ORIGINAL ARTICLE

Work-related injury among direct care occupations in British Columbia, Canada

H Alamgir, Y Cvitkovich, S Yu, A Yassi

Occup Environ Med 2007;**64**:769–775. doi: 10.1136/oem.2006.031914

See end of article for authors' affiliations

Correspondence to: Annalee Yassi, Founding Executive Director, Occupational Health and Safety Agency for Healthcare (OHSAH), 301-1195 West Broadway, Vancouver, BC, V6H 3X5; annaleeY@aol.com

Accepted 4 May 2007
Published Online First 23 May 2007

Objectives: To examine how injury rates and injury types differ across direct care occupations in relation to the healthcare settings in British Columbia, Canada.
Methods: Data were derived from a standardised operational database in three BC health regions. Injury rates were defined as the number of injuries per 100 full-time equivalent (FTE) positions. Poisson regression, with Generalised Estimating Equations, was used to determine injury risks associated with direct care occupations (registered nurses [RNs], licensed practical nurses [LPNs) and care aides [CAs]) by healthcare setting (acute care, nursing homes and community care).
Results: CAs had higher injury rates in every setting, with the highest rate in nursing homes (37.0 injuries per 100 FTE). LPNs had higher injury rates (30.0) within acute care than within nursing homes. Few LPNs worked in community care. For RNs, the highest injury rates (21.9) occurred in acute care, but their highest (13.0) musculoskeletal injury (MSI) rate occurred in nursing homes. MSIs comprised the largest proportion of total injuries in all occupations. In both acute care and nursing homes, CAs had twice the MSI risk of RNs. Across all settings, puncture injuries were more predominant for RNs (21.3% of their total injuries) compared with LPNs (14.4%) and CAs (3.7%). Skin, eye and respiratory irritation injuries comprised a larger proportion of total injuries for RNs (11.1%) than for LPNs (7.2%) and CAs (5.1%).
Conclusions: Direct care occupations have different risks of occupational injuries based on the particular tasks and roles they fulfil within each healthcare setting. CAs are the most vulnerable for sustaining MSIs since their job mostly entails transferring and repositioning tasks during patient/resident/client care. Strategies should focus on prevention of MSIs for all occupations as well as target puncture and irritation injuries for RNs and LPNs.

Direct care occupations comprise the largest proportion (58%) of healthcare employees in Canada and consist of registered nurses (RNs), licensed practical nurses (LPNs) and care aides (CAs).[1–3] Engkvist *et al.* (1998) describe a similar grouping of nursing occupations in Sweden with general RNs, state registered nurses (LPNs) and auxiliary nurses (CAs).[4] Such employees work in various settings (acute care, nursing homes and community care) across the healthcare system. These settings, providing care specific to the needs of patients/residents/clients, have very differing task requirements. Due to shortages in the direct care occupations, workers have more opportunities to choose where they prefer to work. While wage differentials may influence recruitment and retention, as Spetz (2003) has noted, wage increases are not viable solutions for resolving the workforce shortages; work conditions were more important for recruiting and retaining personnel.[5] Thus a study of differential risk of injuries for the various direct care occupations in different health settings is warranted.

RNs can work as independent practitioners in all settings or as team members that assign clients and/or client care functions appropriately. LPNs do not work in isolation but as team members and must exercise clinical judgment in accepting assigned client care functions within their own level of competence.[6] In many nursing homes, LPNs have been used interchangeably with CAs. CAs must work with the support of RNs and LPNs in providing help to patients/residents/clients with their activities of daily living (such as assistance with personal hygiene, dressing, eating and mobility). This often involves lifting, transferring and repositioning of patients/residents/clients.

In the health sector across Canada in 2004, 62.5% of RNs were working in acute care, whereas 13.4% were working in community health and 10.5% in nursing homes.[7] Jansen *et al.* (2000) reports that LPNs were predominantly (57%) in acute care, 33% in nursing homes and 10% in community care.[8] CAs were predominantly working in nursing homes with some in community care and a smaller proportion in acute care.[9] In the future, it is likely that more nurses will be required to work in nursing homes or community care because of policy changes that focus on reducing the number of chronic care residents in acute care settings, and an ageing population who will need ongoing care whether in their home, assisted living or nursing homes. RNs and LPNs may choose not to work in these settings if they perceive these work environments have higher injury risks than acute care.

Changes in the nature of care provided to patients/residents/clients and shifts in work patterns have a great impact on the nursing profession.[10] Because of the different tasks and roles for the three nursing occupations within different care settings, each nursing occupation may have different injury experiences.[8 11 12] Identifying these different patterns of injury through subgroup analysis by care types may allow for more effective targeting of prevention efforts, as well as help nursing staff make informed decisions. The aim of the present study was to examine how injury characteristics and incidence among the three nursing occupations differ in relation to acute care, nursing homes and community care settings in British

Abbreviations: BC, British Columbia; CA, care aide; FTE, full-time equivalent; LPN, licensed practical nurse; MSI, musculoskeletal injury; OLAP, On-line Analytical Processing; OSAH, The Occupational Health and Safety Agency for Healthcare; RN, registered nurse; RR, relative risk; WHITE™, Workplace Health Indicator Tracking and Evaluation; WorkSafeBC, Workers' Compensation Board of British Columbia

Occup Environ Med: first published as 10.1136/oem.2006.031914 on 23 May 2007. Downloaded from http://oem.bmj.com/ on April 9, 2024 by guest. Protected by copyright.

Columbia (BC), Canada. Time-at-risk data can provide more accurate injury rates than general rates published by Workers' Compensation Boards in Canada and the USA.

METHODS

The Occupational Health and Safety Agency for Healthcare (OHSAH), established in 1999 and jointly governed by healthcare employers and healthcare unions, has the mandate to reduce workplace injuries, illness and time-loss in the healthcare sector. OHSAH collects injury incident data among healthcare workers through the Workplace Health Indicator Tracking and Evaluation (WHITE™) database. This web-based surveillance system was developed by OHSAH in collaboration with University of British Columbia researchers to facilitate analysis of workplace incidents and injuries, and provide healthcare stakeholders with comparative performance indicators on workplace health and safety. WHITE™ data include: descriptions of incidents; demographics of the workplace and injured worker; contributory factors related to location and circumstance of injury; nature of injury, body part involved, type of device, etc. Detailed analysis (stratified by occupation, age, health sector, location, body part, circumstance, etc.) was possible through an On-line Analytical Processing (OLAP) database that merged WHITE, payroll and WorkSafeBC (formerly Worker's Compensation Board) databases. OLAP can disaggregate productive hours (denominator values) to the individual level and thus enable rates to be linked to any of the variables associated with injury. Data were cleaned and checked for completeness. Payroll data enabled linking time-at-risk (productive hours) with each person and each injury. Ethical permission was obtained through the University of British Columbia ethical review committee. The administrative databases used in OLAP have only encrypted individual identifiers within an operational tracking system.

This analysis includes 1-year incident data for three large health regions from October 2004 to September 2005: Fraser Health, Northern Health and Interior Health. Incidents that resulted in time-loss or medical care were extracted from WHITE™ for direct care occupations, and rates were calculated using productive hours obtained directly from the health regions. Facility productive hours were converted into full-time equivalent (FTE) positions (1879.2 productive hours were deemed equivalent to 1 FTE) and injury rates were expressed as the number of injuries per 100 FTEs. Productive hours are defined as paid and overtime hours minus vacation, sickness absence, time-loss injury and any paid hours not doing regular healthcare task. There is agreement amongst government authorities, health employers and unions that 1879.2 productive hours equate to one FTE position. The generally accepted calculation is 7.2 hours/day for 261 workdays (e.g., excluding weekends and statutory holidays) equal 1879.2 productive hours. In order to adjust for reporting bias, in this study we only examined injury claims that resulted in compensation or medical costs. Poisson regression with Generalised Estimating Equations was used to determine the relative risks for injuries associated with the healthcare subsector (i.e., acute care, nursing homes or community care).

RESULTS

During the study period, there were 2784 injury incidents (time-loss and/or requiring healthcare) among the three nursing occupations: 1697 in acute care, 355 in community care and 732 in nursing homes. These incidents resulted in injury rates (per 100 FTE) of 24.3 in acute care, 15.1 in community care and 31.6 in nursing homes. Table 1 shows that CAs had the higher all-injury rates in every sector with the highest rate in the nursing home sector (37.0). LPNs had the next highest all-injury rate, with greatest injury risk in acute care (30.5), followed by 26.8 in nursing homes. LPNs were under-utilised in community care with no associated time-loss injury incidents. RNs had the lowest all-injury rates with their highest injury risk (21.9) occurring in acute care. There was a trend of lower injury rates with increased age among RNs and CAs in acute care as well as among LPNs and CAs in nursing homes. Overall, female nurses had higher injury rates than their male counterparts for all occupations and health settings with the exception of RNs in acute care.

Table 2 presents the proportion of different injury types for the nursing occupations according to the healthcare setting. Musculoskeletal injuries (MSIs) comprised the highest proportion of injuries for each nursing occupation and in each sector. MSIs can be catagorised as locomoter system accidents or locomotor system diseases without a former accident (e.g., chronic back pain, especially among the CAs). In our data there were no identified locomotor system disease claims, probably because these claims are very rarely allowed, and as such most workers cite specific traumatic events as having precipitated exacerbations and resulting time lost from work. Thus all MSIs were related to a traumatic event. For RNs, MSIs ranged from 75.9% of all their injuries in the nursing homes sector to 52.1% in acute care. For LPNs, MSIs contributed to a very similar proportion of all their injuries in acute care and nursing homes (71.4% and 69.4%, respectively). For CAs, MSIs represented 73% of all their injuries in the nursing home and community care sectors but only 60.8% of injuries in acute care.

Aggregating all the sectors (Table 2), RNs had a higher proportion of total injuries comprised of puncture injuries (21.3%) compared with LPNs (14.4%) and CAs (3.7%). Of note, RNs' puncture wounds comprised a similar proportion of all injuries in acute care and community care, and a lower proportion in long-term care. Irritation and allergy incidents were highest amongst RNs (11.1%) followed by LPNs (7.2%) and CAs (5.1%). Other injuries (the aggregate of burns, cuts, bruises, infections and psychological trauma) were highest amongst CAs (14.7%) followed by RNs (13.7%) and LPNs (7.5%).

Table 3 shows the distribution of ''nature of injuries'' in acute care departments for RNs, LPNs and CAs. Examining total injuries revealed differences across the nursing occupations by department in which injuries occurred and this distribution reflected the utilisation of RNs predominantly in these areas. For RNs the majority of injuries (59.8%) occurred in general medical wards and surgery. For LPNs the majority (41.5%) of injuries occurred in general medical wards although a substantial amount occurred in rehabilitation/extended care (18.5%), surgery/operating room (15.7%) and in infection control and related areas (12.9%).

For CAs the predominant departments for injury were rehabilitation/extended care (38.6%), and infection control and related areas (24.4%).

For RNs the highest adjusted relative risk (RR) for all-injuries was in acute care, but the risk for MSIs was highest in the nursing homes (Table 4). For LPNs the highest relative risk of all-injuries and MSIs was in acute care. For CAs the highest risk of MSIs was in nursing homes compared with acute care. The risk of all-injuries and MSIs was low among RNs and CAs in the community care compared with similar injuries in acute care.

Table 5 presents injury risk by occupations within each healthcare sector. In acute care, CAs had the highest RR of all injuries (RR 1.40, $p < 0.0001$) and MSIs (RR 1.82, $p < 0.0001$) followed by LPNs (RR 1.33, $p < 0.0001$ and RR 1.75, $p < 0.0001$ respectively). In the nursing homes, CAs had twice the injury risk of RNs for all-injuries (RR 2.06, $p < 0.0001$) and

Occup Environ Med: first published as 10.1136/oem.2006.031914 on 23 May 2007. Downloaded from http://oem.bmj.com/ on April 9, 2024 by guest. Protected by copyright.

Table 1 Demographics factors and injury rates by occupational sector for RNs, LPNs and CAs

	Acute care		Community healthcare		Long-term care	
	No. of injuries	Rates per 100 FTE	No. of injuries	Rates per 100 FTE	No. of injuries	Rates per 100 FTE
RN						
Age group (years)						
< 30	145	28.3	5	7.5	1	8.8
30–39	243	25.2	20	8.9	10	15.4
40–49	352	22.3	27	6.2	24	19.9
50–59	305	18.5	42	8.1	41	18.6
⩾ 60	52	17.0	10	9.5	7	10.5
Sex						
Male	64	23.3	4	5.0	1	3.4
Female	1033	21.8	100	7.9	82	18.1
Overall RN	1097	21.9	104	7.7	83	17.2
LPN						
Age group (years)						
< 30	28	30.1	No data	No data	13	34.6
30–39	56	36.9	No data	No data	20	32.8
40–49	75	28.5	No data	No data	21	23.6
50–59	78	28.8	No data	No data	15	21.6
⩾ 60	11	31.4	No data	No data	3	25.6
Sex						
Male	18	23.0	No data	No data	4	22.2
Female	230	31.3	No data	No data	68	27.1
Overall LPN	248	30.5	No data	No data	72	26.8
CA						
Age group (years)						
< 30	26	43.5	17	23.1	40	49.5
30–39	70	34.0	42	26.5	110	42.1
40–49	126	32.4	77	26.2	219	35.7
50–59	114	27.5	89	24.3	193	37.8
⩾ 60	16	21.0	26	26.1	15	15.9
Sex						
Male	31	29.4	14	21.1	19	15.7
Female	321	30.9	237	25.6	558	38.8
Overall CAs	352	30.7	251	25.3	577	37.0
All direct care	1697	24.3	355	15.1	732	31.6

Direct care comprised RNs, LPNs and CAs.
1 FTE represents 1879.2 productive hours.

MSIs (RR 2.16, $p < 0.0001$). Compared with RNs, the injury risk for LPNs was higher for all-injuries (RR 1.43, $p = 0.01$) but for MSIs, the difference in injury risk was not statistically significant (RR 1.28, $p = 0.12$).

DISCUSSION

This is one of the first studies that examined injuries across all direct care occupations by specific healthcare setting with data analysed from a very large healthcare study population. The

Table 2 Nature of injury for RNs, LPNs and CAs by sector of employment

Injury outcome	FTEs	MSI*	Irritation and allergy†	Other injuries (burns, cuts, bruise, psychological trauma)	Puncture
RN					
Acute care	5015	571 [52.1]	136 [12.4]	147 [13.4]	243 [22.2]
Community care	1348	58 [55.8]	5 [4.8]	20 [19.2]	21 [20.2]
Nursing homes	484	63 [75.9]	2 [2.4]	9 [10.6]	9 [10.8]
RN overall	6847	692 [53.9]	143 [11.1]	176 [13.7]	273 [21.3]
LPN					
Acute care	814	177 [71.4]	21 [8.5]	17 [6.9]	33 [13.3]
Community care	9	No data	No data	No data	No data
Nursing homes	269	50 [69.4]	2 [2.8]	7 [9.7]	13 [18.1]
LPN overall	1092	227 [70.9]	23 [7.2]	24 [7.5]	46 [14.4]
CA					
Acute care	1146	236 [60.8]	31 [8.0]	56 [15.9]	29 [8.2]
Community care	992	199 [73.3]	7 [2.8]	37 [14.7]	8 [2.8]
Nursing homes	1561	462 [73.0]	26 [4.3]	80 [13.9]	9 [1.4]
CA overall	3699	897 [69.4]	64 [5.1]	173 [14.7]	46 [3.7]
Direct care	11638	1816 [65.2]	230 [8.3]	373 [13.4]	365 [13.1]

Direct care comprises RNs, LPNs and CAs.
Values in square parentheses represent row percentage for nature of injury.
1 FTE represents 1879.2 productive hours.
*MSI represents any incident (single or multiple nature of injury) that includes MSIs.
†Irritation and allergy represents the combined incidents comprised of the nature of injury: skin irritation, skin/mucous membrane exposure (including eye), eye irritation, allergic response, and respiratory irritation. Other multiple injuries are included with burns, cuts, etc.

Occup Environ Med: first published as 10.1136/oem.2006.031914 on 23 May 2007. Downloaded from http://oem.bmj.com/ on April 9, 2024 by guest. Protected by copyright.

Table 3 Acute care nature of injury by RNs, LPNs and CAs

	MSIs*	Irritation and allergy†	Other injuries‡	Puncture	All injuries
RN					
ICU	47 (8.3)	19 (14.0)	7 (4.8)	22 (9.2)	95 (8.7)
ER	69 (12.2)	20 (14.7)	15 (10.2)	21 (8.8)	125 (11.5)
Rehabilitation/extended care	20 (3.5)	2 (1.5)	5 (3.4)	5 (2.1)	32 (2.9)
General medical	197 (34.7)	50 (36.8)	46 (31.3)	76 (31.8)	369 (33.9)
Surgery/operating room	127 (22.4)	29 (21.3)	38 (25.9)	88 (36.8)	282 (25.9)
Psychiatric	30 (5.3)	3 (2.2)	13 (8.8)	2 (0.8)	48 (4.4)
IC and related	42 (7.4)	6 (4.4)	9 (6.1)	16 (6.7)	73 (6.7)
Other	23 (4.1)	4 (2.9)	7 (4.8)	4 (1.7)	38 (3.5)
Float staff	12 (2.1)	3 (2.2)	7 (4.8)	5 (2.1)	27 (2.5)
Total acute RN	567 [52.1]	136 [12.5]	147 [13.5]	239 [21.9]	1,089
Total non-acute§	4 [50.0]	0	0	4 [50.0]	8
Total RN overall	571 [52.1]	136 [12.4]	147 [13.5]	243 [22.2]	1097
LPN					
ICU	1 (0.6)	0	0	1 (3.0)	2 (0.8)
ER	9 (5.1)	2 (9.5)	1 (5.9)	2 (6.1)	14 (5.6)
Rehabilitation/extended care	37 (20.9)	4 (19.0)	3 (17.6)	2 (6.1)	46 (18.5)
General medical	73 (41.2)	11 (52.4)	6 (35.3)	13 (39.4)	103 (41.5)
Surgery/operating room	28 (15.8)	3 (14.3)	2 (11.8)	6 (18.2)	39 (15.7)
Psychiatric	0	0	1 (5.9)	0	1 (0.4)
IC and related	20 (11.3)	1 (4.8)	3 (17.6)	8 (24.2)	32 (12.9)
Other	3 (1.7)	0	0	0	3 (1.2)
Float staff	6 (3.4)	0	1 (5.9)	1 (3.0)	8 (3.2)
Total acute LPN	177 [71.4]	21 [8.5]	17 [6.8]	33 [13.3]	248
Total non-acute§	0	0	0	0	0
Total LPN overall	177 [71.4]	21 [8.5]	17 [6.9]	33 [13.3]	248
CA					
ICU	1 (0.5)	2 (7.7)	0	0	3 (1.0)
ER	10 (4.8)	2 (7.7)	2 (4.3)	1 (4.2)	15 (5.0)
Rehabilitation/extended care	89 (43.0)	5 (19.2)	20 (43.5)	3 (12.5)	117 (38.6)
General medical	18 (8.7)	2 (7.7)	5 (10,9)	2 (8.3)	27 (8.9)
Surgery/operating room	17 (8.2)	1 (3.8)	2 (4.3)	2 (8.3)	22 (7.3)
Psychiatic	4 (1.9)	1 (3.8)	2 (4.3)	0	7 (2.3)
IC and related	41 (19.8)	10 (38.5)	8 (17.4)	15 (62.5)	74 (24.4)
Other	22 (10.6)	3 (11.5)	6 (13.0)	1 (4.2)	32 (10.6)
Float staff§	5 (2.4)	0	1 (2.2)	0	6 (2.0)
Total acute CA	207 [68.3]	26 [8.6]	46 [15.2]	24 [7.9]	303
Total non-acute§§	29 [59.2]	5 [10.2]	10 [20.4]	5 [10.2]	49
Total CA overall	236 [67.0]	31 [8.8]	56 [18.5]	29 [8.2]	352

ER, emergency room; IC, infection control; ICU, intensive care unit.
CA represents care-aides, nursing assistants, community health workers; IC and related represents infection control, sterile processing, housekeeping, laundry and cleaners.
Values in round parentheses represent acute department column percentages; values in square parentheses represent row percentage for nature of injury.
*MSI represents any incident (single or multiple nature of injury) that includes MSIs.
†Irritation and allergy represents the combined incidents comprised of the nature of injury: skin irritation, skin/mucous membrane exposure (including eye), eye irritation, allergic response, and respiratory irritation.
‡Other injuries include burns, cuts, bruises, psychiatric trauma and unspecified injuries.
§Personnel allocated to various departments to adjust for workload peaks or to replace missing personel.
§§These are home-care RNs and CAs who work from an office in an acute care facility.

Table 4 Association of health sector with the risk of total injuries and MSIs by nursing occupations

Occupation	Sector	% Of occupation	Injury rate per 100 FTE	Adjusted RR for all-injuries (95% CIs)*	Adjusted RR for MSIs (95% CIs)*
RNs	Acute care	73.2	21.9	1.00 (ref.)	1.00 (ref.)
	Community care	19.7	7.7	0.38 (0.33 to 0.43) $p < 0.0001$	0.41 (0.31 to 0.55) $p < 0.0001$
	Nursing homes	7.1	17.2	0.87 (0.62 to 1.21) 0.4046	1.30 (0.80 to 2.10) $p = 0.2897$
LPNs†	Acute care	74.5	30.5	1.00 (ref.)	1.00 (ref.)
	Community Care	No data	No data	No data	No data
	Nursing homes	24.6	26.8	0.81 (0.73 to 0.90) $p < 0.0001$	0.81 (0.77 to 0.86) $p < 0.0001$
CAs	Acute care	31.0	30.7	1.00 (ref.)	1.00 (ref.)
	Community Care	26.8	25.3	0.80 (0.66 to 0.96) $p = 0.0202$	0.96 (0.87 to 1.06) $p = 0.3925$
	Nursing homes	42.2	37.0	1.22 (0.92 to 1.63) $p = 0.1686$	1.42 (1.09 to 1.85) $p = 0.0086$

CA represents care-aides, nursing assistants, community health workers.
Ref., reference.
RRs, 95% CIs and p values were derived from Poisson regression model with generalised estimating equations.
*Adjusted variables: gender and age; health region were treated as cluster variables in the model.
†LPNs were under-utilised in community care. There were very few LPNs requested for community care-posted positions. The combined productive hours in three health regions produced the equivalent of 9 person-years. This indicates that in community care for LPNs there was only enough time-at-risk hours equivalent to a total of nine people across three health regions working full-time for 1 year. The data are insufficient to make any calculations of relative risk.[40]

Occup Environ Med: first published as 10.1136/oem.2006.031914 on 23 May 2007. Downloaded from http://oem.bmj.com/ on April 9, 2024 by guest. Protected by copyright.

Table 5 Association of nursing occupations with the risk of total injuries and MSIs by health sector

Sector	Occupation	FTEs	% in this sector	Adjusted RR all injuries (95% CIs)*	Adjusted-RR MSIs (95% CIs)*
Acute care	RNs	5015	71.9	1.00 (ref.)	1.00 (ref.)
	LPNs	814	11.7	1.33 (1.10 to 1.60) p = 0.0026	1.75 (1.42 to 2.16) p < 0.0001
	CAs	1146	16.4	1.40 (1.20 to 1.64) p < 0.0001	1.82 (1.56 to 2.12) p < 0.0001
	Total acute care	6,975	100%		
Community care	RNs	1,348	57.4	1.00 (ref.)	1.00 (ref.)
	LPN†	9	0.4	No data	No data
	CAs	992	42.2	3.27 (2.44 to 4.37) p < 0.0001	4.76 (4.35 to 5.21) p < 0.0001
	Total community Care	2349	100%		
Nursing homes	RNs	484	20.9	1.00 (ref.)	1.00 (ref.)
	LPNs	269	11.6	1.43 (1.08 to 1.87) p = 0.0112	1.28 (0.94 to 1.75) p = 0.1150
	CAs	1561	67.5	2.06 (1.69 to 2.51) p < 0.0001	2.16 (1.54 to 3.03) p < 0.0001
	Total nursing homes	2314	100%		

ref., reference.
CA represents care-aides, nursing assistants and community health workers.
RRs, 95% CIs and p values were derived from Poisson regression model with generalized estimating equations.
*Adjusted variables: sex and age, health region were treated as cluster variables in the model.
†LPNs were under-utilised in community care. There were very few LPNs requested for community care posted positions. The combined productive hours in three health regions produced the equivalent of nine FTEs.[40]

rates in our study are high compared with published rates by WorkSafeBC, as our rates are calculated from actual productive hours for each occupation and therefore provide a more accurate measure of time-at-risk per person and per accident. WorkSafeBC uses a different denominator that is not comparable. Published rates by Workers' Compensation Boards in Canada and the USA generally report injury rates based on Labor Force Survey denominator values and so the rates are not occupation-specific (including many occupations in a group). These generalised denominator values inevitably dilute the exposure rate by lumping low-risk occupations with high-risk occupations. This leads to lower calculated injury rates. WorkSafeBC also report 'time-loss only' whereas the present study accounted for any injury requiring time-loss or healthcare. Our data included all healthcare workers working in hospitals and nursing homes affiliated to the publicly funded health regions.

Our study findings confirmed that the different risks for occupational injuries may be based on the particular tasks and roles each occupation is required to fulfil within each healthcare subsector.[13 14] This is consistent with MSIs being found as the most common (54 to 71%) type of injury across all direct care occupations in all healthcare subsectors. RNs were the least vulnerable for all-injuries and MSIs. CAs were the most vulnerable occupation for sustaining most work-related injuries. WorkSafeBC (2006) reported that 4040 (60%) of 6731 compensation claims first paid in 2005 within the BC healthcare and social assistance sector, were related to overexertion and bodily motion injuries.[15] Though MSIs comprise the major portion of time-loss injuries, other injuries are also commonly experienced among direct care occupations.[15 16] Injuries not related to musculoskeletal disability (including burns, bruises, abrasions, cuts, punctures, skin/mucous membrane irritation, respiratory irritation, allergies, infections, psychological trauma, etc.) accounted for 40% of compensation claims. Our study examined incidents by nature of injuries (e.g., MSI, puncture, irritation, etc.), whereas the WorkSafeBC reports were typically based on cause of injury (e.g., exertion, fall, machinery, material handling, etc.). As expected, the department in which injuries occurred (Table 3) reflected the different utilisation of each direct care occupation across the acute care departments. The prevalence of injuries specific to each direct care occupation is dependent on the number of people in that occupation in each department, but we present only the relative proportion of injuries across departments because breaking down the number of injuries by three occupations, three sub-sectors and by five injury categories and nine departments would not leave enough data to calculate meaningful rates.

Studies have indicated that work-related MSIs are predominant amongst nurses and other direct care occupations.[17–20] Low back injury is the most frequent MSI in nurses, followed by neck and shoulder problems.[21] Nursing work is physically demanding, requiring heavy lifting, bending and twisting, and other awkward postures that are associated with MSIs.[22–24] Physical demands increase the odds of injury due to creation of compression, rotation and shear forces that exceed body tolerances.[25–29] Psychological job demands can also amplify the effects of physical exertion and thereby increase injury risk.[30–32] Appropriate workplace interventions must be in place to entice direct care occupations so that the different employment subsectors offer comparable work opportunities for direct care healthcare workforce. Our study enables the comparison of injury rates for various types of injury across the healthcare subsectors by occupation and provides guidance on which of them requires higher and urgent attention.

The are several reports of the high risk of work-related MSI among nursing personnel in a number of healthcare settings, including acute care,[5 22] nursing homes[22] and community care settings.[22 33] The US Bureau of Labor Statistics reported that incidence rates in 2004 were 9.7 injuries per 100 FTE for nursing homes and residential care facilities, whereas hospitals had a rate of 8.3.[34] WorkSafeBC (2002)[35] reported higher risk for workers in nursing homes (9.0 injuries per 100 FTE in 2001) compared with acute care (7.0). The higher nursing home injury rates are attributed to the provision of care for more vulnerable elderly residents, who require much lifting and transferring. Fuortes *et al.* (1994)[14] reported that occupational duties requiring twisting and lifting increased the risk of low-back injury by 4.84 times. Bongers *et al.* (1993)[13] as well as Fredriksson *et al* (2002)[25] found that increased exposure to twisting, lifting and diminished recovery time between exposures increased the likelihood of worker injury. RNs and LPNs have medical/nursing/administrative tasks that take priority

Occup Environ Med: first published as 10.1136/oem.2006.031914 on 23 May 2007. Downloaded from http://oem.bmj.com/ on April 9, 2024 by guest. Protected by copyright.

over the lifting and transferring of residents/patients -— the predominant tasks of CAs. Since CAs perform lifting and transferring more frequently than RNs or LPNs and consequently have shorter periods to recover between events, it is expected that CAs would have higher injury rates. Fuortes *et al.* (1994)[14] found the incidence of low-back injury in CAs was 3.3 times higher than in RNs and LPNs. Ostry *et al.* (2003)[36] found that in acute care, LPNs aggregated with CAs were more likely than RNs to experience: any injury (1.59 times), patient-care injury (1.80 times) and violence-related injury (3.25 times). The different tasks between occupations may explain injury differences between occupations and these differences agree with the findings from previous studies using facility-specific data (e.g., Ostry *et al.*).[36] However, as suggested above, facility-specific data produce higher injury rates than rates reported by Workers' Compensation Boards, as the generic denominator data used by Compensation Boards tend to result in lower injury estimates than the actual exposure risk.

Among CAs in the acute care and nursing home sectors and among RNs in acute care, age was found to protect workers from injury. But this relationship might be confounded by experience, healthy worker effect or the fact that older workers were holding safer positions. The relationship of work-related injury and age was explored by the Canadian Institute For Health Information.[37] The average age of the BC nurses (45.8 years) is higher than any other Canadian province and Canada in general (44.6 years).[37] Across Canada in 2004, 36% of the RN were aged $>$ 50 years.[37] Rahim-Jamal (2001)[9] reported that the LPN age distribution in BC was: 2.0% for those $<$ 25 years; 13.3% for those aged 25–34 years; 29.9% for those 35–44 years; and 54.8% for those $\geqslant$ 45 years.

Our study population was largely female and comparable to the overall Canadian nursing workforce. Women represented 95% of the Canadian RN population in 2004 and this sex ratio has been consistent since 1999.[37] The relationship of work-related injuries and sex was similar to results reported by Gluck and Oleinick (1998)[38] as well as Islam *et al* (2001).[39]

We should interpret the findings of this study with some limitations in mind. The study population appears comparable with the workforce in other BC health regions but differences in utilisation of RNs, LPNs and CAs across other health regions may cause differences in injury risk across the healthcare subsectors. A 1-year period also restricted the identification of long-term trends especially for LPNs, since the LPN workforce is in transition from being under-utilised in some healthcare subsectors to being used to full potential in all subsectors. The composition of direct care occupations in the acute care workforce is currently changing to incorporate more LPNs and CAs because of the ageing patient population.

Injuries and disabilities among nurses and nursing shortages tremendously affect the quality of healthcare delivery and create strain on the available healthcare workforce. In BC, there were only 28 289 RNs serving a population of 41 million.[7] The 1 : 148 ratio of RNs to population in BC is lower that the ratios for Prince Edward Island (1 : 100) or Newfoundland/Labrador (1 : 95).[7] The BC ratio has been consistent over the last few years.[7] The ratio of nurses to population is actually worse if we consider the fact that only half of the nurses are working full-time in Canada and BC. Amongst the 28 289 RN in BC, only 14 122 were working full-time in 2004. We did not have data available in this study to measure familiarity with the workplace. It is conceded that familiarity with the workplace would reduce injury rates. This is partially demonstrated by the lower injury rates of older healthcare workers.

BC has fewer LPNs in proportion to RNs than any other province. In 1998, there were 4424 LPNs in BC representing a ratio of 1 LPN : 6.4 RNs compared with the Canadian average of 1 LPN : 3 RNS. More than 80% of LPNs were $>$ 35 years old and 51% were $>$ 45 years old. Jansen *et al* (2000)[7] found that employers under-utilised the following LPN certified competencies: administering oral medications, dressing simple wounds, catheterisations, psychogeriatrics, subcutaneous injections and performing certain assessments. There was a higher utilisation of competencies in: administering topical medications and assisting with deep breathing and coughing.

According to the College of Registered Nurses of BC (CRNBC), RNs are required to complete the baccalaureate training and successful completion of the Canadian Registered Nurse Examination and be a registrant with the CRNBC.[6] LPNs enter practice after completing a 1-year certification programme and the successful completion of the Canadian Practical Nurse Registration Examination.[39] The certification programme has shifted from a task-oriented model to one that emphasises critical thinking and independent problem-solving. To work as an LPN in BC, the worker must be a registrant with the College of Licensed Practical Nurses of BC.[40] The certificate programme for CAs was standardised to 20 weeks and was designed to enable a combined Resident Care Attendant program and Home Support Worker credential.

Prevention of occupational injuries among the healthcare workforce is vital to provide quality patient care service, improve employee morale, and enhance productivity by reducing time-loss and other absenteeism.[41] This study identified vulnerable groups within the nursing occupation across

Main messages

- Time-at-risk databases provide higher occupational injury rates than those published by Workers' Compensation Boards in Canada and the USA.
- Musculoskeletal injuries comprised the majority of time loss injuries in each of the direct care occupations.
- Nursing homes were the setting of highest injury rates for RNs and CAs.
- Acute care was the setting for the highest rates of injuries other than MSIs.
- CAs had the highest injury rates of the direct care occupations especially in nursing homes and community care.

Policy implications

- Time-at-risk databases should be accessed by Workers' Compensation Boards whenever they publish injury rates. The use of Labor Force Surveys as denominator values in calculating injury rates derive low values and misrepresent the actual injury risk for occupational groups.
- With an ageing healthcare workforce it is essential to reduce MSI through environmental design and increased access to lifting devices especially in nursing homes and community care).
- The acute care setting produces the most injuries related to irritation and allergy, burns, cuts, bruises, psychological trauma and puncture injuries. Injury reduction strategies must target a broad spectrum of injury types requiring changes in practice protocols (safe needle technology, injection and needle disposal procedures) as well as MSI reduction as stated above.

Occup Environ Med: first published as 10.1136/oem.2006.031914 on 23 May 2007. Downloaded from http://oem.bmj.com/ on April 9, 2024 by guest. Protected by copyright.

healthcare settings. Results indicate that rather than focusing only on acute care settings, more attention is required to target injury prevention efforts in nursing homes and community care. Among the many factors that increase risk of injury among healthcare personnel are organisation causes (staffing shortages and stress due to organisational change) and individual causes (an ageing workforce and patients, sicker and obese patients, etc.). Due to the increase in chronic diseases amongst the ageing workforce and the ageing care-recipients, the direct care workforce is more susceptible to injury while the ageing patients/residents/clients require more help with activities of daily living.

Our findings indicate that reduction of injuries may be more easily achieved by targeting the high injury rate of CAs. Since MSIs are the prevalent type of injury, opportunities for reduction of injuries can be optimised by ensuring that all direct care occupations, especially older workers, have easy access to equipment (such as floor and ceiling lifts) to reduce stress on muscles, joints and back. With better understanding of the injury risks across occupations and healthcare subsectors, policy-makers, union representatives and compensation officials will be better able to implement strategies to enable direct care workers to choose safer workplaces that match their career goals and interests with the needs of the care-recipient population.

Authors' affiliations

Hasanat Alamgir, Statistics and Evaluation Department, Occupational Health and Safety Agency for Healthcare, Vancouver, BC, Canada
Yuri Cvitkovich, College of Interdisciplinary Studies, University of British Columbia, Vancouver, BC, Canada
Shicheng Yu, Statistics and Evaluation Department, Occupational Health and Safety Agency for Healthcare, Vancouver, BC, Canada
Annalee Yassi, Department of Healthcare and Epidemiology, and Department of Medicine, and Head, Division of Occupational Medicine, University of British Columbia, Vancouver, BC, Canada

Funding:

Competing interests:

REFERENCES

1 **BC Academic Health Council (BCAHC)**. The Health Human Resource planning landscape in BC. *Landscape Report*, 2004. Available from, http://www.bcahc.ca/HHR-PD-LandscapeReport-April04.pdf.
2 **Canadian Institute for Health Information**. Workforce trends of Licensed Practical Nurses in Canada, 2004. Canadian Institute for Health Information (CIHI) Licensed Practical Nurses Database 2005. Available from, http://secure.cihi.ca/cihiweb/products/Workforce_LPN_2004_e.pdf.
3 **O'Brien-Pallas L**, Murphy GT, Laschinger H, *et al.* Canadian survey of nurses from three occupational groups. Building the future: an integrated strategy for nursing human resources in Canada 2005, Available from:http://www.buildingthefuture.ca/e/study/phase1/reports/Step6_ENG_FINAL.pdf.
4 **Engkvist IL**, Hagsberg M, Hjelm EW, Menckel E, Ekenvail L, PROSA study group. The accident process preceding overexertion back injuries in nursing personnel. *Scand J Work Environ Health* 1998;**24**(5):367–375.
5 **Spetz J**, Given R. The future of the nurse shortage: will wage increases close the gap? *Health Affairs* 2003;**22**(6):199–206.
6 **College of Registered Nurses of BC**. Practice expectations: registered nurses and licensed practical nurses. *College of Registered Nurses of British Columbia*, 2005 Pub.No.417. Available from, http://www.clpnbc.org/content_images/documents/practice_expectations_rev_august_2005.pdf.
7 **Canadian Nurses Association**. 2004 Workforce profile of registered nurses in Canada. Workforce Profiles 2005 [cited 2006 September]. Available from, http://www.cna-nurses.ca/CNA/nursing/statistics/2002highlights/default_e.as.
8 **Jansen I**, Hassan N, Greenlaw B, *et al.* Licensed Practical Nurses and Care Aides in British Columbia. *Research on Roles and Utilization*, 2000. Available from, http://www.heu.org/~DOCUMENTS/Miscellaneous/Research/lpncareaidestudy_complete_1.pdf.
9 **Rahim-Jamal S**. Continuing Care workforce: general analysis. *Health Human Resources Unit Research Reports*, 2001. Report HHRU 01: 1W, Available from:http://www.chspr.ubc.ca/files/publications/2001/hhru01-01W.pdf.
10 **Lipscomb JA**, Trinkoff AM, Brady BA, *et al.* Health care system changes and reported musculoskeletal disorders among registered nurses. *Am J Public Health* 2004;**94**(8):1431–35.
11 **Greenlaw B**. Licensed practical nurses: Current utilization. *LPN Utilization*, 2003. Available from, http://www.heu.org/~DOCUMENTS/Miscellaneous/Research/lpn_current_utilization_2003_1.pdf.
12 **Kenney PA**. Maintaining quality care during a nursing shortage using licensed practical nurses in acute care. *J Nurs Care Qual* 2001;**15**(4):60–8.
13 **Bongers PM**, de Winter CR, Kompier AJ, *et al.* Psychosocial factors at work and musculoskeletal disease. *Scand J Work Environ Health* 1993;**19**:297–312.
14 **Fuortes LJ**, Shi Y, Zhang M, *et al.* Epidemiology of back injury in university hospital nurses from review of workers' compensation records and case-control survey. *Occup Med* 1994;**36**:1022–1026.
15 **Workers' Compensation Board of BC**. Browse the 2007 preliminary rates. Key trends for healthcare rate groups. Retrieved November 2006 from, http://www.worksafebc.com/insurance/premiums/2007_prelim_rates/classification/browse_rate_groups/.
16 **Khuder SA**, Schaub EA, Bisesi MS, *et al.* Injuries and illnesses among hospital workers in Ohio: a study of worker's compensation claims from 1993 to 1996. *Occup Environ Med* 1999;**41**(1):53–9.
17 **Ando S**, Ono Y, Shimaoka M, *et al.* Associations of self estimated workloads with musculoskeletal among hospital nurses. *Occup Environ Med* 2000;**57**:211–6.
18 **Daraiseh N**, Genaidy AM, Karwowski W, *et al.* Musculoskeletal outcomes in multiple body regions and work effects among nurses: the effects of stressful and stimulating working conditions. *Ergonomics* 2003;**46**(12):1178–99.
19 **Maul I**, Laubli T, Klipstein A, *et al.* Course of low back pain among nurses: a longitudinal study across eight years. *Occup Environ Med* 2003;**60**:497–503.
20 **Hoogendoorn WE**, Bongers PM, de Vet HCW, *et al.* High physical work load and low job satisfaction increase the risk of sickness absence due to low back pain: results of a prospective cohort study. *Occup Environ Med* 2002;**59**:323–28.
21 **Alexopoulos EC**, Burdorf A, Kalokerinou A. A comparative analysis on musculoskeletal disorders between Greek and Dutch nursing personnel. *Int Arch Occup Environ Health* 2006;**79**(1):82–8.
22 **Menzel NN**. Back pain prevalence in nursing personnel: measurement issues. *AAOHN J* 2004;**52**(2):54–65.
23 **Trinkoff AM**, Lipscomb JA, Geiger-Brown J, *et al.* Perceived physical demands and reported musculoskeletal problems in registered nurses. *Am J Prev Med* 2003;**24**(3):270–5.
24 **Yip YB**. A study of work stress, patient handling activities and the risk of low back pain among nurses in Hong Kong. *J Adv Nurs* 2001;**36**(6):794–804.
25 **Fredriksson K**, Alfredsson L, Ahlberg G, *et al.* Work environment and neck and shoulder pain: the influence of exposure time. Results from a population based case-control study. *Occup Environ Med* 2002;**59**(3):182–8.
26 **Punnett L**, Wegman DH. Work-related musculoskeletal disorders: the epidemiologic evidence and the debate. *J Electromyogr Kinesiol* 2004;**14**(1):13–23.
27 **Forde MS**, Punnett L, Wegman DH. Pathomechanisms of work-related musculoskeletal disorders: conceptual issues. *Ergonomics* 2002;**45**(9):619–30.
28 **Hoozemans MJ**, van der Beek AJ, Fring-Dresen MH, *et al.* Pushing and pulling in association with low back and shoulder complaints. *Occup Environ Med* 2002;**59**:696–702.
29 **Marras WS**, Davis KG, Kirking BC, *et al.* A comprehensive analysis of low back disorder risk and spinal loading during the transferring and repositioning of patients using different techniques. *Ergonomics* 1999;**42**(7):904–26.
30 **Ariens GAM**, Bongers PM, Hoogendoorn WE, *et al.* High physical and psychosocial load at work and sickness absence due to neck pain. *Scand J Work Environ Health* 2002;**28**(4):222–31.
31 **Davis KG**, Marras WS, Heaney CA, *et al.* The impact of mental processing and pacing on spine loading. *Spine* 2002;**27**:2645–53.
32 **Devereux JJ**, Vlachonikolis IG, Buckle PW. Epidemiological study to investigate potential interaction between physical and psychosocial factors at work that may increase the risk of symptoms of musculoskeletal disorder of the neck and upper limb. *Occup Environ Med* 2002;**59**:269–77.
33 **Meyer JD**, Muntaner C. Injuries in home healthcare workers: An analysis of occupational morbidity from a state compensation database. *Am J Ind Med* 1999;**35**:295–301.
34 **Bureau of Labor Statistics**. Workplace injuries and illnesses in 2004. Bureau of Labor Statistics (BLS) 2005, USDL 05–2195. Available from, http://www.bls.gov/iif/oshwc/osh/os/osnr0023.pdf.
35 **Workers' Compensation Board of BC (WorkSafeBC)**. Fact sheet – Workers' Compensation Board of British Columbia Healthcare Projects Forum held at Vancouver, 26 November 2002.
36 **Ostry AS**, Yassi A, Ratner PA, *et al.* Work organization and patient care staff injuries: The impact of different care models for ''Alternate Level of Care'' patients. *Am J Ind Med* 2003;**44**:392–399.
37 **Canadian Institute for Health Information**. Health personnel trends in Canada: 1995 to 2004 (Revised July 2006). Canadian Institute for Health Information (CIHI) Health Personnel Database 2006. Available from, http://secure.cihi.ca/cihiweb/products/Health_Personnel_Trends_1995-2004_e.pdf.
38 **Gluck JV**, Oleinick A. Claim rates of compensable back injuries by age, gender, occupation, and industry: do they relate to return-to-work experience? *Spine* 1998;**23**(14):1572–87.
39 **Islam SS**, Velilla AM, Doyle EJ, *et al.* Gender differences in work-related injury/illness: analysis of workers compensation claims. *Am J Ind Med* 2001;**39**(1):64–91.
40 **College of Licensed Practical Nurses of BC**. Practice guidelines: appropriate utilizations of LPNs. *College of Licensed Practical Nurses of British Columbia*, 2004. Available from, http://www.clpnbc.org/content_images/documents/Appropriate%20Utilization%20of%20LPNs.pdf (accessed September 2006).
41 **IJzelenberg W, Burdorf A**. Impact of musculoskeletal co-morbidity of neck and upper extremities on healthcare utilisation and sickness absence for low back pain. *Occup Environ Med* 2004;**61**:806–10.

Occup Environ Med: first published as 10.1136/oem.2006.031914 on 23 May 2007. Downloaded from http://oem.bmj.com/ on April 9, 2024 by guest. Protected by copyright.