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Effectiveness of a nationwide interdisciplinary preventive programme for latex allergy

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Abstract Objectives: The increasing prevalence of latex allergy among healthcare workers is a large socio-economical problem for the society and affected individuals. The objective of this study was to describe and evaluate a nationwide, interdisciplinary campaign by the institution for the German workers' compensation scheme for non-public healthcare providers that targeted the reduction of exposure to powdered high-protein latex gloves. **Methods:** The effectiveness of the prevention programme is described and evaluated with a before-and-after design comparing data on compensation claims for latex-related skin and airway diseases of the German statutory compensation scheme for work-related diseases in non-public health services. A survey on change in glove use was conducted after the programme. **Results:** The main feature of the campaign among healthcare workers (budget €340,000) was to increase awareness by means of educational components on the aetiology of latex hypersensitivity for healthcare workers and their providers, and professional trainers. The number of reported compensation claims for latex-induced skin diseases increased from a pre-measure of 664 in 1996 to 884 during the programme in 1998 and decreased after the programme (post-measure $n = 567$ in 1999 and $n = 204$ in 2002). Doctors' assistants in practices and nurses/nurse assistants/midwives filed most claims. Similar decreases were observed for confirmed claims and latex-related respiratory diseases, while two other prevalent occupational diseases in healthcare

workers (low-back disorders, infections) increased during this time period. The survey demonstrated a considerable concurrent drop in the use of powdered latex gloves (hospitals 76% vs 37% for unsterile gloves and 86% vs 62% for sterile gloves). **Conclusions:** The campaign against latex allergy in connection with concurrent corresponding recommendations, activities of State authorities for worker protection, and regulations, is an example for the successful incorporation of research results into preventive measures that directly affect the frequency of a work-related disease. This effective programme can be regarded as a model for the reduction of other occupational diseases such as bakers' or isocyanate asthma.

Keywords Healthcare workers · Occupational diseases · Latex allergy · Evaluation · Compensation claims · Prevention · Intervention

Introduction

During the late 1990s the use of medical gloves and other medical devices made of natural rubber latex (NRL) increased worldwide. In Germany, more than one billion pairs of latex gloves were annually used in the healthcare sector, primarily in acute-care hospitals (Allmers et al. 2002; Fuchs 1995). This quantity, as well as an increased allergen content due to modifications in the manufacturing of gloves, resulted in a strong increase in allergic reactions among healthcare workers (HCWs). According to data from epidemiological studies, the prevalence of positive NRL skin prick tests among exposed working groups ranged from 5% to 17%, with a history of allergic symptoms in approximately half of the sensitised individuals (Arellano et al. 1992; Konrad et al. 1997; Lagier et al. 1992; Leung et al. 1996; Liss et al. 1997; Mace et al. 1998; Tarlo et al. 1990; Turjanmaa 1987; Vandenplas et al. 1995). The increase in the frequency of NRL sensitisation and allergic

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reactions was followed by a sharp amplification of the number of occupational diseases due to latex allergy. This rise led to a considerable loss of working hours and, in severe cases, to disablement.

Research focusing on the complex pathogenesis of latex allergy revealed that the respective allergens (NRL proteins) adhered to the surface of glove powder (corn starch) (Baur et al. 1993; Beezhold and Beck 1992; Jäger et al. 1992; Tomazic et al. 1994; Turjanmaa et al. 1990; van der Meeren and van Erp 1996). This powder becomes airborne when gloves are put on or taken off (Heilman et al. 1996; Swanson et al. 1994; Tarlo et al. 1994) causing respiratory latex allergies (rhinitis, asthma). A main step to prevent respiratory allergies was to inhibit allergen inhalation.

On the basis of these results, many recommendations for primary and secondary prevention were published. In Germany the most important one was from the Interdisciplinary Working Group on Latex Allergy (Baur et al. 1996; Baur and Chen 1999). Regional campaigns by physicians within State authorities for worker protection followed. Recently, an international panel recommended institutional policies in order to prevent new cases of latex allergy (Charous et al. 2002).

Based on the evidence from the scientific literature, the Institution for Statutory Accident Insurance for Non-Public Healthcare and Welfare Providers in Germany (BGW) made considerable financial resources available to reduce the number of latex allergies among HCWs. The BGW is responsible for insurance of work-related accidents and occupational diseases. It insures all healthcare providers, with their employees, in German healthcare facilities run by private and charitable enterprises, such as hospitals, general practitioners, and dental practices. It does not insure hospitals run by state, county, or city authorities (approximately 60% of all hospitals during the campaign (Allmers et al. 2002).

The purpose of this evaluation was to answer two main questions: (1) How can the evidence from the scientific literature be applied to prevent latex allergies among HCWs? (2) Was the chosen approach effective? The paper illustrates the programme of preventive strategies against latex allergy in the healthcare sector that was coordinated by the BGW. The effectiveness of the campaign was demonstrated by the monitoring of compensation claims for occupational diseases before and after the campaign and by a survey on changes in the use of powdered latex gloves in hospitals and dental practices. The costs of the prevention programme are weighed against the estimated annual savings made on rehabilitation of patients with latex allergy.

Methods

Description of the programme

The different features and facts about the programme are presented in Table 1.

Evaluation

An experimental design was not possible because of the multi-level campaign-style approach adopted by the BGW. Consequently, a before-and-after-design was chosen.

The numbers of compensation claims for latex-related skin and airway diseases are reported for the years 1996 (prior to the campaign), 1997–1998 (during the campaign) and 1999–2002 (after the campaign). The statutory accidents insurance institutions compensate two latex-related occupational diseases: severe, recurrent urticaria or eczema (occupational disease no. 5101), and obstructive lung diseases of allergic origin (occupational disease no. 4301) due to occupational exposure to NRL. Severe, recurrent urticaria or eczema includes both contact allergy to latex (due to rubber chemicals) and immediate-type allergy to latex (caused by NRL). Whereas many early latex-related skin diseases were caused by rubber chemicals, most cases filed between 1996 and 2002 were due to NRL proteins (data not shown). All compensation claims for latex-related occupational respiratory and skin diseases are registered because every German physician has to report cases suspected of representing an occupational disease either to State authorities for worker protection or directly to the branch-specific statutory accident insurance institution.

Confirmation of a report is based on exposure assessment, diagnostics, comment of the State physician for industrial health, and medical expert examination and opinion. Standard diagnostic procedures for latex-related skin and/or airway diseases usually include skin prick testing, specific IgE analysis, wearing tests, and type IV hypersensitivity screening, as well as lung function testing and inhalative workplace-related exposure tests for obstructive lung diseases (Ruëff and Przybilla 1999). The medical expert opinion requires the conclusion that an occupational disease exists and whether there is a causal link between workplace exposure and the diagnosed disease or whether it is at least probable. Diagnosis of latex allergy is confirmed if history, wearing and/or inhalative workplace exposure tests and skin prick tests and/or NRL-specific IgE antibodies are positive. Claims for latex-related skin and/or airway diseases are accepted by the statutory accident insurance institutions if the medical expert opinion verifies latex allergy and if legal definitions are fulfilled (in the case of BK 5101/4301, the conditions must be so severe as to have forced the person to refrain from all activities which led or could lead to the development, aggravation or recurrence of the illness). The administrative process takes about 2 years, on average.

The observed proportions with 95% confidence intervals of NRL-related compensation claims in relation to total claims before the campaign were compared with the proportions after the campaign, assuming normal distribution and independent groups (Altman 1991). For comparison, time trends for latex-related

Table 1 Major facts and features of the campaign against latex allergy among German non-public healthcare and welfare providers

Facts

Goal: reduce exposure to powdered high-allergen latex gloves in hospitals and dental practices

Strategy: interdisciplinary campaign with nationwide activities on several levels

Interdisciplinary task force: physicians, lecturers, psychologists specialised in occupational medicine, public relations staff, industrial hygienists within companies, and the BGW

Target population: 475,000 non-public healthcare and welfare providers with approximately 5,000,000 employees

Duration: information, motivation, and implementation phase within 18 months (1997–1998)

Budget: €340,000^a (excluding staff and costs as indicated)

Coordination: one physician (F.H.) (2 person years) for project-style organisation

Features

Approach: creation of employees', employers' and professional trainers' critical awareness

Central message: powdered natural latex gloves cause allergic diseases and have to be replaced by powder-free gloves with a low latex allergen content

Information material

One information folder for healthcare providers (print run 70,000; €128,000 without mailing costs)

One brochure for healthcare workers (print run 200,000; printing and mailing costs not included)

One information package for lecturers (20 copies; 0.5 person years for compilation)

One video-tape for nursing schools (€41,000)

Events

Information booths at four trade fairs (€41,000)

Fourteen special regional events at 12 medical centres, including one kick-off event (€92,000)

Additional activities

Advice and counselling regarding glove management and purchase (including a list of latex gloves with protein content and individual consumer prices)

Motivation through intervention in one hospital that showed the effectiveness of a change to powder free-gloves [€38,000 (Allmers et al. 1998)] and through support of effective secondary prevention for healthcare workers with latex allergy

Participation in legislative boards [the central message of the campaign was included in a quality standard (Bundesministerium 1997)]

Information by the media (popular press)

Co-operations: academic institutions, legislative authorities within occupational safety and health

Programme evaluation

Surveillance of compensation claims for latex allergies

Survey on change in glove-wearing behaviour

^aThe budget was in German Marks: 1 German Mark was converted to €0.51

diseases of public healthcare providers (Standke, Bundesverband der Unfallkassen, Munich, personal communication) and the Federation of Statutory Accident Insurance Institutions for the industrial sector (Butz, HVBG-Referat ZIGUV, Sankt Augustin) are shown.

In 1999, a self-administered questionnaire was sent to all hospitals ($n=600$) and dental practices ($n=2,600$) insured by the BGW to evaluate the change in glove-wearing behaviour. The response was 54.6% ($n=1,746$). Random samples of 500 from hospitals and dental practices were further evaluated.

Results

Development of compensation claims due to latex allergy

The number of compensation claims due to latex-related allergic diseases of the respiratory tract and the skin rose from 944 in 1996 to 1,211 in 1997 (Fig. 1). During the campaign, the increase levelled off, reaching its maximum in 1998 ($n=1,262$). After the campaign the number of latex allergies dropped continuously each year (1999: $n=845$; 2000: $n=600$; 2001: $n=392$; 2002: $n=286$). Between 1996 and 2002, 3,887 claims for latex-related skin diseases were reported and 3,584 were confirmed. The

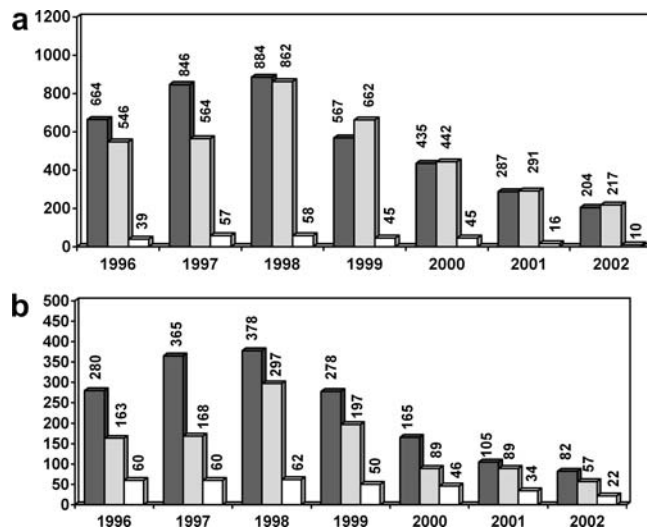


Fig. 1a,b Compensation claims for latex-related allergies among non-public healthcare and welfare providers. **a** Latex-related skin diseases (occupational disease no. 5101). **b** Latex-related airway diseases (occupational disease no. 4301). Annual number of reported compensation claims (*black columns*), claims with confirmed occupational cause (*grey columns*) and accepted claims with fulfilment of legal requirements (*white columns*) for latex-related skin diseases (**a**, mainly contact urticaria) and airway diseases (**b**, rhinitis and/or bronchial asthma) within the German BGW for 1996 (pre-measure), 1997–1998 (campaign), and 1999–2002 (post-measures)

corresponding values for latex-related airway diseases were 1,653 and 1,060.

When the proportions of reported latex-related claims were related to the annual numbers of all claims within the BGW, the proportion of latex-related skin diseases was lower after the campaign than before the campaign in 1996 (Table 2). The difference was 0.6% for 1999 and 1.8% for 2000. The confidence intervals did not include the null. A significant drop in the proportion of latex-related airway diseases before and after the campaign was observed only when the proportions for 1996 and 2000 were compared.

With a time lag of 1–2 years, the number of confirmed cases continuously decreased after the programme (Fig. 1; number of confirmed latex-related skin and airway diseases after the programme in relation to the number before the programme in 1996; 1999: 121.1%; 2000: 74.8%; 2001: 53.6%; 2002: 38.7%). The number of accepted claims showed a related time trend (number of accepted latex-related skin and airway diseases after the programme in relation to the number in 1996; 1999: 96.0%; 2000: 91.9%; 2001: 50.5%; 2002: 32.3%). In the case of latex-related skin diseases there was no decrease between 1999 and 2000.

For comparison, the time course of compensation claims for two other prevalent occupational diseases in the healthcare sector are presented. Work-related low-back disorders and infectious diseases showed no decrease between the pre-measure in 1996 and the post-measures in 1999 and 2000, respectively (Table 2).

Doctors' assistants in practices and nurses/nurse assistants/midwives filed most claims (Fig. 2). If the values for the years before and after the campaign are compared, these occupational groups also had the largest decrease in the number of latex-related diseases. In 2002 the number of reported compensation claims for nurses/nurse assistants, and doctors' assistants in practices was 25% and 24%, respectively, of the number in 1996. The respective value for all occupations was only 30%.

In total, 5,851 cases of latex-related skin and airway diseases were confirmed within the public and industrial sectors in Germany between 1996 and 2002, of which

79.4% were recognised by the BGW (Fig. 3). Sectors that were not targeted by the campaign showed no decrease in the first years after the campaign as observed within the non-public healthcare and welfare providers. The number of confirmed latex-related skin and airway diseases after the programme, in relation to the number in 1996, among public providers, even increased (1999: 289.2%; 2000: 184.2%; 2001: 153.9%; 2002: 86.2%). The values for the industrial sectors without non-public healthcare and welfare providers were more or less stable, with a peak in 1998 (numbers of confirmed latex-related skin and airway diseases in relation to the number in 1996 were 1999: 135.0%; 2000: 117.5%; 2001: 107.5%; 2002: 165.0%).

Change in the use of gloves

The answers from the questionnaire show an impressive change in the use of gloves (Table 3). The use of powdered unsterile latex gloves in hospitals decreased from 76.2% before the campaign to 37.3% afterwards (Table 3A), whereas the utilisation of powder-free and low-protein latex gloves increased. Although the use of latex-free gloves doubled, it remained comparatively small. Similar effects can be demonstrated for dental practices (Table 3B).

The effects are less pronounced for sterile powdered latex gloves, both in hospitals and dental practices, e.g. surgical gloves.

Evaluation of costs

Given that the campaign was effective, and assuming a time period of at least 2 years between filing of a compensation claim and decision of the compensation scheme on its acknowledgement, the drop is first obvious in 2000. The difference between accepted latex-related occupational diseases in 1996 and 2001 was 49 cases (Fig. 1). The respective number for 2002 was 67 saved cases. This corresponds to a decrease from 1996 to 2001, and to 2002 of 50.5% and 32.3%, respectively. The

Table 2 Proportion of specific claims in relation to the annual numbers of all claims for occupational diseases within the BGW before and after the prevention programme

Specific claims	Post-measures (%)			Difference (%) between pre-measure and post-measures (95% confidence interval)	
	1996 ^a	1999 ^b	2000 ^c	Δ 1999–1996	Δ 2000–1996
Latex-related claims					
Skin diseases	5.7	5.1	3.9	–0.6 (–0.1 to –1.3)	–1.8 (–1.2 to –2.4)
Airway diseases	2.4	2.5	1.5	0.1 (0.1–0.5)	–0.9 (–0.6 to –1.3)
Selected other claims					
Low-back disorders	19.3	21.1	21.7	1.8 (0.8–2.9)	2.4 (1.4–3.5)
Infectious diseases	7.9	10.1	11.1	2.2 (1.5–2.9)	3.2 (2.5–3.9)

^aAnnual number of all claims: $n = 11,604$

^bAnnual number of all claims: $n = 11,237$

^cAnnual number of all claims: $n = 11,072$

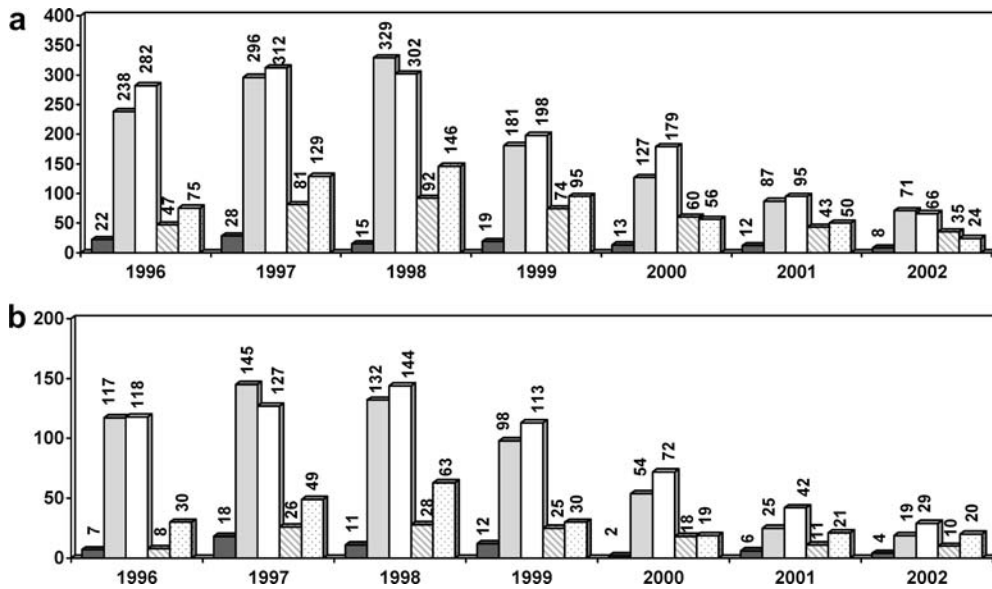


Fig. 2a,b Compensation claims for latex-related allergies by occupational group among non-public healthcare and welfare providers. **a** Latex-related skin diseases (occupational disease no. 5101). **b** Latex-related airway diseases (occupational disease no. 4301). Annual number of compensation claims filed by medical doctors (*black columns*), nurses/nurse assistants/midwives (*grey columns*), doctors' assistants in practices (*white columns*), workers in social services and in services for the elderly (*hatched columns*) and all other occupations (*stippled columns*: mainly physical therapist/masseur, social educationalist/matron, hairdresser, cleaner, no information of occupation) for latex-related skin diseases (**a**, mainly contact urticaria), and airway diseases (**b**, rhinitis and/or bronchial asthma) within the German BGW for 1996 (pre-measure), 1997–98 (campaign), and 1999–2002 (post-measure)

number of accepted latex-related skin and airway diseases in relation to the number in 1996 for public providers was 124.2% in 2001 and 87.9% in 2002 (data not shown).

As estimated by figures from the BGW, each case costs approximately €51,000 for new professional

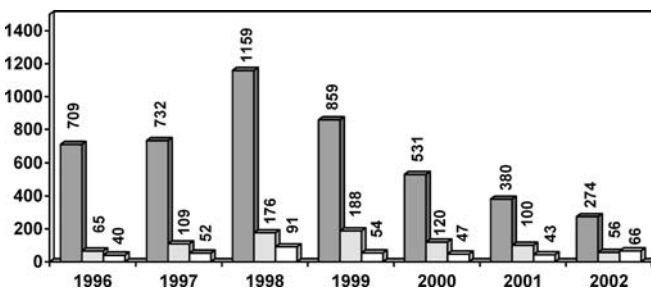


Fig. 3 Confirmed compensation claims for latex-related skin diseases (occupational disease no. 5101) and airway diseases (occupational disease no. 4301) in different economic sectors. Annual number of confirmed compensation claims for latex-related skin diseases (mainly contact urticaria) and airway diseases of the German BGW (*black columns*), the German Federal Statutory Accident Insurance (Bundesverband der Unfallkassen) for public healthcare providers (*grey columns*) and the Federation of Statutory Accident Insurance Institutions for the industrial sector (HVBG), without non-public healthcare and welfare providers (*white columns*) for 1996–2002

training. Thus, about €2,499,000 and €3,417,000 were saved in 2001 and 2002, respectively.

At the beginning of the campaign the costs for powder-free latex gloves were approximately 50% higher than for powdered latex gloves. The price difference fell to about 30% during the campaign and to 15%–20% after.

Discussion

Choice of the preventive strategy

Based on the available evidence from the scientific literature on the aero-allergic potential of powder from latex gloves and dose–response relationships between (surrogates of) latex exposure and prevalence of sensitisation or work-related symptoms (Arellano et al. 1992; Baur et al. 1993; Beezhold and Beck 1992; Heilman et al. 1996; Jäger et al. 1992; Konrad et al. 1997; Lagier et al. 1992; Leung et al. 1996; Liss et al. 1997; Mace et al. 1998; Swanson et al. 1994; Tarlo et al. 1990, 1994; Tomazic et al. 1994; Turjanmaa 1987; Turjanmaa et al. 1990; van der Meeren and van Erp 1996; Vandenplas et al. 1995), the nationwide campaign was aimed at reducing the exposure to two definable and modifiable risk factors of latex allergy (glove powder, protein content). Studies during and after the campaign accumulated additional evidence (Allmers et al. 2002; Baur et al. 1998a, b; Chen et al. 1997; Gautrin et al. 2000; Levy et al. 1999; Tarlo et al. 1997). The preventive strategy presented within a campaign is a suitable approach when many individuals are concerned, and the necessary measures are relatively easy to understand and put into action. The prevention targeted individual attitudes and behaviour. It included educational components for employees, employers and multipliers, advice, and counselling. Previously described interdisciplinary programmes targeting a change in policies in order to re-

Table 3 Survey on the use of latex gloves among German health-care workers in non-public hospitals and dental practices, 1999. All entries as number (percent), $n = 500$. Missing values were excluded for the determination of the percentage

Parameter	Latex-free gloves	Powder-free, low-allergen latex gloves ^a	Powdered latex gloves
(A) Hospitals			
Use of unsterile gloves			
Past	20 (4.1%)	95 (19.7%)	368 (76.2%)
Present	38 (7.8%)	269 (54.7%)	183 (37.3%)
Use of sterile gloves			
Past	7 (1.8%)	47 (12.2%)	332 (86.0%)
Present	12 (3.1%)	136 (35.1%)	240 (61.9%)
(B) Dental practices			
Use of unsterile gloves			
Past	25 (5.2%)	188 (39.2%)	267 (55.6%)
Present	38 (7.7%)	281 (57.2%)	172 (35.0%)
Use of sterile gloves			
Past	15 (4.6%)	129 (39.7%)	181 (55.7%)
Present	22 (6.6%)	170 (50.7%)	143 (42.7%)

^aAccording to a mandatory German quality standard, latex gloves with a protein content below 30 µg per gramme of material are considered to be low allergen latex gloves (Bundesministerium 1997)

duce latex allergy were confined to regional clinical settings (Hammer and Paulsen 1997; Hunt et al. 1996; Turjanmaa et al. 2002). An intervention similar to the approach described in this paper, that included education, secondary preventive measures, and a change to lower protein, powder-free latex gloves, was restricted to the employees of a large teaching hospital (Hammer and Paulsen 1997; Hunt et al. 1996; Tarlo et al. 2001).

Effectiveness of the interdisciplinary campaign against latex allergy

The fact that the observed drop in the number of latex allergies among non-public healthcare and welfare providers followed shortly after the different activities of the campaign suggests that the preventive measures as a whole were successful. Furthermore, there was a parallel decline in the number of latex allergies affecting the respiratory tract and the skin. As no such effect was seen with two other highly prevalent occupational diseases of HCWs, a random effect (regression to the mean) seems unlikely.

In order to discriminate between the direct effect of the programme and the indirect effect due to the change in the national regulation on the use of latex gloves that was enacted in 1998 (Bundesministerium 1997), the activities of the German Interdisciplinary Working Group on Latex Allergy (Baur 1996; Baur and Chen 1999), and State authorities for worker protection, we compared the time course of latex-related occupational diseases among non-public healthcare and welfare providers with other industrial sectors. The campaign could be regarded as effective. One year after the campaign, in 1999, the number of latex-related diseases outside the targeted non-public healthcare providers was higher

than in 1996 (289% among public healthcare providers and 135% in the industrial sector outside of healthcare and welfare), whereas the values for the non-public sector in 1999 were already close to those for 1996 (96%). So far, the effect on the reduction of latex-induced occupational diseases in Germany continues. In 2002 the number of latex allergies was lower than in the first year after the campaign, in 1999. However, latex allergy was still a problem in 2002, with 396 confirmed cases of latex-related skin and airway diseases in the German industrial and public sector. Future monitoring will reveal if the effects are permanent.

The drop in the number of compensation claims for latex allergies was probably due to a change in the use of gloves. In a survey about 12 months after the end of the campaign, 35%–62% of HCWs in hospitals and dental practices continued to use powdered latex gloves, as compared with 56%–86% before. The drop was most prominent for unsterile gloves in hospitals (from 76% to 32%). Accordingly, the utilisation of powder-free and low-protein gloves increased. Industrial reports (Bundesverband 1998) show adequate changes in consumer habits. Owing to the low response rate in the survey (54.6%), a bias cannot be ruled out. However, the observed difference between past and present use of unsterile powdered latex gloves in hospitals among responders was so large that a reduction would even be detected if all non-responders had reported no change in exposure to powdered latex gloves, assuming that the past exposure of non-responders would be the same as for responders (data not shown). The observed concurrent drop in the nationwide compensation claims and the change in the use of gloves are similar to the observed decrease in the annual incidence of latex allergy after an intervention in a Canadian teaching hospital (Tarlo et al. 2001) and a Finnish University Hospital (Turjanmaa et al. 2002). A temporal association between the number of compensation claims and various ongoing interventions was also observed in Ontario (Liss and Tarlo 2000).

It remains unclear which features of the programme were most effective, due to the multi-level approach of the programme and the chosen evaluation design. Another drawback of the presented evaluation is the monitoring of effect based on compensation claims. The claims show a bias towards underestimation of the number of affected individuals, due to selection effects during the registration of the occupational diseases. With respect to the legal definition of occupational skin diseases, only those cases have to be reported that are severe or recurrent, and that may or will result in permanent abandonment of the occupation. Owing to the meanwhile more readily available latex-free gloves for HCWs, affected subjects may be able to remain at their workplaces, resulting in a reduced number of claims. For recognition, abandonment of all activities causing the latex-induced skin and/or airway diseases is mandatory. So far, nationwide data on change in the incidence of latex sensitisation and allergies among HCWs in relation to the allergen content of the latex gloves are

not available. An ecological comparison in German acute-care hospitals demonstrated a linear relationship between the number of purchased latex examination gloves and the number of suspected occupational asthma cases (Allmers et al. 2002). The presented data suggest that latex glove use should be restricted to low-protein, non-powdered gloves. Non-powdered gloves can contain small amounts of corn starch and other types of powder (Phillips et al. 2001). The United States Food and Drug Administration (FDA) recommended that powder-free gloves should not contain more than 2 mg residual powder (Food and Drug Administration 1999). Not all low-protein gloves are low-allergen (Brehler et al. 2002; Mahler et al. 2000). The authors could not evaluate allergenicity of the gloves and frequency of use of powder-free high allergen gloves after the prevention programme. In 2002, 86% of unsterile examination gloves and 99.6% of surgical gloves in German acute-care hospitals were made from NRL (Allmers et al. 2004). In the same year, their use of powder-free NRL unsterile and sterile gloves was 88% and 89%, respectively. Although the number of airborne allergens diminishes through the use of powder-free, low-protein gloves, individuals are still in danger of becoming sensitised from contact with powder-free, low-protein, high-allergen gloves. Other evaluation programmes (Hunt et al. 1996; Tarlo et al. 2001) present no allergen content or arbitrary allergy units of low-protein latex gloves and give no recommendation regarding safe allergen concentrations. In Germany, a protein content for latex gloves of below 30 µg per gramme of material is now mandatory (Bundesministerium 1997). As judged by measurements of the latex gloves for HCWs that are on the German market (Baur 1996), the protein content has dropped during the past years. Before the campaign, only five out of a sample of 21 latex gloves tested had a protein content below 30 µg per gramme of material (highest 1,034 µg). After the campaign, only three out of a sample of 57 powder-free latex gloves from 23 companies had a protein content above 30 µg per gramme of material (BGW 1999). Although the values are not representative, given the number of different brands, changes between charge numbers, and unknown market shares, they show a remarkable trend. Whether these limits are appropriate should be investigated in a longitudinal study on the incidence of latex allergy among exposed trainees.

Cost effectiveness

The presented results demonstrate how the implementation of preventive measures can be cost effective from an insurance company's point of view. The expenses of the campaign (about €340,000) were low compared to the savings in compensation benefits (estimated €250,000,000, and €3,400,000 for professional training in the years 2001 and 2002, respectively). The observed time lag of about 2 years between the drop in the number of filed claims and accepted cases is mainly

attributable to the legal confirmation procedure required by the insurance administration. As the reduction cannot be solely attributed to the campaign but also to ongoing other activities, the time trend in accepted latex-related occupational diseases among non-public health-care and welfare providers was compared with public providers. The decrease among public providers started later and was less prominent. Thus, neglecting the differences between the two economic sectors in the report of an occupational disease and the duration of its administrative process, the benefit of the campaign within the non-public sector might be even higher.

From the employer's point of view, the excess costs due to the more expensive latex-free or powder-free, low-allergen latex gloves have to be weighed against the loss of working hours. In a report of a German hospital, enforced careful glove management notably reduced the additional costs due to the choice of the more expensive powder-free low-allergen latex gloves (Nolte 1997). This is in agreement with the results of campaigns in the Mayo clinic (Hunt et al. 1996) and in a Canadian teaching hospital (Tarlo et al. 2001) where costs for gloves did not increase because no correlation was found between the cost and the allergen-level of gloves. In addition, prices were successfully re-negotiated.

Application of the campaign to other problems in occupational health

The successful programme to reduce latex allergies can be transferred to other prevalent occupational diseases for which preventive measures are available and easily communicable, such as bakers' or isocyanate asthma. In some respects, the German institutions for statutory accident insurance resemble health maintenance organisations (HMOs). The strategy might be transferred to federal or privately organised compensation schemes for work-related diseases in other countries.

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