included. The questionnaire was piloted in a small number of HCWs whose experience guided its final version. It included questions on HCW occupation and the differing numbers of therapeutic, vaccination, and phlebotomy injections administered on average each day; procedures performed; the number of SI during the previous 12 months; their circumstances; and

medical care during or following the most recent SI. The questionnaire also gathered data on the frequency of 2-handed recapping of needles, how needles and syringes are disposed following injections, HCWs reported history for adult tetanus and hepatitis B vaccination, previous training on injection safety, and knowledge of bloodborne pathogens transmitted through unsafe injections. HCWs were also asked whether they were aware of any such infections among coworkers or patients following a SI. A sample of 304 (28%) of a total of 1098 HCWs who provide injections or handle sharps at the 2 facilities were interviewed face-to-face during a 2-week period. HCWs included staff physicians, resident physicians, staff dentists, nurses, and laboratory technicians. Excluded were administrative personnel, who did not handle used sharps, as well as laundry and janitorial staff, per hospital management policy.

Injection safety questionnaire for immunization clinics

A similar but shorter questionnaire was administered to HCWs at 136 ICs outside of Santo Domingo as part of an instrument used for supervisory oversight. EPI workers attended a 1-day training session at which the instrument was explained. Data collection took place during a 4-week period in September 2005. For each IC, the HCW who reported administering the most injections was interviewed by an EPI worker.

Observation of facilities

Unannounced visits were made to all 138 study sites to observe and document the preparation and administration of injections and the disposal of used sharps. Twenty-six of 52 injection preparation areas at hospitals A and B were visited. Observations were conducted according to WHO guidelines.^{11,12}

Ethical approval

The study was exempted from human subjects review by the Institutional Review Board of the Centers for Disease Control and Prevention because no personal identifiers were collected and no questions were considered sensitive. Similarly, because of the nature of the questionnaire and the observational aspects, there was no requirement for review in the Dominican Republic by ethics committees of the hospital facilities studied, only review by their directors, who approved the study. EPI authorities approved the study for its ICs.

Data analysis

Epi Info version 3.3.2 (Centers for Disease Control and Prevention, Atlanta, GA) was used for data entry,

Table 1. Incidence in person-years of sharps injuries and proportion of health care workers sustaining ≥ 1 reported sharps injury in the previous 12 months, by facility type, Dominican Republic, 2005

Occupation	Facilities											
	Hospital A			Hospital B			Hospitals A and B			Immunization clinics		
	Incidence (per 100 p-y)	PI (no.)	N	Incidence (per 100 p-y)	PI (no.)	N	Incidence (per 100 p-y)	PI (no.)	N	Incidence (per 100 p-y)	PI (no.)	N
Resident physician	244	47% (16)	34	73	41% (9)	22	177	44.6% (25)	56			
Staff dentist				144	67% (6)	9	144	66.7% (6)	9			
Nurse	54	32% (29)	92	35	23% (14)	60	47	28.3% (43)	152	14	10% (12)	122
Staff physician	4	2% (1)	51	39	29% (9)	31	17	12.2% (10)	82	0	0%	2
Laboratory technician	0	0%	4				0	0%	4			
Other [†]				0	0%	1	0	0%	1	8	17% (2)	12
Total	75	25% (46)	181	50	31% (38)	123	64.8	27.6% (84)	304	13*	10% (14)	136

p-y, Person-years; PI, proportion injured; (no.), number injured; N, number surveyed.

*The incidence of sharps injuries at immunization clinics was significantly lower than the incidence at facilities A or B ($P < .0001$).

[†]Other occupations include outreach workers and health promoters

descriptive epidemiology, and analyses such as the frequencies of SI and injection safety practices among HCWs. The incidence of SI was calculated by summing the total number of sharps injuries reported in the last 12 months and dividing by the person-years (p-y) contributed by the study participants for this window of interest. The proportion of injured HCWs was the number of HCWs who had at least 1 SI during the last 12 months divided by the total number of respondent HCWs.

Unadjusted relative risks and their 95% confidence intervals (95% CI) were calculated to identify risk factors associated with SI. Significant ($P < .05$) or marginally significant associations ($P < 0.1$) were further examined by log-binomial regression models¹⁵ using STATA software version 8.0 (Stata Corporation, College Station, TX) to determine adjusted relative risks (aRR) and the individual contribution of each factor. Each factor or variable was subdivided and coded as 0 for the grouping of lowest risk and 1 for the grouping of highest risk. Factors examined as predictors of SIs included being a staff dentist (no, 0; yes, 1), being a resident physician (no, 0; yes, 1), being a staff physician (no, 0; yes, 1), being a nurse (no, 0; yes, 1), number of therapeutic injections given per day (≤ 10 injections, 0; ≥ 11 injections, 1), number of vaccinations given per day (≤ 10 vaccinations, 0; ≥ 11 , 1), number of phlebotomy procedures performed each day (≤ 10 procedures, 0; ≥ 11 procedures, 1), number of patients seen each day (≤ 5 patients, 0; ≥ 6 patients, 1), facility at which health care worker is employed (immunization clinics, 0; hospitals A or B, 1), training in injection safety (≥ 2 training sessions, 0; ≤ 1 session, 1), 2-handed needle recapping after an injection (never or rarely, 0; always or generally, 1).

A log-binomial regression analysis was performed first in a full model using manual selection of all

covariates, followed by backward reduction of variables for the final model. At each step, the variable with the largest P value was removed from the model. This process was repeated until all the variables had a P value of $\leq .05$. If removal of a variable affected the aRR of any of the other variables by 10% or more, that variable was considered a confounder and retained in the final model.¹⁴

Estimates of bloodborne infections

We used a spreadsheet tool developed by the World Health Organization to estimate the burden of disease caused by sharps injuries among HCWs.¹⁵ We applied estimated HBV, HCV, and HIV/AIDS infection prevalence rates from published sources.⁸⁻¹⁰ Census data for the Dominican Republic were obtained from its National Statistical Office.¹⁶

RESULTS

A total of 98 (22.3%) of 440 HCWs from hospitals and ICs reported 1 or more sharps injury (SI) during the previous 12 months. ICs had a lower incidence of SIs (13 per 100 p-y; $P < .0001$) than general hospital A (75 per 100 p-y) or pediatric hospital B (50 per 100 p-y; Table 1). Resident physicians and staff dentists reported the highest incidence of SI, 177 and 144 per 100 p-y, respectively.

Among injection practices reported by study participants (Table 2), recapping a needle after use in a patient was reported always by 274 (90.7%) of 302 HCWs at public hospitals but by only 5 (4%) of 133 HCWs at ICs ($P < .0001$). Sharps were reported discarded into regular waste by 26.2% (79/301) of HCWs at public hospitals but by only 5% (6/133) at ICs ($P < .001$). There was no association between SI and type of container used for sharps disposal. Only 4.3%

Table 2. Reported characteristics, experience, and injection safety practices of health care workers at public hospitals A and B and immunization clinics in the Dominican Republic

	No. of HCWs (%)	
	Hospitals A and B	Immunization clinics
Occupation		
Nurse	152 (50.0)	122 (90)
Staff physician	82 (27.0)	2 (1)
Resident physician	56 (18.4)	0
Staff dentist	9 (3.0)	0
Laboratory technician	4 (1.3)	0
Other	1 (0.03)	12 (9)
Total	304 (100)	136 (100)
Average therapeutic injections given per day		
Less than 11 injections	195 (64.1)	116 (85)
≥ 11 Injections	109 (35.9)	20 (15)
Total	304 (100)	136 (100)
Average vaccinations given per day		
None	293 (96)	2 (2)
1-9 Vaccinations	9 (3)	40 (30)
≥ 10 Vaccinations	2 (1)	91 (68)
Total	304 (100)	133 (100)
Needle recapping after use in patient		
Always	274 (90.7)*	5 (4)
Sometimes	20 (6.6)	21 (15)
Never	8 (2.6)	107 (81)
Total	302 (100)	133 (100)
Use of specified containers to dispose sharps		
Designated commercial sharps box or puncture-proof other container	216 (71.8)	125 (94)
Nonpuncture-proof other container	6 (2.0)	2 (1)
Regular waste	79 (26.2)*	6 (5)
Total	301 (100)	133 (100)
Received training in safe injection practices		
Never trained	213 (70.1)	1 (1)
1 Session	78 (25.6)	28 (22)
≥ 2 Sessions	13 (4.3)*	99 (77)
Total	304 (100)	128 (100)

*A higher number of HCWs at facilities A and B reported to always recap a needle following an injection and discard sharps with regular waste, compared with HCWs at immunization clinics ($P < .0001$). Fewer HCWs at facilities A and B received training in safe injection practices than HCWs at immunization clinics ($P < .0001$).

(13/304) of HCWs in the hospitals reported receiving training in safe injection practices, in contrast to 77% (99/128) of HCWs at ICs ($P < .0001$). All HCWs were knowledgeable about bloodborne pathogens transmitted through unsafe injection. Seventeen (5.6%) of 304 HCWs at the hospitals indicated reuse of syringes and/or needles in the same patient. Fifteen explained this was done to save money or when equipment was scarce or not available (reuse in different patients was denied).

Only 247 (58%) of all HCWs reported being fully immunized with 3 doses of hepatitis B vaccine (Table 3). Only 45% of nurses at hospitals A and B were fully

immunized against HBV in contrast to 65% of nurses at ICs ($P < .01$). Overall, 94% of HCWs at hospitals A and B reported having been vaccinated as adults against tetanus. Tetanus immune status was not assessed at ICs.

Observations of injections and sharps disposal

In public hospitals in the Dominican Republic, injections are generally prepared in small rooms adjacent to the hospital wards, and used sharps are discarded in ad hoc puncture-proof containers but not in boxes designed specifically for sharps. In contrast, ICs are supplied with sharps boxes by the EPI but may use recycled puncture-proof containers (eg, plastic gallon beverage containers) when these are unavailable. In the hospitals and ICs, the health care facility provided the injection equipment for all injections observed. In the 2 hospitals, only 8% of HCWs were observed to wash their hands prior to the injection session (Table 4). No evidence of needle and syringe reuse in patients was observed. On occasion, dried medication was reconstituted with fluid removed from bags of intravenous solution without preservatives.

Two-handed recapping of needles after administering injections was observed in 58 (98%) of 59 injections at hospitals A and B but only in 11 (12%) of 95 injections at ICs ($P < .0001$). In the hospitals, used needles and syringes were not observed discarded into regular waste immediately following an injection. However, later, they were observed in regular waste in 92% of the injection preparation areas in public hospitals but in only 8% at ICs ($P < .0001$). Sharps were observed in nonpuncture-proof containers in 81% of the injection areas at the hospitals but in only 14% of ICs ($P < .0001$).

Injection and disposal practices were similar among all types of IC (data not shown); however, presence of sharps on the floor and in areas surrounding the facility were observed more frequently in ICs in municipal hospitals than those in primary health centers (33% and 16%, respectively; $P = .05$). HCWs in ICs at primary health clinics were less likely to have received 3 or more doses of HBV vaccine (52%) than HCWs in ICs at municipal hospitals (76%) ($P = .01$). Recapping ($P = .002$) and the presence of sharps on the floor ($P = .02$) were more frequently observed at ICs in region 4 (Enriquillo, in the southwestern corner of the country) than in any of the other health regions.

Risk factors for SI

Initial univariate analysis found the following variables associated with SI among HCWs: being a staff dentist, being a medical resident, giving more than 10 therapeutic injections per day, being a nurse at

Table 3. Percentage of health care workers who reported ever receiving hepatitis B and adult tetanus vaccine at public hospitals A and B and immunization clinics in the Dominican Republic, 2005

Occupation	HBV vaccine (%)					Tetanus vaccine (%)		
	Not known	Never	1 Dose	2 Doses	3 + Doses*	Yes*	No	Not known
Hospital HCWs								
Staff dentist (n = 9)	11	0	0	11	78	89	0	11
Laboratory technician (n = 4)	0	0	0	25	75	100	0	0
Staff physician (n = 82)	1	12	2	20	66	95	1	4
Resident physician (n = 56)	0	9	4	23	64	100	0	0
Nurse at hospitals A and B (n = 152)	5	28	6	17	45	92	3	5
Hospital subtotal (n = 303)	2.9	18.8	4.2	18.8	55.4	58.1	1.7	4.0
Immunization clinics/Nurses (n = 122)	2	12	3	18	65 [†]	NA [‡]	†	
Total (n = 425)	2.5	16.9	4	18.5	58.1	94.1	1.7	4.0

*Percentage of participants fully immunized with 3 or more doses of HBV and tetanus vaccine.

[†]A significantly higher percentage of nurses was fully immunized at immunization clinics than nurses at facilities A and B combined ($P < .01$).

[‡]Nurses at IC were not asked for their history of tetanus vaccination.

Table 4. Observations of injection practices at public hospitals A and B and immunizations clinics in the Dominican Republic, 2005

Observations	Facilities			
	Hospitals A and B		Immunization clinics	
	Number observed/total observations	%	Number observed/total observations	%
Handwashing prior to injection session	6/76	8	Not observed	Not observed
Recapping following an injection	58/59	98*	11/95	12
Container in which sharps were discarded immediately following an injection				
Designated commercial sharps box or puncture proof other container	58/62	94	87/102	85
Nonpuncture proof other container	1/62	2	6/102	6
Regular waste	0/62	0	9/102	9
Other, unknown	3/62	5		

*Recapping, was more often observed at hospitals A and B than at immunization clinics ($P < .0001$).

hospitals A or B, being any kind of HCW in hospital A or B, performing 11 or more phlebotomies per day, and performing recapping (Table 5). Having attended more than 1 training session in safe injections, giving 11 or more immunizations per day, and being a staff physician were protective for SI. The results of the log-binomial regression analysis confirmed that being a staff dentist (aRR, 5.9; 95% CI: 2.8-12.6), being a resident physician (aRR, 3.5; 95% CI: 1.8-6.9), and giving 11 or more therapeutic injections per day (aRR, 1.6; 95% CI: 1.1-2.4) were significantly associated with SI.

Estimates of bloodborne infections among HCWs

By extrapolating from our survey using the Dominican Republic population of 8,562,541,¹⁶ national prevalence rates,⁸⁻¹⁰ and the WHO spreadsheet tool,¹⁵ we estimated that nationwide each year 8 HCWs (range,

1-32) would acquire HBV infection, 6 (range, 2-35) would acquire HCV, and 1 (range, 0-5) would acquire HIV/AIDS as a result of occupational sharps injuries.

DISCUSSION

We found that safe injection practices were followed more often by HCWs at ICs than by HCWs in the studied public hospitals in the Dominican Republic. This difference probably contributed to our finding an SI incidence rate 5 times lower in ICs than in public hospitals.

Two-handed recapping of a needle after patient use—considered a dangerous practice—and disposal of sharps with regular waste were reported and observed in both types of facilities, although these practices were markedly more frequent in the hospitals than the ICs. Interviews with HCWs revealed that, when puncture-proof containers are unavailable,

Table 5. Risk factors associated with sharps injuries in health care workers who experienced a SI during the previous 12 months, by univariate and log-binomial regression analysis

Characteristic	Injured HCW No. (%)	Univariate analysis uRR (95% CI)	Full model aRR (95% CI)	Final model aRR (95% CI)
Occupations				
Staff dentist	6 (67)	3.1 (1.9-5.2)	5.8 (2.7-12.3)	5.9 (2.8-12.6)
Resident physician	25 (45)	2.4 (1.7-3.4)	3.8 (1.7-8.4)	3.5 (1.8-6.9)
Nurse in hospitals A or B	43 (29)	1.5 (1.1-2.1)	1.8 (0.9-3.7)	1.9 (0.9-3.9)
Nurse at immunization clinic	12 (10)	0.4 (0.2-0.7)	1.7 (0.2-12.8)	1.7 (0.2-13.1)
Staff physician	10 (12)	0.4 (0.2-0.8)	Ref	Ref
Any kind of health care worker in hospital A or B	84 (27.7)	2.7 (1.6-4.6)	1.2 (0.1-10.3)	1.1 (0.1-8.6)
Performed ≥ 11 phlebotomies per day	18 (43.9)	2.2 (1.5-3.3)	0.9 (0.4-1.7)	-
Recapping after use in patient	84 (26.3)	2.5 (1.4-4.4)	0.8 (0.3-2.2)	-
Giving ≥ 11 therapeutic injections per day	41 (35.3)	2.0 (1.4-2.8)	1.7 (1.1-2.5)	1.6 (1.1-2.4)
Giving ≥ 11 vaccinations per day	11 (11.5)	0.5 (0.3-0.8)	0.9 (0.4-2.5)	-
Attended ≥ 2 training sessions in safe injection practices	10 (9)	0.3 (0.2-0.6)	0.5 (0.2-1.1)	0.5 (0.2-1.1)

uRR, unadjusted relative risk; aRR, adjusted relative risk; CI, confidence intervals; Ref, referent group.

some admit discarding sharps with regular waste. This practice was confirmed by observation at injection preparation areas in public hospitals, at which sharps were frequently seen with regular waste or in containers not designed for used sharps. In contrast, only a few ICs were noted to discard sharps into regular waste. This finding may be explained by a more regular supply of sharps boxes or other puncture-proof containers by the EPI.

We found that HCWs who received 2 or more training sessions in safe injection practices had a lower frequency of SIs than those workers who trained once or not at all. This may partly explain the lower rate of SIs among HCWs at ICs. Others have found that training in safe sharps handling may increase compliance with certain precautionary measures¹⁷ and that training combined with an intervention may decrease the number of needlestick accidents.¹⁸ More frequent training at ICs may partly explain the lower rate of SIs.

Although most HCWs were knowledgeable about bloodborne pathogens transmitted through unsafe injections, reuse of a needle in the same patient was reported by some at the hospitals. The practice we saw of reconstituting dried (lyophilized) medication using intravenous solution from bags that do not contain preservatives has been associated with fatal outbreaks of nosocomial infections from overgrowth of microorganisms in the bags, presumably seeded by needles used to withdraw their fluid, in Brazil, Egypt, and Mexico.¹⁹⁻²¹ This practice has also been reported to occur in most Santo Domingo hospitals, but its extent is not fully known (P. Balcacer, personal communication, 2005).

Only 63% of survey participants reported being vaccinated with 3 full doses of hepatitis B vaccine despite its availability free of charge to HCWs in the Dominican Republic. Of particular concern is that only 47% of

nurses at public hospitals and 64% of resident physicians reported receiving the 3 full doses of HBV vaccine. This immunization coverage contrasts with the HBV vaccine coverage rate in infants of 87% for 2005 as a result of its recent inclusion in the routine immunization schedule.²² This low coverage, coupled with a high incidence of SIs in these groups (Table 1), places these HCWs at very high risk for HBV disease.

In log-binomial regression analysis, HCWs who administered 11 or more therapeutic injections per day had on average more than one-and-a-half the risk of SIs than those who administered fewer therapeutic injections. Paradoxically, giving 11 or more vaccinations per day at ICs was associated with a lower risk in the initial univariate analysis (but not statistically significant on multivariate analysis). Immunizations are often given at a fixed station in the IC, and this practice may explain this trend toward a lower risk. Therapeutic injections, on the other hand, are often given at different hospital locations using various types of needle syringes, with the HCW moving from patient to patient, increasing the risk of injury.

The risk of SIs for staff dentists and resident physicians was 6 and 3 times higher, respectively, than staff physicians. This higher risk may be attributable to the number of risky procedures performed. HCWs who performed 11 or more phlebotomies per day were found to have a higher risk of SIs than those who performed fewer or none, but the unadjusted relative risk became nonsignificant in the final regression model. Univariate analysis also found that HCWs at public hospitals had an almost 3-fold higher risk of SIs than HCWs at ICs. This may also be explained by the type and number of procedures performed at the 2 types of facilities. Potential confounders that might explain the observed differences between public hospitals and ICs—but not

explored in this study—include extended work duration and injections in uncooperative patients.^{23,24}

This study has a number of limitations. Participating HCWs may not be representative of all HCWs exposed to sharps. Other workers exposed to used sharps and at risk of SIs—cleaning and laundry personnel—were excluded by hospital management. In one study conducted in a Peruvian hospital, laundry personnel were almost 5 times as likely to sustain a sharps injury than any other occupational group.²⁵ Although facilities A and B were believed typical of other public hospitals in Santo Domingo in bed size, number of employees, and type of procedures performed, they may differ in some other ways unknown to the investigators. Our results cannot be generalized to private medical clinics and hospitals in Santo Domingo or to public hospitals outside of Santo Domingo. Because we interviewed HCWs regarding events in the previous 12 months, there is the potential for recall bias over this window of interest, which may result in over- or underestimation. We relied on self-reports for vaccination status instead of medical records review, which would likely be more accurate. There is also a possible “Hawthorne effect”²⁶ that, while under observation, some HCWs may have modified their responses and injection practices toward the norm.

Our estimates of the burden of bloodborne infection among HCWs resulting from SIs in the Dominican Republic are based on several assumptions and generalizations,¹⁵ which may affect their accuracy. The use of similar but nonidentical questionnaires by different study personnel may have affected the comparability of results between the two types of health care facilities. Finally, as a cross-sectional study that collected information at a given point in time, it was not possible to ascertain cause and effect. However, the strong associations between unsafe injection practices and needle-stick injuries in this study suggest that the former predispose to the latter.

Compliance with universal precautions can minimize SIs.^{7,27,28} Best practices that can help prevent infections among injection recipients, HCWs, and the community include (1) use of a sterile syringe and needle for each injection, (2) avoidance of 2-handed recapping after sharps use in a patient, (3) collection of sharps waste in safety containers at the point of use, and (4) proper sharps disposal.^{7,27} Although universal precautions are the standard of practice now in Dominican Republic ICs, this study revealed that unsafe injection and disposal practices continue to occur and predispose to SIs and environmental contamination with sharps.

In contrast to ICs, much higher rates of unsafe practices and SIs were observed in hospitals. Preventive strategies to reduce sharp injuries and the risk of bloodborne infections to HCWs in hospitals would include

adopting universal precautions policy, increasing the availability of sharps boxes, improving sharps waste management, training on safe injections, and increased hepatitis B vaccination.

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