

Natural Rubber Latex-Related Occupational Asthma: Association With Interventions and Glove Changes Over Time

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Background Exposure to natural rubber latex (NRL) has been recognized as a cause of occupational asthma (OA), especially among health care workers (HCWs) associated with use of gloves. Little or no population-based data are available which chart the changes over time in the number of cases of OA as this problem was increasingly recognized and then interventions instituted.

Methods We obtained the numbers of allowed asthma claims with exposure to latex by year in the province of Ontario, Canada from the Ontario Workplace Safety and Insurance Board; details of the cases from the largest teaching hospital were reviewed. Interventions included: (1) in 1996, the Board recommended in its focus for accommodation of sensitized workers, the reduction of aerosols of latex proteins and that hospital facilities use powder-free, low-protein or nonlatex gloves; and (2) hospitals instituted latex policies and glove changes at various dates. For example, at the largest teaching hospital, interventions included education and voluntary medical surveillance in 1994; substitution of low protein, "powder-free" NRL gloves for non-sterile powdered gloves in 1995; and replacement of powdered sterile NRL gloves by lower protein, "powder-free" NRL gloves in 1997.

Results Through 1999, there were 60 allowed claims for asthma in Ontario with exposure to latex; of these 49 (82%) were among HCWs. The number of claims among HCWs changed from 0 to 2 per year up to 1990; increased to 7 to 11 per year between 1991–1994; and declined to 3 per year in 1995–1996 and 1 to 2 per year in 1997–1999. Of the ten institutions having two or more OA latex claims, all claims occurred in 1996 or earlier at 8 (80%). At the largest hospital, there were five accepted claims with year of diagnosis in 1993 (1 case), 1994 (3 cases), and 1995 (1 case).

Conclusions These findings suggest that, despite the effect of increasing recognition, the introduction of gloves with reduced powder and/or protein, as well as other interventions have been associated temporally with declines in the number of cases of latex OA. Am. J. Ind. Med. 40:347–353, 2001. © 2001 Wiley-Liss, Inc.

KEY WORDS: natural rubber latex; latex; occupational asthma; interventions; glove types; surveillance

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Presented in part at the 2000 ALA/ATS International Conference, May 2000, Toronto, Ontario, Canada.

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Accepted 27 June 2001

INTRODUCTION

Allergy to natural rubber latex (NRL) has become an important occupational health concern in recent years, particularly among health care workers (HCWs) [Sussman et al., 1991; Charous, 1994; Slater, 1994; Hunt et al., 1995; Sussman and Beezhold, 1995; Vandenplas et al., 1999]. The main source of workplace exposure was the use of powdered latex gloves by HCWs. Type I (IgE mediated) latex allergy

includes urticaria, angioedema, rhinitis, conjunctivitis, asthma, and anaphylaxis. NRL has contributed to the sensitization of approximately 5–12% of health care workers in North America and Europe [e.g., Turjanmaa, 1987; Arellano et al., 1992; Lagier et al., 1992.; Liss et al., 1997; Vandenplas et al., 1999]. Vandenplas et al. [1995b] documented 2.5% of HCWs to have latex-induced occupational asthma confirmed with specific inhalation challenge. As of July 1999, in the United States, the FDA had received reports of five deaths associated with latex-containing medical gloves; four of these occurred among nurses (Brock Hefflin, Center for Devices and Radiological Health, FDA. Personal communication, July 1999).

Sensitization of these workers may involve high costs, involving possible risks at work, including potentially fatal anaphylactic reactions, as well as workers' compensation and workplace modification. The costs of a case of occupational asthma (OA) can be high. For example, estimates from one hospital in Ontario exceeded Can \$200,000 for nurses unable to return to work (R. Gorman, Personal communication, 1999). Powder and high levels of glove protein are thought to play a role in this sensitization. The usual approach for sensitized symptomatic latex-allergic HCWs is to recommend avoidance of further exposure, because further personal use of latex products or by-stander exposure from co-workers may result in maintaining or worsening of sensitivity and health effects. This advice is made under the hypothesis that avoiding latex allergen exposure may result in a decrease (or elimination) of symptoms as suggested by Tarlo et al. [1994] and Vandenplas et al. [1995a], and a decrease in objective measures of sensitization (IgE in blood and skin test sensitivity), as suggested by Hamilton and Brown [2000]. Moreover, it has been suggested but not clearly demonstrated that the use of low protein gloves will reduce the incidence of sensitization (and asthma).

Few reports have assessed the effects of interventions involving decreases in NRL glove powder and protein over time. At the *institution level*, for example, Allmers et al. [1998] in Germany and Turjanmaa et al. [2000] in Finland reported cessation or declines in sensitization following changes in powder and/or "allergen" levels in gloves. Levy et al. [1999] reported that no cases of sensitization occurred among dental students using powder-free gloves while 5–15% of those using powdered gloves were sensitized; however, the strength of this evidence was limited by its cross-sectional design. At the *level of the individual patient*, Turjanmaa and Lahti [1992] reported that people already sensitized to NRL reacted less to an extract from a low protein glove than to an extract from a regular glove. Tarlo et al. [1994] and others showed that the use of non-powdered, low-protein gloves resulted in reduced concentrations of airborne latex allergens, and was effective in allowing a laboratory worker with latex-induced OA to

return to work. Moreover, Vandenplas et al. [1995a] suggested that gloves with a lower protein content could be useful in reducing the risk of asthmatic reactions in subjects with NRL-induced asthma.

We are not aware of population-based data to assess the temporal effects of interventions on latex-induced OA in a jurisdiction. In this report, we examined the number of OA compensation claims allowed for exposure to NRL in the province of Ontario, Canada over time; the number of cases at the largest teaching hospital in the province over time; and how these may be associated with policies, changes in gloves, and other interventions that have been instituted.

MATERIALS AND METHODS

Occupational Asthma Claims in Ontario

The Province of Ontario is the largest in Canada, with a population exceeding 11 million. We obtained data on claims for OA (not aggravation of pre-existing or underlying asthma) that were allowed by the Ontario Workplace Safety and Insurance Board (WSIB; formerly the Workers' Compensation Board) for the entire province, through the end of 1999. The WSIB classifies these by year of claim set-up as well as "accident date" (the estimated year of onset of symptoms or complaints). We categorized the claims according to whether the workers were HCWs or not, and the institutions as to whether there were only one versus two or more claims for OA.

Interventions Considered

WSIB policy

In 1996, the compensation board recommended in its focus for accommodation of sensitized workers, the reduction of "aerosols of latex proteins" and encouraged hospitals to use powder-free, low-protein or non-latex gloves.

Example of hospital-based interventions

At the various hospitals in Ontario, interventions involving education; establishment of latex committees; surveillance; and changes in gloves took place at different times during the 1990s. Although the dates of the interventions are not known for most hospitals, we present the following as examples:

(a) *Workplace description and interventions for the largest hospital in Ontario.* This hospital had two sites

at the time of the intervention with approximately 8,000 employees of whom about 5,000 use gloves during their usual work. Intervention measures consisted of the following:

1. Since the first sensitized worker was identified in 1985 [Spaner et al., 1989], diagnosed NRL-allergic workers 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 co-workers did not wear powdered NRL gloves.
2. In 1994, education programs were established through the latex committee to increase awareness by hospital staff of the symptoms of NRL allergy via 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/or the allergy clinic including a questionnaire and skin prick testing with low ammoniated NRL extract (Bencard, Mississauga, Ontario). Workers with "incident reports" relating to glove usage were referred by the hospital occupational health department for subsequent allergy assessment to the hospital allergy clinic. Staff with NRL concerns could also come directly to the allergy clinic for assessment.
3. In 1995, after trials of various low protein, low powder NRL gloves, a low protein, "powder-free" glove (i.e., <2 mg powder per glove) was substituted for the previous powdered non-sterile NRL gloves. In 1997, after trials of acceptability in the operating rooms, sterile NRL gloves were replaced with lower protein "powder-free" NRL gloves.

(b) The hospital with the most OA claims. A different hospital in Hamilton, Ontario (which had two sites during the mid-1990s and four sites by the late 1990s following restructuring) had the largest number (11) of allowed claims for OA due to latex. In 1992–1993, a latex committee was established; and in 1994–1995, educational sessions of staff were undertaken. In 1995–1996, the employee health service implemented assessment of employees who were symptomatic or suspected of having NRL allergy, including questionnaire, referral to an allergist for skin prick testing, and determination of degree of restriction based on diagnosis. In 1995–1996, NRL examination gloves were switched to non-latex gloves at the original two sites. NRL surgical gloves were switched to low protein, low powder NRL gloves in the fall of 1995 at two of the four sites, and in 1996–1997 at the other two sites.

RESULTS

Occupational Asthma Claims Due to Latex in Ontario

Of the 60 claims allowed for OA due to NRL between through 1999, 49 (82%) occurred among HCWs in 26 institutions (range 1–11 per facility). The ages of the claimants who were HCWs were (mean±SD) 34.4±7.4 years, and 93.9% were female. This was similar to that for all claimants (mean age 34.3±8.0 years; 91.7% female). Ten institutions had two or more claims. The occupations of the HCWs included registered nurses (41), registered nursing assistants (3), dental hygienists/assistants (2), and dental laboratory technician, medical technician, and physiotherapist (1 each).

The allowed claims according to estimated year of the onset of health problems and HCW status are presented in Figure 1. The number of claims among HCWs changed from 0 to 2 per year up to 1990, increased to 7 to 11 per year between 1991–1994, and declined thereafter to 3 per year in 1995–1996 and 1 to 2 per year in 1997–1999. The distribution according to year of claim set-up was similar (Fig. 2), but as expected by the definition of these dates, the curve is shifted slightly to the right, with more cases in the final several years. The timing of claims among those health care institutions having two or more OA claims indicated that, of the 10 hospitals, all claims occurred in 1996 or earlier in 8 (80%), while in only 2 institutions did any claims occur in 1997 or after.

Occupational Asthma Claims due to Latex at the Largest Teaching Hospital

At the largest hospital, there were five accepted claims for NRL-induced OA. All were female, mean age 31 (range 27–37), and the occupations were ICU or coronary care unit nurses (3 cases), and medical floor nurse and i.v., nurse (1 each). The year of onset of symptoms was 1991 (1 case), 1992 (3), and 1995 (1), while the year of diagnosis was 1993 (1), 1994 (3), and 1995 (1). There were no subsequent claims after 1995. All had positive skin prick tests to dilutions of low ammoniated NRL extract (Bencard, Mississauga, Ontario), three demonstrated at least a threefold improvement in methacholine PC₂₀ while away from work, and three had serial peak expiratory flow recordings supportive of OA. One case was accepted on the basis of anaphylaxis with an asthmatic component at that time, not objectively documented by pulmonary function tests at work versus off work.

DISCUSSION

Our data indicate that the number of allowed claims for OA due to NRL in Ontario declined sharply starting around

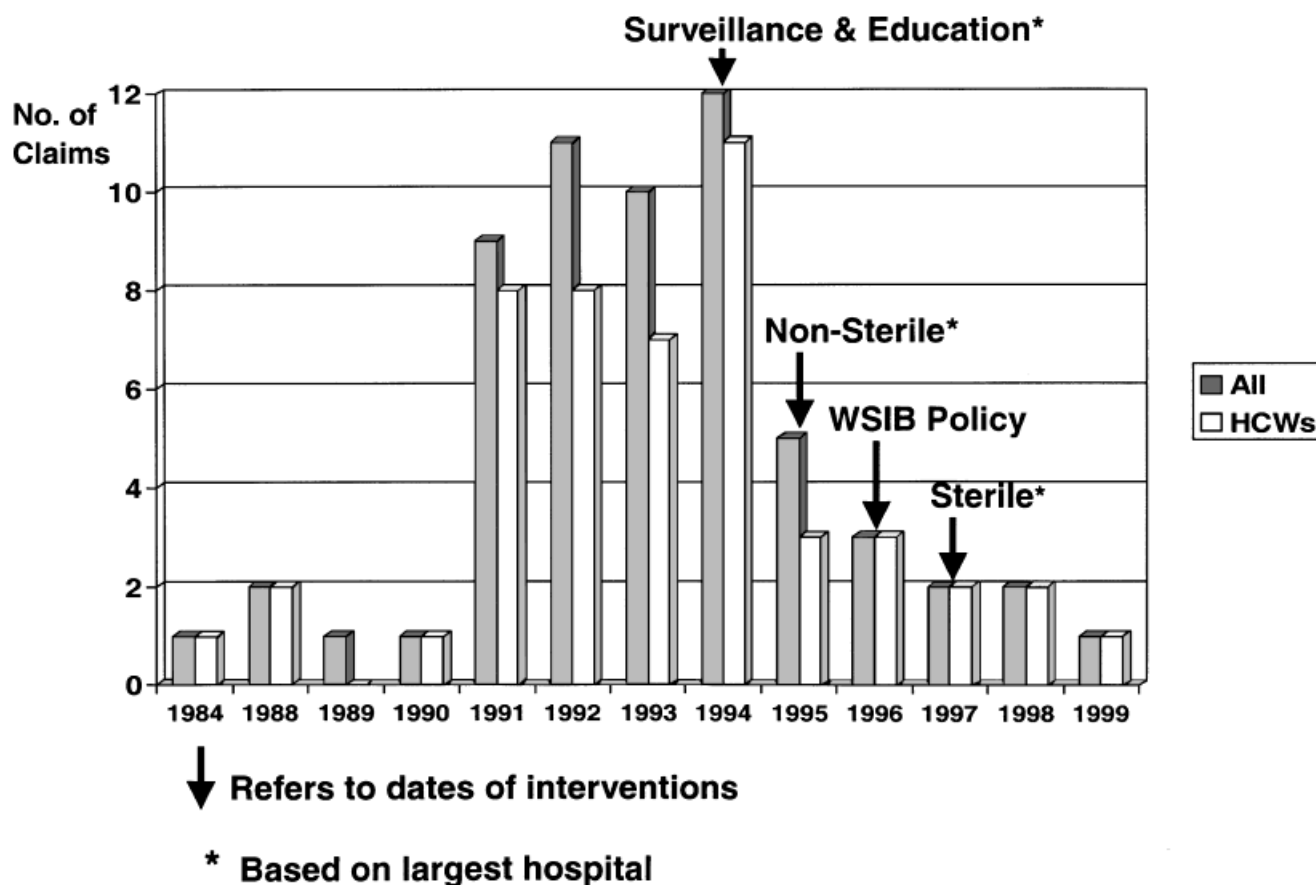


FIGURE 1. Allowed claims for asthma due to NRL according to year of "accident" and health care worker status.

1995-1996 (according to "year of accident") or 1997 (according to year of claim setup). Thus it appears that the interventions implemented including the WSIB policy for accommodation of sensitized workers, and the substitution of powdered NRL gloves by non-latex or low protein, low (or no) powder gloves undertaken at hospitals were associated temporally with the observed decline in OA.

To our knowledge, this study represents the first population-based assessment of asthma claims due to NRL over time as related to interventions. This temporal decline was observed despite the effect of increasing recognition of NRL-related asthma over time (by both workers and physicians), which might be expected to have increased the numbers of cases in the later years. However, our investigation is limited by the absence of data on the interventions at each of the individual institutions in the province, plus the fact that some hospitals switched to non-latex as well as (or instead of) to low protein, low-powder gloves. Further, there is some evidence that the protein levels in (regular) powdered NRL gloves also declined during the mid to late 1990s [Sussman et al., 1998; Turjanmaa et al., 2000]. Thus, it may not be possible to attribute the observed decline specifically to the WSIB

policy, to the substitution by non-latex gloves, to the introduction of low protein, powder-free gloves, to changes in powdered gloves themselves, or to a combination of these factors. An additional weakness that should be noted is the selection bias inherent in compensation data; social and economic factors influence who seeks and successfully obtains compensation.

At the level of the institution, the findings presented here at the largest teaching hospital also suggest that the occurrence of OA was related temporally with the interventions undertaken, and are consistent with the time trends observed by us in the same hospitals for total staff identified with NRL allergy manifestations, with sensitization to NRL confirmed by skin prick testing [Tarlo et al., 2000]. A total of 52 hospital staff with clinical NRL allergy had been identified by review of occupational allergy clinic records and data from incident reports. Among these, five hospital staff had OA claims accepted for compensation, related to NRL. The onset of NRL-allergic symptoms among the 52 workers occurred mainly from 1990 to 1995, and then the annual numbers of newly sensitized workers identified in this hospital sharply fell, concurrently with the hospital intervention measures.

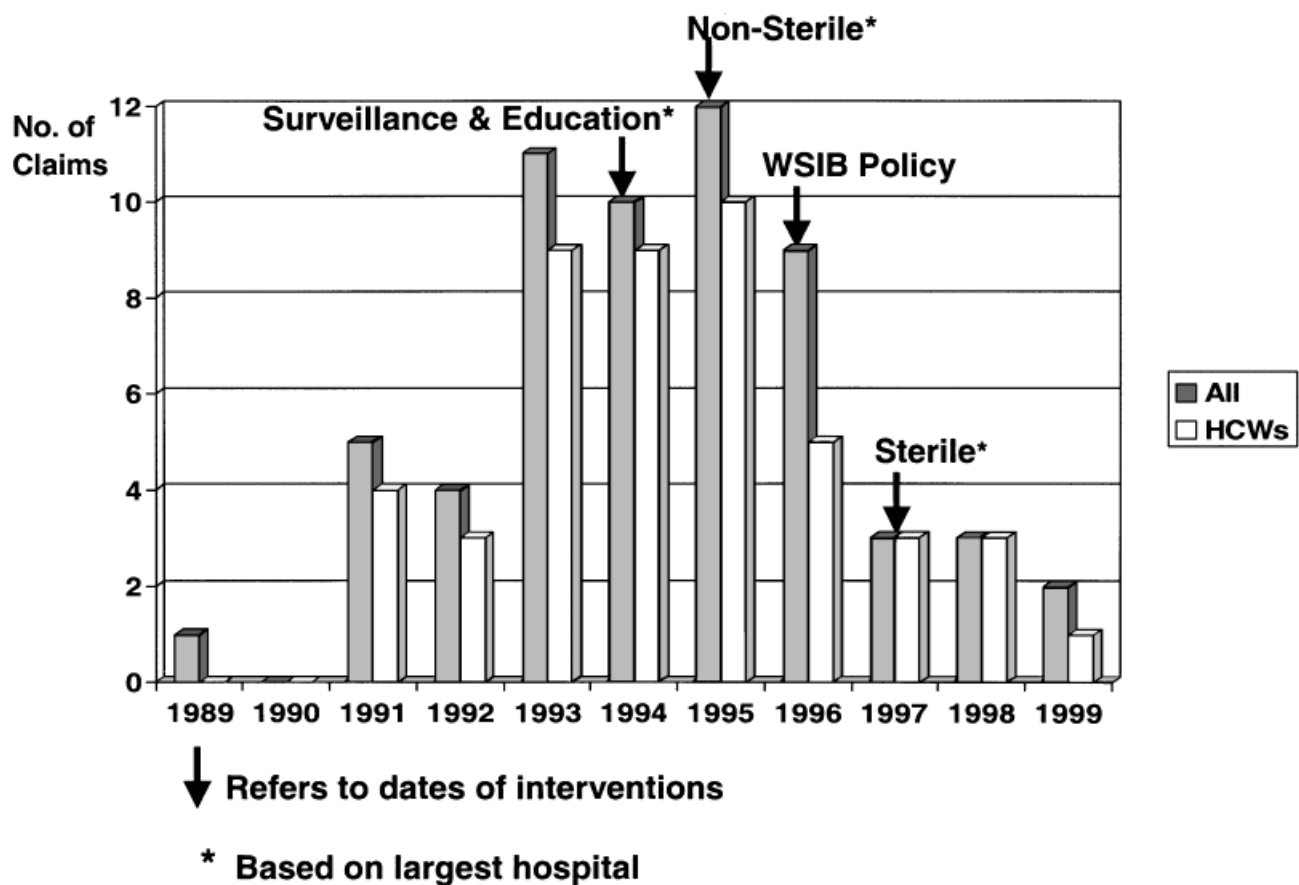


FIGURE 2. Allowed claims for asthma due to NRL according to year of claim setup and health care worker status.

These observations at both levels of intervention are consistent with previous investigations. Allmers et al. [1998] from Germany reported that after removal of powdered NRL gloves from the hospital and use of powder-free gloves, “no new cases of sensitization occurred in areas where only powder-free gloves were used during the 1-year follow-up period.” Baur et al. [1997] noted that respiratory sensitization was observed exclusively in hospital areas with detectable airborne NRL allergens. Levy et al. [1999] reported 15% of French and 5% of English dental students who had used powdered gloves, had positive skin test reactions to NRL, whereas none of those who had used powder-free gloves were sensitized. However, as noted above, this study was limited by its cross-sectional study design with no baseline test. This study did not report new cases of asthma, although NRL-induced asthma would not be expected in the absence of skin sensitization to NRL.

Changes in prevalence of sensitization of HCWs over time: Turjanmaa et al. [2000] described decreases in NRL allergen levels in medical gloves in a series of nationwide market surveys in Finland between 1994 to 1999 and concurrent decreases in the prevalence of NRL allergy

in a large university hospital. In 1999, of 58 surgical and examination gloves analyzed, only 5 (9%) fell into their high allergen category, compared to 30% in 1994, and the mean allergen level in the high-allergen gloves decreased to about one-third, similar to our observations in Canada [Sussman et al., 1998]. Among glove-using hospital employees in a large Finnish university hospital, mainly in operating and delivery rooms and laboratories, the prevalence shown to be allergic to NRL by skin prick testing declined from 2.9% in 1986 to 1% in 1999. The authors noted that in 1990, a strictly controlled glove usage policy, “allowing the use of only allergen-free or low-allergen gloves” was started in the hospital. The decline in allergy prevalence was statistically significant [Turjanmaa et al., 2000].

Changes in symptoms or immunologic measures among those already sensitized: Allmers et al. [1998] also reported that after intervention measures were introduced, six of the seven sensitized subjects had a significant decrease of latex-specific IgE antibody concentrations following avoidance of powdered latex glove use during this period.

Hamilton and Brown [2000] followed 20 U.S. anesthesiologists who were sensitized to NRL over 10 to 15 months

after switching to synthetic gloves. However, the participants continued to work in operating rooms where powdered surgical gloves were still used. After switching their own glove use, all four subjects with systemic symptoms and all eight with localized symptoms became and remained asymptomatic. Of the 16 individuals with initial positive serologic tests, 14 (88%) showed a decrease in the detectable level of latex-specific IgE, similar to the findings reported by Allmers et al. [1998]. However, in the 18 individuals described by Hamilton and Brown [2000] who were skin tested with NRL extracts, only 6 showed a decrease, eight showed no change, and four had an increase in their prick skin test reactivity. They concluded that in situations where powdered latex gloves are used in close proximity by other medical staff, personal avoidance may be insufficient to reduce sensitization.

Finally, among HCWs with a history of NRL-glove-induced OA from using powdered gloves, challenge testing with low protein, powder-free gloves did not induce significant changes in spirometry or bronchial reactivity [Vandenplas et al., 1995a; Laoprasert et al., 1998], suggesting that the use of such gloves by co-workers would be an effective means of reducing the risk of asthmatic reactions in those with NRL-related OA.

In summary, the findings described indicate that workplace interventions involving changes in types of gloves used and other measures highlighted here which reduce exposure to NRL in the occupational setting are linked temporally with decreases in the number of cases of OA and perhaps declines in the prevalence of sensitization to NRL. It also supports indirectly the evidence previously reviewed [Liss and Sussman, 1999], that there are differences in prevalence of latex sensitization between those occupationally exposed and those not so exposed. The data are also consistent with the earlier report by Levy et al. [1999] that the use of powder-free low protein NRL gloves may reduce the development of NRL sensitization and help to eliminate this workplace health problem.

ACKNOWLEDGMENTS

We thank Carol Luce of the Workplace Safety and Insurance Board for providing the data on asthma claims, and Irene Rule and Fermin Labog for preparing the figures. Dr. Liss has provided assistance in litigation of latex allergy on behalf of the patients.

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