J Occup Health 2009; 51: 132–136

Journal of Occupational Health

Chinese EPINet and Recall Rates for Percutaneous Injuries: An Epidemic Proportion of Underreporting in the Taiwan Healthcare System

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Abstract: Chinese EPINet and Recall Rates for Percutaneous Injuries: An Epidemic Proportion of Underreporting in the Taiwan Healthcare System: Judith Shu-Chu SHIAO, *et al.* Department of Nursing, National Taiwan University, College of Medicine and NTU Hospital, Taiwan—Objectives: As an occupational injury, percutaneous injury (PI) can result in chronic morbidity and death for healthcare workers (HCWs). A pilot surveillance system for PIs using the Chinese version of Exposure Prevention Information Network (EPINet) was introduced in Taiwan in 2003. We compared data from EPINet and recall of PIs using a cross-sectional survey for rates to establish the reliability of the new system. **Methods:** HCWs from hospitals that had implemented EPINet for ≥12 months completed a survey for recall of contaminated PIs sustained between October 2004 and September 2005, type of item involved, and reasons for reporting or not reporting the PI. Comparative data from EPINet for the same period were analyzed. **Results:** The EPINet rate, 36.1/1,000 HCW (95%CI 31.8–41.1) was almost 5 times lower (p<0.0001) than the PI recall rate for 2,464 HCWs of 170/1,000 HCWs (95%CI 155.4–185.5). Approximately 2.5 PIs were recalled for every 1,000 bed-days of care. The recall rate by physicians was 268.3/1,000, 188.5/1,000 for nurses, 88.9/1,000 for medical technologists and 81.3/1,000 for support staff. Hollow-bore needle items most commonly recorded on EPINet includ, disposable needles and syringes were underreported by 81%, vacuum tube holder/needles by 67%, and arterial blood gas needles by 75%. Nearly 63% of the reasons for underreporting were related to the complexity of the reporting process, while 37% were associated with incorrect knowledge about the risks associated with PIs. **Conclusions:** EPINet data underestimates a commonplace occupational injury with nearly four in five PIs not reported. Addressing the real barriers to reporting must begin with hospital administrators impressing on HCWs that reporting is essential for designing appropriate safety interventions.
(J Occup Health 2009; 51: 132–136)

Key words: Epidemiology, Healthcare workers, Percutaneous injuries, Surveillance, Underreporting

Percutaneous injuries (PIs) include needlestick and injuries from sharp devices. They are a serious occupational health and safety concern globally for healthcare workers (HCWs) including the estimated 180,000 HCWs employed in the 420 accredited hospitals around Taiwan[1)]. This preventable injury remains by far the most common cause of occupational transmission of bloodborne infection in HCWs in highly resourced countries[2, 3)] as well as Southeast Asia[4, 5)], despite efforts to reduce PIs in recent years[6–8)]. Many lowly and highly resourced healthcare systems have not yet introduced routine measurement of PIs and associated seroconversion rates.

In Taiwan, a barrier to the use of routine surveillance was overcome with the development of a Mandarin version of the Exposure Prevention Information Network (EPINet) surveillance software. In 2004, a pilot for the routine surveillance using EPINet was introduced in 36 pilot sites in Taiwan[1)]. To establish the reliability of the EPINet database compared EPINet reports with rates

Received Aug 8, 2008; Accepted Jan 7, 2009
Published online in J-STAGE Feb 18, 2009
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estimated from a commonly used method, a survey for the recall of PIs over the same period. This opportunity was taken to establish whether particular sharp devices were associated with reporting bias and to examine reasons for underreporting associated with EPINet.

Subjects and Methods

EPINet

Between January 2004 and June 2005, the Center for Medical Employee Safety and Health, invited all 420 hospitals accredited by the Department of Health, Taiwan in 2004, to participate in a surveillance program of PIs (for detailed methodology see Shiao *et al.*)[1]. Eligible hospitals collected surveillance data on PIs using the Mandarin version of the EPINet for at least 12 mo. Details of hospitals using EPINet were provided by 36 hospitals and 14 were chosen using stratified random selection to ensure representation of primary, secondary, and tertiary hospitals from five Taiwanese health regions, north, central, mid-south, south, and east. The study was approved by the institutional review board of each participating hospital.

Recall

Healthcare workers, supporting personnel and laboratory staff from the above chosen hospitals were invited to complete an anonymous survey to report using recall PIs they experienced during the same period EPINet PI data were collected. Survey questionnaires were delivered to 4,358 physicians, nurses, support personnel and medical technologists via representatives of each hospital and collected by the same person one week later. The response rate for the survey was 56.5% (2,464/4,358), physicians 30.8% (164/533), nursing staff 87.6% (1,735/1,980), suppor personnel 49.6% (295/595), and medical technologists 57.2% (270/472).

The survey included items about: the frequency of PIs with contaminated sharps in the 12 months, between 01 October 2004 and 30 September 2005, the type of needle involved in the injury, whether the episode was reported, and if not reported, the reasons for not reporting the incident. Test-retest reliability of the survey, separated by 2 wk, with a sample of 20 cases from the participating hospitals prior to this study was found to be high (r=0.90). he validity and reliability of PI data collection using the Mandarin EPINet have been previously reported[1].

Statistic methods

The rate of reported PIs using the EPINet system was expressed as the number of PIs reported on the EPINet divided by the number of HCWs employed during October 2004 and September 2005 in the study sites and expressed as a percentage. The recalled PI rate was calculated from the number of PIs reported by the survey divided by the number of healthcare workers who participated in the survey, and expressed as a percentage. The frequency and comparison of proportions for the reporting behavior were examined by job category, attending to a prevention program and items involved in PIs using the JMP 5.0 statistical package (SAS Institute Inc. Cary, NC. 1989–2002). The rationale for the Pratt's method using the F distribution to calculate 95% Confidence Intervals (95%CI) was its accuracy for all sample sizes[9]. Pearson's correlation was used for the comparisons of not reported PIs identified from the questionnaire and those episodes reported on EPINet for the same period, specific comparisons included the frequency of PIs, location and devices associated with the PI, and mechanism of injuries. An estimate of the true number of PIs was calculated by multiplying the reciprocal of the underreporting rate of PI given in the survey by the number of PIs reported to EPINet. Chi-square and Fisher's Exact Test were used to calculate the difference between the rates with alpha set at the 5% level.

Results

EPINet rates

Nine hospitals from four districts volunteered to provide an average 6,226 full-time equivalent HCWs for an average 88,673 bed-days between January 2004 and September 2005 (Table 1). The PI rate estimated using EPINet data was 36.1/1,000 HCW (95%CI 31.8–41.1) (Table 2). Approximately 2.5 PIs occurred (255/88,673, 2.54/1,000 HCWs, 95%CI 2.23–2.89) every 1,000 bed-days of care. EPINet records showed significantly more PIs sustained by nursing staff than by physicians (59.5/1,000 nursing staff and 26.2/1,000 physicians, p=0.0003).

Recall rates

Conversely, regarding the utilization of EPINet, the highest survey rate was by physicians, at 268.3/1,000 physicians (95%CI 202.2–343.0) which was significantly higher (p=0.0137) than those of nursing staff, 188.5 / 1,000 nurses (95%CI 170.3–207.7), medical technologists, 88.9/1,000 (95%CI 57.8–129.4), and support staff, 81.3/1,000 (95%CI 52.8–118.6).

Comparisons

The EPINet rate of 36.1/1,000 HCWs (95%CI 31.8–41.1) represented 21.2% of the survey rate of 170.0/1,000 HCWs (95%CI 155.4–185.5) (p<0.0001), indicating an underreporting rate of approximately 5 times. The EPINet rates underestimated the survey recall rate for nursing staff by 68.4%, for physicians by 90.2%, for supporting personnel by 86.4%, and for medical technologists by 73.3%.

PI type items

Only 19.1% of the hollow-bore items and 28.6% of the non-hollow-bore items were reported (Table 3).

Table 1. Enrolment and demographics of participating hospitals

Enrolment in EPINet 2004	Hospital code	Location	Bed capacity[1]	One-month total bed-days[2]	Healthcare worker full time equivalence[2]
January	7-002	Mid-South	253	5,313	393
January	7-003	Mid-South	534	7,077	707
February	7-004	Mid-South	650	18,564	301
February	9-001	South	304	553	73
March	6-001	Central	299	4,087	406
April	2-001	North	501	10,036	836
May	7-001	Mid-South	637	16,281	878
August	9-002	South	740	13,508	1,253
September	6-002	Mid-South	739	13,254	1,379
Total	9	4	4,657	88,673	6,226

1. January 2006, 2. Average for 12 months between Oct 2004–Sep 2005.

Table 2. Comparison of the incidence of PI reported during October 2004 to September 2005 to EPINet with PI reported for the same period using an anonymous recall survey in October 2005

Healthcare workers	EPINet		Anonymous survey		Rate Ratio (%) (EPINet rate/ survey rate × 100)	Difference in EPINet and survey rates χ^2 *p*-value
	PI/HCW October 2004–September 2005 N	Rate/1,000 HCW 95% CI	PI/HCWs in survey N	Rate/1,000 HCW 95% CI		
		36.1		170.0		461.35
Total*	225/6,226	31.8–41.1	419/2,464	155.4–185.5	21.2	<0.0001
Physician		26.2		268.3		122.89
	20/762	16.1–40.2	44/164	202.2–343.0	9.8	<0.0001
Nursing staff		59.5		188.5		184.14
	167/2,808	51.3–68.8	327/1,735	170.3–207.7	31.6	<0.0001
Support		11.1		81.3		64.03
personnel	22/1,982	7.0–16.8	24/295	52.8–118.6	13.6	<0.0001
Medical		23.7		88.9		20.16
technologists	16/674	13.6–38.3	24/270	57.8–129.4	26.7	<0.0001

Not including other HCWs not belonging to the listed job categories.

Estimated reporting rates identified the top three hollow-bore needle items. The highest proportion was for vacuum tube holder/needles, 32.9%, followed by arterial blood gas needles, 24.6%, and disposable needles and syringes, 18.8%. The most common reasons for underreporting on EPINet were related to the reporting protocol, 47%, followed by an assumption the patient associated with the PI was not infected with a bloodborne virus, 37%, the HCW had hepatitis B virus antigen or antibody, 28%, too busy, 28%, the HCW thought they were not unfortunate enough to contract a disease, 27% (Table 4). Reasons given for underreporting were related to the reporting process and included an unfriendly protocol, 47%, unaware of the reporting requirements/ mechanism, 13%, or that reporting did not help, 2%. The remaining 37% of reasons were associated with incorrect knowledge about the risks associated with PI.

Discussion

Recall rates will be consistently higher than rates estimated by EPINet databases[2, 6, 10, 11]. The cause of higher recall of PIs may reflect perception rather than reality, yet it is the only rapid, available method of comparison. Given the EPINet rate for all staff is at epidemic levels and accepting the recall rate with reservations, we believe the true rate of PI reflects rates of lowly or moderately

Table 3. PI by type of item reported by EPINet and anonymous survey

Type of Sharps	EPINet		Anonymous survey		Rate ratio %
	PI N	Rate/1,000 HCW (95% CI)	PI N	Rate/1,000 HCW (95% CI)	(EPINet rate/ survey rate 100)
Hollow-Bore needles:	157/6,226	25.2 (21.5–29.4)	325/2,464	131.9 (118.8–145.9)	19.1
Disposable needle & syringe	116	18.6 (15.4–22.3)	244	99.0 (87.5–111.5)	18.8
Vacuum tube blood collection holder/needle	10	1.6 (0.8–3.0)	12	4.9 (2.5–8.5)	32.9
Arterial blood gas	9	1.4 (0.7–2.7)	14	5.7 (3.1–9.5)	24.6
Needle on IV line (includes piggybacks & IV line connectors)	7	1.1 (0.5–2.3)	13	5.3 (2.8–9.0)	20.8
IV catheter stylet	7	1.1 (0.5–2.3)	19	7.7 (4.6–12.0)	14.3
Hypodermic	3	0.5 (0.1–1.4)	3	1.2 (0.2–3.6)	41.1
Winged (Butterfly) steel	3	0.5 (0.1–1.4)	6	2.4 (0.9–5.3)	20.5
Pre-filled cartridge needle & syringe	1	0.2 (0–0.9)	5	2.0 (0.7–4.7)	9.9
Central line catheter	0	0.0	4	1.6 (0.4–4.2)	0.0
Arterial catheter introducer	0	0.0	2	0.8 (0.1–2.9)	0.0
Other vascular catheter	1	0.2 (0–0.9)	1	0.4 (0.0–7.3)	49.3
Spinal/Epidural	0	0.0	2	0.8 (0.1–2.9)	0.0
Other:					
	68/6,226	10.9 (8.5–13.8)	94/2,464	38.1 (30.9–46.5)	28.6
Lancet	27	4.3 (2.9–6.3)	17	6.9 (4.0–11.0)	62.3
Suture needle	19	3.1 (1.8–4.8)	42	17.0 (12.3–23.0)	18.2
Other needle	12	1.9 (1.0–3.4)	21	8.5 (5.3–13.0)	22.3
Needle unknown	8	1.3 (0.6–2.5)	6	2.4 (0.9–5.3)	53.4
Other Syringe	2	0.3 (0–1.2)	8	3.2 (1.4–6.4)	9.2
All PIs	225/6,226	36.1 (31.6–41.1)	419/2,464	170.0 (155.4–185.5)	21.2

Table 4. Reasons given by 166 healthcare workers for not reporting a contaminated PI

Reasons	HCW N	%
Unfriendly reporting protocol	78	47
I assumed the patient associated with the PI did not have a bloodborne virus	61	37
I had either hepatitis B antigen or antibody	46	28
Too busy	46	28
I thought I was not unfortunate enough to contract a disease	45	27
Unaware of reporting requirement or mechanism	22	13
Too stressed to report	16	10
I had been stuck so many times and I have reported in the past	6	4
My colleagues suggested that I would be all right and did not have to worry	5	3
Personal confidentiality	4	2
Believed reporting does not help	4	2
*** Number of Responses/Responding HCWs**	333/166	100

*Multiple answers by 166 HCWs

resourced healthcare systems[12, 13] and is unacceptable when we compare these results with other highly resourced healthcare systems[8, 14–16].

In Australia the underreporting rate has ranged from 4–24%[2]. In 1996–7, PI was at epidemic levels in Taiwan with the majority of injuries, 82%, never reported[10]. Of all injuries at that time, 52% were associated with syringes of which 81% remained underreported[10]. This current investigation showed some improvement in the reporting rate (21.2%), but of incidents still went 78.8% unreported.

The reporting rates were not universally improved for all items. By 2004–5, underreporting associated with syringe injuries the rate of reporting is 19%. Back in 1996–7, 71% of butterfly needles injuries were never reported. This proportion is now 79.5%. While 63% of IV catheter stylet injuries not reported in 1996–7 has risen to 85.7%. Therefore, our survey has highlighted that PIs remain a common occupational injury across both clinical and non-clinical staff, with all staff under-utilizing the new Mandarin version of EPINet.

Our survey found 13% of HCWs were unaware of reporting requirements while in 1996–7 the proportion was 14%; 28% are now too busy to report yet in 1996–7 the proportion was 15%. Nearly a third of HCWs who did not report their PI believed they would not be unfortunate enough to contract a disease, while 27% now use the same rationale for underreporting. In 1996–7, 10% assumed the patient associated with their PI would not have a bloodborne virus and by 2004–5 this rationale was expressed by 37% of HCWs.

The reasons for underreporting have remained similar, and somehow irrational, over the years. This suggests that the Taiwanese healthcare system has improved its work safety culture among HCWs, but still has some way to go. Healthcare workers' behaviour has been the focus of many safety issues such as hand hygiene, however significant and impressive reductions in PIs have been associated with engineering rather than behavioural changes[8, 11, 17]. Nevertheless, HCWs must take some responsibility for their personal safety and report their injuries, while hospital administrations must take the responsibility for a decade during which an unsafe working culture has developed and where complacency about nor reporting is accepted. Underestimated EPINet rates or over-estimated recall rates beg the question—when will rates be high enough for administration to introduce safety equipment devices (SEDs)? No ethical administration could surely choose to remain unaware of the need to supply safety equipment given the high epidemic level of PIs[8, 11, 17, 18].

Acknowledgments: The authors are grateful to the nine participating hospitals of Chinese EPINet. This project is partially sponsored by the Taiwan Institute of Occupational Safety and Health (IOSH94–M305).

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