

Outcomes of a natural rubber latex control program in an Ontario teaching hospital

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Background: Allergy to natural rubber latex (NRL) has been frequently reported in health care workers. However, there is little published evidence of the outcome of hospital intervention programs to reduce exposure and detect cases of sensitization early.

Objective: This study assesses the effects of intervention to reduce NRL allergy in an Ontario teaching hospital with approximately 8000 employees.

Methods: A retrospective review assessed annual numbers of employees visiting the occupational health clinic, allergy clinic, or both for manifestations of NRL allergy compared with the timing of introduction of intervention strategies, such as worker education, voluntary medical surveillance, and hospital conversion to low-protein, powder-free NRL gloves.

Results: The number of workers identified with NRL allergy rose annually, from 1 in 1988 to 6 in 1993. When worker education and voluntary medical surveillance were introduced in 1994, a further 25 workers were identified. Nonsterile gloves were changed to low-protein, powder-free NRL gloves in 1995: Diagnoses fell to 8 workers that year, and 2 of the 3 nurses who had been off work because of asthma-anaphylaxis were able to return to work with personal avoidance of NRL products. With a change to lower protein, powder-free NRL sterile gloves in 1997, allergy diagnoses fell to 3, and only 1 new case was identified subsequently up to May 1999. No increased glove costs were incurred as a result of consolidated glove purchases.

Conclusions: This program to reduce NRL allergy in employees was effectively achieved without additional glove costs while reducing expenses from time off work and workers' compensation claims. (*J Allergy Clin Immunol* 2001;108:628-33.)

Key words: Latex allergy, natural rubber latex allergy, occupational asthma, medical surveillance

IgE antibody-mediated allergic responses among workers wearing natural rubber latex (NRL) gloves have been reported in North America since 1989, when a nurse

Abbreviations used

NRL: Natural rubber latex

OA: Occupational asthma

from our hospital was reported to have anaphylaxis from NRL glove use in the operating room.¹ Since that time, there have been numerous reports indicating that 3% to 17% of hospital workers become sensitized to NRL proteins.²⁻⁵ The most common symptom is contact urticaria, but other manifestations include angioedema, allergic rhinitis, conjunctivitis, asthma (reported in 2.5% of health care workers⁶), and anaphylaxis.

High-protein, powdered NRL glove use in the workplace has been shown to result in measurable levels of airborne NRL allergen, which can trigger respiratory and anaphylactic responses in sensitized workers.^{6,7} Early recognition of NRL sensitization can lead to appropriate personal protective strategies, such as avoidance of NRL contact in and out of the workplace and avoidance of powdered glove use by coworkers in the area of a sensitized worker. However, personal protective measures may not be sufficient to prevent ongoing occupational asthma (OA) caused by NRL unless there is site-wide substitution of powdered NRL gloves, as recently reported by Charous et al.⁸ Substitution with exclusive use of powder-free gloves, non-NRL gloves, or both has been reported to reduce airborne NRL levels to below the detection limit.^{7,8} However, there are little published data as to the effectiveness of surveillance strategies for NRL-exposed workers in a hospital setting and little information as to the outcome of glove changes in such a setting.^{7,8}

The early introduction of education and medical surveillance measures for NRL allergy at a large teaching hospital in addition to preventive strategies has provided the opportunity to assess the effectiveness of such a program.

METHODS

Workplace description and interventions

The 2 site hospitals (Toronto General and Toronto Western Hospital) are part of the largest teaching hospital in Ontario, the University Health Network. A third hospital was added to the Network after the NRL interventions had been initiated, and this third hospital is not included in this study. The 2 hospitals included have approximately 8000 employees, including around 2500 nurses, 400

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laboratory technicians, and 350 housekeeping staff who use gloves during their usual work (approximately 240,000 sterile and 280,000 nonsterile pairs of NRL gloves per year). Annual turnover rates for staff have averaged about 5% overall and 7% for nursing staff.

Increasing concern about NRL allergy in the hospital staff led to the formation of a hospital latex committee in 1994 after 3 nurses were unable to continue working because of NRL allergy and 5 claims for OA caused by NRL allergy had been submitted by hospital staff for workers' compensation. The committee included an allergist-respirologist, an infection-control physician and infection-control nurses, operating-room and medical nurses, and representatives from purchasing, administration, and occupational health.

Intervention measures consisted of the following. First, since the first hospital worker with diagnosed NRL allergy in 1985 (published as a case report in 1989¹), workers with diagnosed NRL allergy were provided with non-NRL gloves and local avoidance measures. Those with symptoms from airborne NRL allergen exposure were accommodated, where possible, in local environments where coworkers did not wear powdered NRL gloves.

Second, in 1994, education programs were established through the latex committee to increase awareness by hospital staff of the symptoms of NRL allergy by means of newsletters, in-service education sessions, and educational rounds. Unnecessary use of NRL gloves was discouraged. A voluntary medical surveillance program was established and offered to all staff through occupational health and the allergy clinic, including administration of a questionnaire and skin prick testing with low ammoniated NRL extract (Bencard, Mississauga, Ontario, Canada). Workers with incident reports relating to glove use were referred by the hospital occupational health department for subsequent allergy assessment to the hospital allergy clinic (assessed by S.M.T.). Staff with NRL concerns could also come directly to the allergy clinic for assessment. NRL-free kits were made available for patients with NRL allergy, and hospital patients were screened by means of a questionnaire for NRL allergy.

In 1995, after trials of various low-protein, low-powder NRL gloves, low-protein, powder-free gloves (ie, <2 mg of powder per glove; Safeskin) were substituted for the previous powdered, nonsterile NRL gloves. Purchases of gloves (which previously had been separately ordered by each hospital unit) were consolidated through one distributor at a similar cost. In 1997, after trials of acceptability in the operating rooms, sterile NRL gloves were replaced with lower protein, low-powder NRL gloves from the same manufacturer (Baxter Triflex) provided at the same cost.

Assessment of intervention measures

A retrospective review was performed to assess temporal relationships between the intervention measures and worker outcomes between 1985 and 1999.

First, annual numbers of worker's incident reports received by the occupational health department pertaining to NRL gloves were tabulated. These forms are required to be completed for employees who experience an adverse health event that they relate to work. Because of reasons of confidentiality, the occupational health department could not release information other than the number of annual reports. An individual worker could have more than one report submitted if more than one incident related to NRL at work occurred.

Second, a retrospective review was performed of the charts of all new patient visits by hospital employees to the allergy clinic for NRL-attributed concerns. Those with NRL allergy confirmed with skin prick testing (3 mm or greater mean wheal diameter to a low-ammoniated NRL extract, Bencard), as previously described,⁹ were classified as having one or more of the clinical manifestations of NRL allergy as follows: contact urticaria; angioedema; allergic rhinitis, conjunctivitis, or both; asthma; and anaphylaxis. Workers who had an incident report from NRL were routinely advised to

come to the clinic by the occupational health department, but not all attended. In addition, some workers without an incident report attended the clinic because of NRL concerns. Therefore the 2 sources of review overlapped, but some workers were represented in one source and not the other.

RESULTS

Incident reports for NRL allergy

Incident reports for NRL allergy increased from 1 per year in 1985, 1988, and 1990 (Fig 1) to 7 in 1991, 19 in 1993, and peaked at 45 in 1994, coincident with the educational strategies introduced in 1994. Reports subsequently fell, coincident with the change in nonsterile NRL gloves, in 1995 to 11 and in 1998 to 6; there were no new incident reports in 1999.

Initial patient visits to the allergy clinic in relation to symptoms attributed to NRL showed a slight lag in relation to incident reports (Fig 1). There were fewer new clinic visits compared with incident reports in 1993 and 1994 but greater numbers of new clinic visits relative to incident reports from 1995 to 1998 after establishment of the medical surveillance and education programs. New allergy clinic visits for NRL from hospital staff also peaked in 1994 and subsequently fell to 1 by 1999.

NRL allergic manifestations

Chart review of the hospital staff allergy clinic visits for NRL indicated a total of 99 assessments from 1985 to 1999. Fifty-two workers (52% of the hospital workers with new allergy clinic visits) had a history consistent with IgE-mediated allergic responses to NRL and had a positive skin prick test response, whereas 42% had negative skin test responses (Fig 2). An additional 5 workers (5% of the total and 9% of all workers with positive NRL skin test responses) had a positive skin test response to NRL but no history of clinical allergic responses to NRL. Among workers seen in the clinic for assessment of possible NRL allergy, the diagnosis was confirmed in the majority until 1994, in 50% in 1995, and in only a minority subsequently (Fig 2). The patients with clinical NRL allergy had a mean age of 35.75 years (range, 25-57 years), 94% were women, and 92% were atopic, as indicated by one or more positive skin prick test responses to 13 common aeroallergen extracts (Table I). Most workers with NRL allergy were nurses, especially intensive care nurses. The most commonly reported clinical manifestation of NRL allergy was contact urticaria (87%) with NRL gloves, although 27% reported symptoms of work-related asthma, and 12% had experienced anaphylactic episodes on NRL contact either at work or during personal dental, medical, or surgical procedures (including 4 with asthma symptoms as part of their anaphylactic response). An objective diagnosis of OA related to NRL was reached in 4 workers on the basis of a positive methacholine challenge test response ($PC_{20} < 8$ mg/mL) during a work week, improving at least 3-fold away from work (in 3 patients), and serial peak expiratory flow readings supportive of OA (in 3 patients). In these patients asthma symptoms started before 1995 (1 patient in 1991

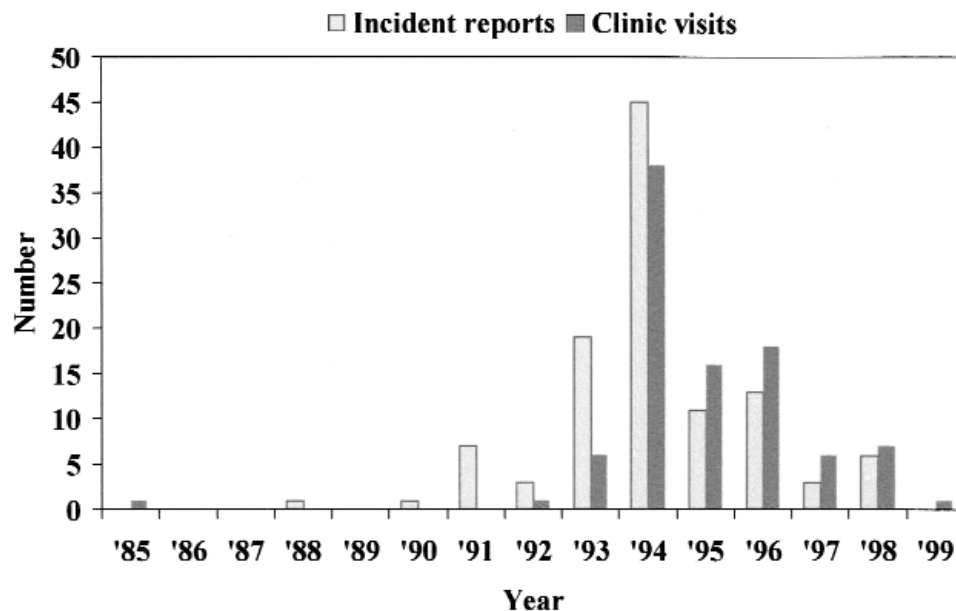


FIG 1. Annual incidence of occupational health department incident reports (n = 109) and allergy clinic visits for hospital staff relating to perceived NRL allergy (n = 99).

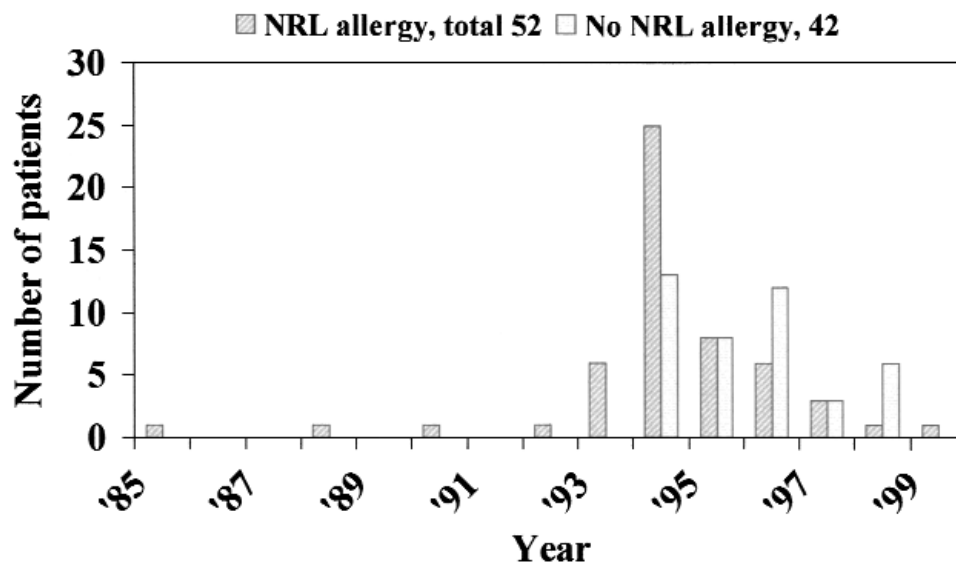


FIG 2. Annual numbers of workers who were seen in the allergy clinic for assessment of possible NRL allergy subdivided according to the final diagnosis (on the basis of history, skin prick testing, and contact glove challenge, if needed).

and 3 patients in 1992). There was one further accepted workers' compensation NRL-related OA claim (associated with anaphylaxis) in a patient whose symptoms started and in whom the diagnosis of OA was made in 1995, but there were no subsequent NRL-related OA claims or lost-time claims as a result of NRL allergy.

Skin test responses to NRL were most commonly to the undiluted extract but included 3 workers with positive responses to a dilution of 1:10,000 and 5 workers with positive responses to a dilution of 1:1,000 (Table I).

The mean duration of symptoms before the clinic visit for the workers with NRL allergy was 2.9 years. The number of workers with NRL allergy with a new onset of symptoms was similar from 1990 to 1995 (between 5 and 9 per year, Fig 3), and subsequent to the glove changes in the hospital in 1995, the yearly rates of clinic visits and new onset of symptoms fell. The peak of new clinic visits by patients with NRL allergy coincided with the hospital educational and medical surveillance strategies and not with a peak in new onset of symptoms.

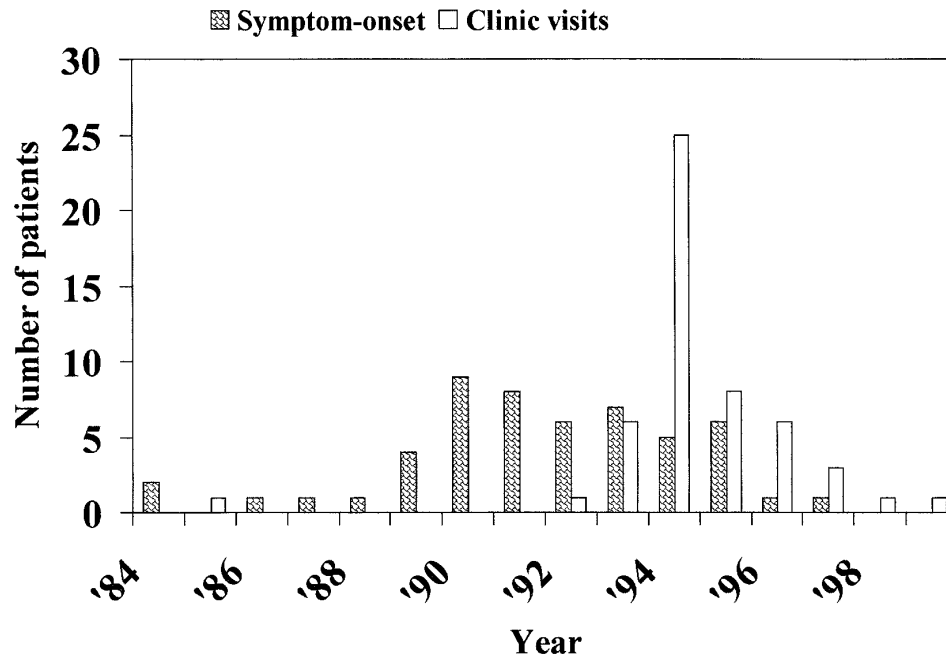


FIG 3. Year of onset of NRL allergy symptoms and year of allergy clinic diagnosis for hospital staff with confirmed clinical NRL allergy (mean time from symptom onset to diagnosis, 2.9 years).

TABLE I. Descriptors of 52 hospital staff with positive skin test responses and clinical NRL allergy

Mean age, y (range)	35.75 (25-67)
Female sex, %	94
Atopic, % (≥ 1 positive [≥ 3 mm wheal diameter] skin tests to 13 common aeroallergen extracts)	92
Latex-related symptoms (%)	
Urticaria	87
Angioedema	23
Rhinitis-conjunctivitis	63
Asthma	27
Anaphylaxis	12
Occupation	
Intensive care-coronary care nurse	14
Medical floor nurse	5
Labor and delivery nurse	3
Other nurse	6
Laboratory technician-PhD	6
Respiratory technician	4
Other technician	8
Physician-medical student	3
Housekeeping staff	1
Lowest NRL skin test dilution resulting in a positive response	
1:10,000	3
1:1000	5
1:100	11
1:10	15
Undiluted	18

Annual hospital total glove costs rose approximately 2% to 3% from before the changes in 1994 up to the year 2000. Before the glove changes, several different brands of gloves purchased through different suppliers were used. Glove costs per year were relatively unchanged by

the conversion to low-protein, low-powder or powder-free NRL gloves because of consolidation of glove purchases through one supplier (as well as savings from a change in the brand of nonlatex gloves previously purchased from a different supplier).

DISCUSSION

Our findings suggest a benefit in this population from primary and secondary preventive strategies to reduce the incidence and effects of NRL allergy. The intervention component, which likely contributed to the observed fall in incidence reports, allergy clinic visits, and diagnoses of NRL allergy, was the change in hospital glove use to a low-protein, powder-free NRL glove. With glove-manufacturing changes brought about by the recognition of NRL allergy, the levels of NRL allergen, even in those gloves that were not powder free, are reported to have fallen,¹⁰ and it is possible the reduction in allergen might be at levels that would no longer induce new sensitization to NRL. We do not have data from hospitals that did not specifically change their glove use during this time period to assess this possibility.

In this study airborne levels of NRL were not systematically measured in the hospitals. In a previous study performed before the glove changes, we did demonstrate airborne NRL levels in a biochemistry laboratory from one of the study hospitals to be about 300 ng/m³ while powdered NRL gloves were in use.⁷ Use of low-protein, powder-free gloves has been associated with airborne NRL levels below the detection limit (<5 ng/m³)^{6,7} and, in some sensitized health care workers, a reduction in measurable specific IgE antibodies or skin test responses to NRL allergens.¹¹ Such a reduction might be expected to result in both primary prevention of respiratory sensitization to NRL and tertiary prevention in reducing continuing workplace symptoms caused by NRL-related OA. In the present study there was a reduction (and perhaps elimination) of new onset of NRL-related OA, and previously diagnosed workers with NRL-induced OA were able to continue to work in the hospital setting.

The number of workers' compensation claims for NRL-induced OA throughout Ontario also fell during this period,¹² which may reflect similar glove changes in other hospitals, such as has been described in another report from Sussman et al¹³ in the center where the largest number of NRL-related OA compensation claims in Ontario previously occurred.

It is possible that incident reports and hospital allergy clinic visits for NRL allergy fell in part during this period as a result of symptomatic hospital staff not reporting their symptoms because of fears of adverse outcomes at work or other reasons. Nevertheless, all sensitized workers who wished to continue work in the hospital were able to do so, and therefore fear of job loss is not likely to account for the results.

Further preventive measures in this hospital consisted of case identification by measures of education as to early symptoms of sensitization, voluntary screening, and early allergy referral of those identified by incidence reports. The rapid rise in allergy clinic visits by hospital staff for NRL allergy assessment without a similar rise in new-onset symptoms suggests that the case-finding methods were of benefit, although there was no systematic screening of other workers to permit an estimate of

the true prevalence or incidence of NRL allergy in the hospital staff. It is likely that there were other sensitized workers who were not identified in this study because our identified prevalence (about 1%) is lower than that reported in other studies of hospital workers.^{2-5,13} It is likely that some workers were sensitized and symptomatic but did not reveal symptoms to their supervisors to be submitted as an incident report and did not volunteer to participate in the medical surveillance program. However, it is unlikely that there was a systematic reduction in reporting on this basis from 1995 onward, and therefore the time trends in this study are likely to be reflective of overall changes.

Our findings illustrate that NRL allergy is largely or possibly completely preventable among health care workers by means of the exclusive use of low-protein, low-powder and powder-free NRL gloves or non-NRL gloves. This has also been suggested by findings from studies of schools of dentistry.^{14,15} The recommendation to use such gloves in place of powdered NRL gloves has also been supported by a previous report from the Mayo Clinic,¹⁶ as well as North American groups, such as the National Institute for Occupational Safety and Health.¹⁷ Nevertheless, such recommendations have not been universally applied,¹⁸ possibly because such gloves have generally been more costly than powdered gloves. Hermes et al¹⁹ estimated that the cost burden of converting a dental school to powder-free NRL gloves would be a 32% increase, although a cost-benefit analysis in a health care setting did indicate a cost benefit.²⁰ In the current report opportunities to consolidate glove purchases permitted the change to occur in this hospital with an estimated 2% to 3% increase in total glove costs. Maximum worker compensation costs to an employer in Ontario for an employee unable to return to work rose in this time period, from \$146,400 in 1989 to \$236,800 in 1999 (C. Wray, personal communication). The hospital in this study has had no claims for lost time related to NRL allergy since 1995. (In that year, a lost-time claim cost the hospital \$29,406, but the worker was able to return to work with the change in glove use.) Therefore although not specifically quantitated in this study, there were savings from time off work and workers' compensation claims, suggesting a likely overall financial benefit from this approach.

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REFERENCES

- Spaner D, Dolovich J, Tarlo SM, Sussman G, Butto K. Hypersensitivity to natural latex. *J Allergy Clin Immunol* 1989;83:1135-7.
- Turjanmaa K. Incidence of immediate allergy to latex gloves in hospital personnel. *Contact Dermatitis* 1987;17:270-5.
- Yassin MS, Lierl MB, Fisher TJ, O'Brien K, Cross T, Steinmetz C. Latex allergy in hospital employees. *Ann Allergy* 1994;72:245-9.
- Vandenplas O, Tarlo SM, Charous L. Latex allergy. In: Bernstein L, Chan-Yeung M, Malo JL, Bernstein D, editors. *Asthma in the workplace*. 2nd ed. New York: Marcel Dekker Inc; 1999. p. 425-44.

5. Liss GM, Sussman GL, Deal K, Brown S, Cividino M, Siu S, et al. Latex allergy: epidemiologic study of 1351 hospital workers. *Occup Environ Med* 1997;54:335-42.
6. Vandenhplas O, Delwiche JP, Evrard GI, Aimont P, van der Brempt X, Jamar J, et al. Prevalence of occupational asthma due to latex among hospital personnel. *Am J Respir Crit Care Med* 1995;151:54-60.
7. Tarlo SM, Sussman G, Contala A, Swanson MC. Control of airborne latex by use of powder-free latex gloves. *J Allergy Clin Immunol* 1994;93:985-9.
8. Charous BL, Schuenemann PJ, Swanson MC. Passive dispersion of latex aeroallergens in a healthcare facility. *Ann Allergy Asthma Immunol* 2000;85:285-90.
9. Hadjiliadis D, Khan K, Tarlo SM. Latex skin test responses in an allergy/asthma clinic population. *J Allergy Clin Immunol* 1995;96:431-2.
10. Turjanmaa K, Reinikka-Railo H, Reunala T, Palosuo T. Continued decrease in natural rubber latex (NRL) allergen levels of medical gloves in nationwide market surveys in Finland and co-occurring decrease in NRL allergy prevalence in a large University hospital. *J Allergy Clin Immunol* 2000;104:S373.
11. Allmers H, Brehler R, Chen Z, Raulf-Heimsoth M, Fels H. Reduction of latex aeroallergens and latex-specific IgE antibodies in sensitized workers after removal of powdered natural rubber latex gloves in a hospital. *J Allergy Clin Immunol* 1998;102:841-6.
12. Liss G, Tarlo SM. Changing prevalence of occupational asthma due to latex allergy [abstract]. *Am J Respir Crit Care Med* 2000;161:A731.
13. Sussman GL, Liss GM, Deal K, Brown S, Cividino M, Siu S, et al. Incidence of latex sensitization among latex glove users. *J Allergy Clin Immunol* 1998;101:171-8.
14. Levy DA, Allouache S, Chabane MH, Leynadier F, Burney P. Powder-free protein-poor natural rubber latex gloves and latex sensitization. *JAMA* 1999;281:988.
15. Saary J, Tarlo SM, Kanani A, Holness DL. Reduction in rates of latex sensitivity among dental students and staff after changes in latex gloves [abstract]. *Am J Respir Crit Care Med* 2001;163:A809.
16. Hunt LW, Boone-Orke JL, Fransway AF, Fremstad CE, Jones RT, Swanson MC, et al. A medical-centre-wide, multidisciplinary approach to the problem of natural rubber latex allergy. *J Occup Environ Med* 1996;38:765-70.
17. NIOSH Alert: Preventing allergic reactions to natural rubber latex in the workplace. Cincinnati, Ohio: Department of Health and Human Services; 1997. p. 1-11. Publication No. 97-135.
18. Jackson EM, Arnette JA, Martin ML, Tahir WM, Frost-Arner L, Edlich RF. A global inventory of hospitals using powder-free gloves: a search for principled medical leadership. *J Emerg Med* 2000;18:241-6.
19. Hermes CB, Spackman GK, Dodge WW, Averlardo Salazar D. Effect of powder-free latex examination gloves on airborne powder levels in a dental school clinic. *J Dental Ed* 1999;63:814-20.
20. Phillips VL, Goodrich MA, Sullivan TJ. Health care worker disability due to latex allergy and asthma: a cost analysis. *Am J Public Health* 1999;89:1024-8.