

Potential Allergy and Irritation Incidents Among Health Care Workers

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RESEARCH ABSTRACT

This study describes the types, causes, and outcomes of potential irritation and allergy incidents among workers in British Columbia's health care industry. Data on occupation-induced allergy and irritation incidents were extracted from a standardized database using the number of productive hours obtained from payroll data as a denominator during a 1-year period from three British Columbia health regions. Younger workers, female workers, facility support service workers, laboratory assistants and technicians, and maintenance and acute care workers were found to be at higher risk for allergy and irritation incidents. Major causes of allergy and irritation incidents included chemicals, blood and body fluids, food and objects, communicable diseases, air quality, and latex. A larger proportion of chemically induced incidents resulted in first aid care only, whereas non-chemical incidents required more emergency room visits.

Exposure to potentially hazardous allergens and irritants is frequent for workers in the health care industry, especially those working in acute care settings. During diagnostic and therapeutic procedures, laboratory work, and preparation and remediation activities, workers are exposed to chemicals, radiation, latex, dust, and blood and body fluids. Those involved in cleaning, laundry, painting, plumbing, and maintenance tasks also bear the risk of chemical exposures.

Laboratory workers are exposed to a broad range of chemical reagents; histology technicians are exposed to dyes and stains and pathologists to fixative and preservative solutions. Furthermore, many health care workers are exposed to anesthetic gases. Occupational exposure to medications can cause allergic reactions among nurses and pharmacists. Chemical disinfecting and sterilizing agents are potentially hazardous chemical exposures for health care workers. Techniques such as laser surgery and electro-cauterization and the use of other radiofrequency and high-energy devices can lead to thermal degradation

of tissues. Painters and maintenance workers are exposed to solvents and lubricants, whereas plumbers and workers engaged in soldering are exposed to lead and flux fumes. Housekeeping workers are exposed to soaps, detergents, cleansing agents, and other chemicals. Cooks and food service workers are exposed to broiling and frying fumes and nitrogen oxide emitted by natural gases used as fuel.

Previous studies have reported the long-term effects of certain allergy- and irritation-inducing reagents (Takahashi, Hanaoka, & Pan, 2004; Tsai, Kaye, & Bove, 2006). These studies have investigated such exposures for particular industries (Chou et al., 2004; Kim, Hong, Koh, & Paik, 2006), particular types of agents (Bernstein, 2003; Lutz & Palczynski, 2003; Uter, Schwanitz, Lessmann, & Schnuch, 2001), or specific outcomes (e.g., latex allergy [Filon & Radman, 2006; Liss et al., 1997] or dermatitis [Nettis et al., 2002]). However, despite the constant and serious nature of exposure risk and the significant number of workers in the health care sector, little research in occupational health and safety to date has identified the types of events, causes, or the specific groups of workers at risk of contracting workplace allergies or irritations. This research is a recent Canadian study that investigated all such incidents across the broad range of health care workers. The findings of this study will provide occupa-

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Applying Research to Practice

Time-at-risk databases indicate higher occupational allergy and irritation rates than those published by workers' compensation boards in Canada and the United States. The latter only observe reports that have been compensated, whereas the former include all reports leading to lost work time. Younger workers, female workers, facility support service workers, laboratory assistants and technicians, maintenance workers, and workers at acute care facilities are at highest risk for allergy and irritation events. Chemically induced incidents were the most common cause of potential allergies and irritations. Employers determine the appropriate personal protective equipment for each hazard and provide appropriate training for various safety precautions. Allergy and irritation reduction strategies can decrease incident rates by targeting sensitized worker groups with training and workplace evaluations.

tional health nurses with a guide to improve working conditions for all health care workers.

The Occupational Health and Safety Agency for Health Care (OHSAH), in the Canadian province of British Columbia, collects incident data on injuries and exposures among health care workers from British Columbia health regions through the Workplace Health Indicator Tracking and Evaluation (WHITE) database. This database provides a unique opportunity to investigate chemically induced and other allergy and irritation incidents among workers in the health care industry. Investigations using WHITE data aid in planning prevention efforts to reduce the risk of workplace injury.

DATA SOURCES AND METHODS

WHITE is a web-based surveillance system developed by OHSAH in collaboration with British Columbia health regions. WHITE facilitates the analysis of workplace incidents and injuries to ascertain whether the development of preventive measures is a priority and, if so, what these might be. It is also designed to provide health care stakeholders with comparative performance indicators of workplace health and safety. WHITE data include a description of the incident, demographics of the injured worker, contributory factors related to the location and circumstances of the injury, nature and cause of the injury, and body part involved. Currently, four of British Columbia's six health regions are tracking incidents using WHITE. The health regions encrypt the worker identifier to protect the confidentiality and privacy of each worker.

Affected workers report incidents to their manager or supervisor. Details of the incident are recorded on a triplicate form by the supervisor or manager after the worker

responds to each question. This form mirrors the questions and fields included in the WHITE database. The form is then forwarded to the occupational health and safety department of the relevant health region, where designated staff verify the incident details and ensure the completion of the document. If an incident requires health care or lost time, a portion of the form is sent to the claims department of the workers' compensation board of British Columbia (WorkSafeBC). In the event of work-related injuries, WorkSafeBC collaborates with the affected parties to provide return-to-work rehabilitation, compensation, health care benefits, and a range of other services.

WHITE categorizes incidents by both nature and cause. The system for classification and injury coding was developed by OHSAH in partnership with the health regions and unions. For this analysis, the following standard WHITE "nature of injury" categories were retained:

- Skin irritation.
- Eye irritation.
- Allergic response.
- Respiratory irritation.

The incident can be either self-reported or clinically diagnosed by a physician or occupational health nurse. This study includes both self-reported and clinically diagnosed incidents. Each reported incident was considered a separate case.

Information relating to causal factors was available in the dataset. Chemically induced incidents were identified and presented as a separate set of analyses due to the size of and interest in this problem. In addition, each event had a description variable, which was used to identify the responsible agent or chemical.

The WHITE database can merge incidents with workers' compensation data and payroll data. Detailed analyses (stratified by occupation, age, subsector of employment, and experience) were possible using an On-Line Analytical Processing (OLAP) database that merged WHITE, payroll, and WorkSafeBC databases. The OLAP database computed productive hours (denominator values) for individuals and thus enabled rates to be linked to any of the associated variables. Incident rates per 100 person-years were calculated using the health region payroll productive hours (defined as paid and overtime hours minus vacation, sickness absence, and workers' compensation time). For this analysis, 1 person-year was deemed equivalent to 1,879.2 productive hours (determined by 261 days at 7.2 hours per day).

The data included incidents of three health regions within British Columbia during a 1-year period: April 8, 2005, to March 23, 2006, for regions A and B and January 12 to December 27, 2006, for region C.

The analysis was conducted using Poisson regression with the occurrence of a work-related event acting as the dependent variable to examine its association with other variables: age group, years of experience, subsector (acute, long-term, or community care), job status (full-time or part-time), and occupation. Because workers in the industry are categorized by facility and health region, conventional Poisson regression modeling was not an ap-

propriate statistical technique. As a result, Poisson regression modeling using generalized estimating equations, with facility and health region as the clustering variables, was used to examine associations (Zeger, Liang, & Albert, 1988). Generalized estimating equations provide a method to accommodate correlated data. These datasets may arise from longitudinal studies, in which participants are measured at different points in time, or clustering, in which measurements are taken of participants who share a characteristic, such as facility within the health region. Rate ratios were presented with 95% confidence intervals after adjusting for age, gender, occupation, employment status (part-time, full-time, or casual), subsector (acute, community, or long-term), and facility and health region. Statistical analysis was conducted using SPSS software (version 14.0) with two-tailed significance levels of $p \leq .05$.

RESULTS

During the study period, among 45,733 employees working a total of 23,970 person-years, 707 incidents were reported. The overall rate was 2.95 per 100 person-years. Almost 80% of the incidents occurred in the acute care subsector (3.6 per 100 person-years). Ninety-one percent occurred among female workers (3.1 per 100 person-years), 37% among registered nurses (3.6 per 100 person-years), and 51% among full-time workers (2.7 person-years) (Table 1).

Multivariate models with adjusted rate ratios (Table 1) show that when compared to registered nurses, facility support service workers, laboratory assistants and technicians, and maintenance workers had a significantly higher risk of allergy or irritation incidents. Compared to community care and long-term care workers, acute care workers showed higher rates for such incidents. Compared to younger workers (< 30 years), older workers (40 years and older) had a significantly lower risk of allergy or irritation incidents ($p < .0001$). Female workers were also more likely to report such incidents.

The two most frequent causal categories were identified to be exposure to chemicals and blood and body fluids (Table 2). The chemically induced incidents were analyzed separately because they represented a significant proportion of the reported cases. During the study period, 272 chemically induced incidents resulted in an incident rate of 1.13 per 100 person-years. Almost 82% of such events occurred in the acute care sector (1.41 per 100 person-years). Ninety-one percent occurred among female workers (1.19 per 100 person-years), 25% among registered nurses (0.93 per 100 person-years), and 49% among full-time workers (1.02 per 100 person-years). More than 60% of all such incidents among facility support service workers, laboratory assistants and technicians, and maintenance workers were chemically induced.

For chemically induced incidents, multivariate models with adjusted rate ratios showed that compared to registered nurses, facility support service workers, laboratory assistants and technicians, and maintenance workers had significantly higher risk for allergies and irritation incidents. Compared to acute care workers, community

care and long-term care workers experienced a significantly lower risk. Compared to younger workers (< 30 years), older workers (40 years and older) had a lower risk of chemical incidents ($p < .04$). Female workers were again more likely to report allergy and irritation incidents compared to their male counterparts.

The incident descriptions allowed the researchers to identify some of the responsible chemical agents that resulted in allergy or irritation. Most of the responsible chemical agents could be identified from the incident descriptions provided. Disinfectants and sterilants, including soap, sanitizers, cleaners, and bleach, were responsible for a significant group of chemical incidents. In terms of chemical composition, formaldehyde, quaternary ammonium compound, a mix of ethanol and propanol, and a mix of sulphuric acid, paracetic acid, acetic acid, and hydrogen peroxide were frequently reported. The smell and odor category was also commonly reported as inducing allergies and irritations. Paint and fumes and smoke were responsible for a few incidents.

Among chemically induced incidents, 14.7% resulted in "first aid only" care, compared to 7.13% of non-chemically induced incidents. Chemically induced incidents also resulted in more "report only" injury outcomes compared to non-chemically induced incidents (46% compared to 39%). The two types of incidents were equally likely to result in time lost from work and a visit to a general practitioner. However, a larger proportion of non-chemical incidents required emergency room visits (34.25%). The Figure compares the various outcomes between these two categories.

DISCUSSION

Workers in the health care industry were found to have high reported risks of allergy and irritation incidents. Younger workers, female workers, facility support service workers, laboratory assistants and technicians, maintenance workers, and workers at acute care facilities were found to be the most vulnerable, suggesting that prevention efforts should be prioritized in these areas.

Compared to long-term care and community care facilities, the risks were found to be higher in acute care facilities. The types of jobs performed and the agents handled in hospitals are numerous and diverse. Therefore, this result was expected.

The difference in risk rates between male and female workers could be explained by female workers' increased exposure to hazardous agents or being more likely to report events. Previous studies have shown that women are at higher risk for injury in the health care industry (Ashbury, 1995; Islam, Velilla, Doyle, & Ducatman, 2001; Messing & Mager Stellman, 2006). Additional research studies are needed to understand why women experience these higher reported injury rates.

Regarding age, it was expected that older workers, possibly due to more experience or awareness of potential hazards, would experience fewer allergy and irritation incidents. Further confounding this relationship is the healthy worker effect's association with age (Monson, 1986) or that older workers may have seniority and

Table 1

Number and Rate of Reported Allergy and Irritation and Chemically Induced Incidents by Subsector, Age Group, Experience, Employment Status, Gender, and Occupation

	Allergy and Irritation			Chemically Induced Allergy and Irritation		
	No. of Reported Incidents	Rate (per 100 Person-Years)	Adjusted Rate Ratio (95% Confidence Interval)	No. of Reported Incidents	Rate (per 100 Person-Years)	Adjusted Rate Ratio (95% Confidence Interval)
Subsector						
Acute care	569	3.6	1.00 (ref)	224	1.41	1.00 (ref)
Community care	34	0.8	0.27 (0.18–0.40); $p < .0001$	11	0.27	0.24 (0.12–0.48); $p < .0001$
Long-term care	96	2.9	0.75 (0.55–1.04); $p = .0810$	35	1.06	0.63 (0.39–0.997); $p = .0485$
Age group (years)						
< 30	92	3.9	1.00 (ref)	35	1.47	1.00 (ref)
30–39	178	3.8	0.94 (0.69–1.27); $p = .6861$	50	1.06	0.64 (0.37–1.12); $p = .1196$
40–49	222	2.7	0.63 (0.49–0.81); $p = .0003$	95	1.17	0.62 (0.38–1.01); $p = .0568$
50–59	199	2.6	0.59 (0.45–0.77); $p = .0001$	85	1.13	0.60 (0.34–1.08); $p = .0885$
≥ 60	16	1.3	0.28 (0.16–0.52); $p < .0001$	7	0.58	0.30 (0.12–0.74); $p = .0091$
Experience (years) ^a						
< 1	58	2.7	1.00 (ref)	15	0.69	1.00 (ref)
1–5	269	3.2	1.14 (0.82–1.58); $p = .4244$	113	1.34	1.95 (0.98–3.90); $p = .0570$
6–10	128	3.1	0.96 (0.66–1.39); $p = .8212$	42	1.02	1.10 (0.50–2.42); $p = .8035$
11–15	82	2.4	0.70 (0.48–0.998); $p = .0486$	33	0.98	1.02 (0.49–2.12); $p = .9675$
16–20	105	3.4	0.95 (0.65–1.38); $p = .7836$	41	1.33	1.36 (0.64–2.93); $p = .4259$
> 20	65	2.3	0.65 (0.41–1.00); $p = .0524$	28	1.01	1.05 (0.49–2.25); $p = .9027$
Employment status						
Full-time	360	2.7	1.00 (ref)	134	1.02	1.00 (ref)
Part-time	229	3.7	1.15 (0.95–1.39); $p = .1628$	93	1.50	1.27 (0.94–1.72); $p = .1152$
Casual	118	2.5	0.71 (0.55–0.91); $p = .0078$	45	0.97	0.72 (0.43–1.18); $p = .1919$

Gender									
Male	65	2.1	1.00 (ref)	25	0.79	1.00 (ref)			
Female	642	3.1	1.71 (1.27–2.31); $p = .0004$	247	1.19	2.18 (1.18–4.02); $p = .0129$			
Occupation									
Registered nurse	260	3.6	1.00 (ref)	67	0.93	1.00 (ref)			
Licensed practical nurse	43	3.3	0.87 (0.60–1.26); $p = .4645$	14	1.06	1.13 (0.57–2.23); $p = .7233$			
Care aide	110	2.7	0.83 (0.60–1.15); $p = .2607$	40	0.99	1.12 (0.66–1.92); $p = .6767$			
Facility support services	93	6.4	1.94 (1.31–2.88); $p = .0010$	61	4.21	4.84 (2.48–9.42); $p < .0001$			
Health sciences professional (e.g., OT/PT/SW/Pharm)	71	2.6	0.71 (0.45–1.12); $p = .1382$	31	1.14	1.26 (0.55–2.93); $p = .5831$			
Management and clerk	43	1.2	0.35 (0.25–0.49); $p < .0001$	18	0.51	0.58 (0.32–1.05); $p = .0712$			
Resident or student and unknown	7	0.5	0.17 (0.07–0.41); $p < .0001$	2	0.15	0.20 (0.05–0.87); $p = .0321$			
Maintenance	28	5.9	2.25 (1.09–4.65); $p = .0286$	17	3.58	6.28 (1.92–20.55); $p = .0024$			
Laboratory assistant or technician	29	10.5	2.54 (1.60–4.04); $p < .0001$	8	2.90	2.75 (1.14–6.65); $p = .0247$			
Health services assistant (e.g., Rec or Prog)	23	1.4	0.40 (0.24–0.66); $p = .0004$	14	0.85	1.04 (0.47–2.30); $p = .9298$			

Note. One person-year = 1,879.2 productive hours. The adjusted variables were age group, employment status, gender, and occupation. Health region and facility were treated as the clustering variables in the model. OT = occupational therapist; PT = physiotherapist; SW = social worker; Pharm = pharmacist; Rec = recreational therapist; Prog = program coordinator.

^aExperience group was not put in the same model with age group due to its high correlation with age group.

Table 2
Causes of Allergy and Irritation Incidents

<i>Cause</i>	<i>No.</i>	<i>Percent</i>
Chemical exposure	272	38.47
Blood and body fluid exposure	211	29.84
Food, objects, flowers, cat, etc.	57	8.06
Air quality	39	5.52
Communicable disease	32	4.53
Latex	25	3.54
Multiple causes	19	2.69
Dust or particulate	18	2.55
Aggression	12	1.70
Equipment	10	1.41
Bite: human or animal	8	1.13
Other causes	4	0.56
Total	707	100

work in positions with varying injury risks (Levtak, 2005; Norman et al., 2005; Yassi et al., 1995). Therefore, younger workers starting new jobs may be more susceptible to such incidents. The findings of this study corroborate this theory, yet research probing the effect of age on injury risk is needed to understand why such trends exist and the possible interaction of variables.

Regarding type of occupation, maintenance and facility support service workers were at high risk for chemically induced events, as the task requirements of these jobs expose workers to potential sources of allergy and irritation (Garvey, Roed-Petersen, & Husum, 2003; Rideout, Teschke, Dimich-Ward, & Kennedy, 2005). A large category of incidents involved blood and body fluid exposure. These incidents are detailed elsewhere (Alamgir, Cvitkovich, Yu, Astrakianakis, & Yassi, 2007a; Moloughney, 2001).

Seeking health care or time off was used as an indicator of injury severity in this study. About 7% of these incidents resulted in time lost from work. These incidents were less severe in general than injuries such as musculoskeletal injuries, which usually result in higher rates of time lost from work (Alamgir, Cvitkovich, Yu, & Yassi, 2007b).

The findings of this investigation add to data already reported by WorkSafeBC and other related studies. This study includes all incidents reported by workers, regardless of compensation. As a result of these differences in injury categorization, findings may be difficult to generalize when compared to other published works. The researchers recommend that future investigations conducted for health care workers differ from those reported across other industries, as workplaces differ by task, pace, environment, work processes, and materials

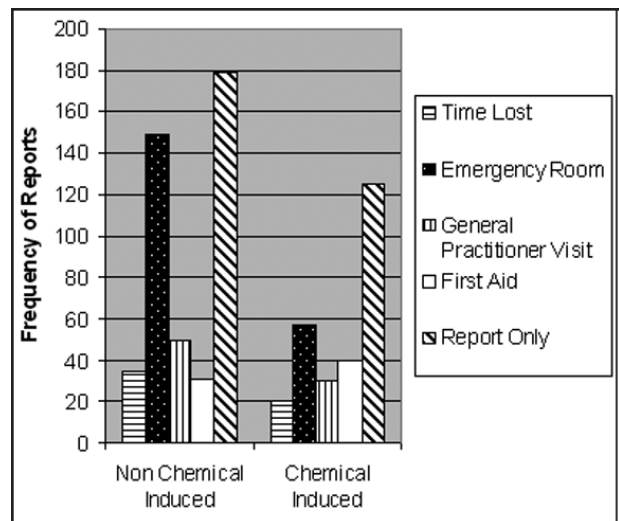


Figure. Outcome of allergy and irritation incidents.

handled. Although some tasks, including cleaning and maintenance, share similarities across sectors, the health care workplace is unique in its exposure to allergens and should therefore not be combined with other industries when conducting such research.

When compared to published rates, the rates in this study may appear high as they are calculated from actual productive hours for each occupation and therefore provide a more accurate measure of injury risk. Workers' compensation boards in Canada and the United States generally report compensated injury and calculate rates based on labor force survey denominator values. As such, the rates are not occupation specific (including many occupations in a group). These generalized denominator values inevitably dilute the exposure rate by merging low-risk occupations with high-risk ones.

The analyses were limited to three health regions, which include approximately 25% of the health care work force of the province. Also, this investigation only accounted for reported events. Underreporting may be an issue among workers if they assume that incidents are part of the job or that reporting would not affect relevant hazards. Moreover, self-reported and clinically diagnosed incidents were combined, causing the researchers to infer that the incidents were only "potentially" allergic in nature. Furthermore, "asthmatic" incidents were not included in this study. As incidents of allergy and irritation may have been reported under an asthmatic category, the reach of this study to every true allergy and irritation report may have been limited.

ROLE OF THE OCCUPATIONAL HEALTH TEAM

Evaluation and control of chemicals and other exposures in the workplace are major components of an effective health and safety program. Workplace controls at the source of release or potential exposure are inherently superior to controls at the worker level (e.g., personal protective equipment). If direct physical contact with particularly hazardous substances can be avoided, workers are distanced from the source of exposure.

Air quality can be improved by isolating the source of exposure through actual physical enclosure, preferably with separate rooms or buildings, closed doors, and unidirectional airflow into the restricted area. Proper ventilation devices that fully fumigate areas prone to airborne allergens must be designed and implemented in the required vicinities (Schwartz, Hasselblad, & Pitcher, 1988). Vyas et al. (2000) studied respiratory irritations among endoscopy nurses and found that ventilation devices were ineffective due to poor design. These nurses were at added risk of acquiring chemical allergies due to exposure to sensitizing disinfectants (Jachuck, Bound, Steel, & Blain, 1989; Vyas et al.). Such studies demonstrated that employers should ensure their investment in anti-allergenic equipment reflects the needs of the work environment.

The removal of dust or particulate, cleaning chemicals, and other allergens from rooms and work surfaces is necessary. For example, floors, walls, ceilings, doors, stairs, tables, chairs, diagnostic equipment, and tools should be maintained to prevent hazardous materials from contaminating the skin or food of health care workers. Wet wiping and mopping will raise less dust and result in cleaner surfaces. Prompt spill remediation by properly trained and equipped personnel will aid in preventing exposures. Use of fragrance-free materials may also decrease allergy-related incidents reported under the smell and odor category.

All workers exposed to chemicals should be informed of the generic chemical name, brand or trade name, chemical mixture, and health and safety hazards of the substances. Employers are required by law to provide this information along with safety training for chemical use. Written operating procedures for all activities involving chemicals are required, including safety guidelines for handling spills.

Employers will determine the appropriate personal protective equipment for each hazard and train employees on how and when to use such equipment. It may be less expensive to control a hazard at the source than to provide personal protective equipment and monitor its use. Furthermore, alternatives to personal protective equipment should be made available to individuals who have experienced previous allergies and irritations when using them. Filon and Radman (2006) surveyed latex glove allergies among health care workers and found that non-powdered or non-latex gloves were useful alternatives for health care workers who suffered from latex-related allergies.

Masks that prevent inhalation of chemicals and allergens can safeguard the respiratory system and should be used. Gloves can provide some protection from chemicals when skin contact cannot be avoided. Special protective clothing such as coveralls, aprons, head covers, shoes, and boots can be used to protect parts of the body potentially exposed to chemicals. Splash-proof chemical goggles, face shields, and respirators with full face pieces provide some protection against chemical splashes. Employees should be instructed to wash their hands and face prior to eating, drinking, or smoking to prevent transfer of allergens and irritants.

Workers in the health care industry are at high risk of occupational allergy and irritation exposure in the workplace. Prevention policies should be developed to reduce hazards present at their workplaces and promote safer work practices. From the findings of this study, it is apparent that simple prevention, worker training, and education programs on hazard identification and reduction can substantially decrease the risk of injury among targeted health care workers.

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Correction

The following individuals should have been listed as coauthors on the article "The Energy Envelope Theory and Myalgic Encephalomyelitis/Chronic Fatigue Syndrome," which appeared in the May issue of the Journal:

Kathleen Muldowney, BA
Susan Torres-Harding, PhD

Jason, L., Muldowney, K., & Torres-Harding, S. (2008). The energy envelope theory and myalgic encephalomyelitis/chronic fatigue syndrome. *AAOHN Journal*, 56(5), 189-195.

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