

ORIGINAL ARTICLE

Evaluating interventions aimed at reducing occupational exposure to latex and rubber glove allergens

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ABSTRACT

Objective Concerns over occupational exposures to blood-borne viruses resulted in increased protective glove use; consequentially latex allergy became a hazard for some occupational groups. Interventions aimed at managing this problem included substitution measures (eg, non-powdered/non-latex gloves), but such changes may not occur simultaneously across occupational sectors. This study evaluated whether the incidence of occupational dermatoses fell after interventions aiming to reduce exposure to 'latex and rubber glove allergens' ('latex') were introduced, and whether these interventions were more effective for healthcare workers (HCWs), compared with non-HCWs.

Methods Incidence rate ratios (IRRs) comparing cases reported to EPIDERM (a UK-wide surveillance scheme) during post versus pre-intervention periods were calculated, both where 'latex' was cited and for cases associated with other exposures ('controls').

Results Among HCWs, cases of contact urticaria and allergic contact dermatitis (ACD) where 'latex' was cited showed significant downward trends post-intervention, with IRRs of 0.72, 95% CI: 0.52 to 1.00 and 0.47, 95% CI: 0.35 to 0.64 respectively. For HCWs, this fall in 'latex' associated ACD was significantly greater ($p=0.02$) than for other exposures ('controls') IRR=0.85, 95% CI: 0.57 to 1.28, and greater than that among non-HCWs (IRR 0.75, 95% CI: 0.61 to 0.93). Increases over time were seen for irritant contact dermatitis (ICD) reporting for HCWs, both for cases associated with 'latex' (IRR 1.47, 95% CI: 1.02 to 2.13) and for other exposures ('controls') IRR 1.36, 95% CI 1.06 to 1.76, but not for non-HCWs.

Conclusions A reduction in overall ACD, particularly in HCWs, coincided with interventions aimed at managing workplace contact dermatoses associated with 'latex' exposure. A coincidental rise in ICD reporting is also important, both for hand care and for infection control strategies.

INTRODUCTION

The debate about risks of transmission of blood-borne viruses between infected individuals and occupational groups is longstanding, and has led to the publication of guidelines on precautions and management of exposure to blood or body fluids.^{1 2} These concerns have also resulted in widespread use of personal protective equipment such as gloves (especially natural rubber latex). Modified starch powder that is used to make it easier to put on or remove latex gloves enhances

What this study adds

- ▶ Concerns over exposures to blood-borne viruses have resulted in increased use of protective gloves; however, associated hazards include latex (type I) and chemical accelerator (type IV) allergies for some occupational groups
- ▶ A reduction in allergic contact dermatitis reporting to a UK-wide surveillance scheme in health-care workers coincided with interventions aimed at managing workplace latex contact dermatoses
- ▶ An increase in irritant contact dermatitis reporting over the same time period shows that infection control strategies need to take hand care into consideration

their hazardous potential.^{3 4} Rubber glove allergy therefore became a hazard within industrial sectors such as healthcare. Reported diagnoses affecting employees include latex contact urticaria (with or without respiratory sensitisation), and allergic contact dermatitis.⁵⁻⁷ Suggested practical interventions aimed at managing latex sensitisation have included substitution measures, such as replacing powdered with non-powdered latex gloves and substitution with non-latex gloves.

The evaluation of whether interventions are effective is important. Evidence is often available (eg, before and after a change in practice), which may be analysed using quasi-experimental designs.⁸ In the UK, practical measures may not be uniformly implemented between occupational sectors. Employees with better access to occupational health advice (such as health care workers (HCWs)) might take more rapid action in comparison with those where such advice is not readily available (eg, hairdressing and beauty services),⁹ therefore HCWs were of particular interest for evaluating interventions.

In June 1998 the UK Medical Devices Agency issued mandatory advice,¹⁰ aiming to increase awareness in glove users about previously published guidance on the allergic potential and risks associated with latex.¹¹ Subsequently, in November 2002, the England and Wales Court of Appeal (Civil Division) issued a Decision associated with a claimant, which outlined the

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timescales when employers should have known about potential risks (of producing sensitisation in employees) associated with latex glove use.¹² Both the 1998 advice and the 2002 legal Decision can be considered as 'interventions' at a national level; the 2002 Decision should have led to further changes away from latex glove use. Furthermore we hypothesise that these interventions were more likely to be effective within health-care, compared with other employment sectors.

Changes over time in the incidence of type I immediate hypersensitivity (contact urticaria (CU)) and type IV contact sensitivity (allergic contact dermatitis (ACD)) – whether associated with 'latex and rubber glove allergens' ('latex') or not – might occur for reasons other than the intervention. We hypothesised that, if the intervention was effective, reductions would be greater for cases associated with 'latex' than for cases associated with non-'latex' exposures.

Investigation of the effectiveness of these interventions was carried out using data collected within The Health and Occupation Research (THOR) network.¹³ THOR is a UK-wide surveillance scheme which captures incident case reports of work-related ill-health, and contains data spanning the relevant time periods; as THOR also provides information on employment, analysis by occupation and industrial sector is also possible.

METHODS

The study design might be described as a 'before and after' comparison.¹⁴ The study analysed incident case reports of occupational skin disease originating from clinical specialists in dermatology who report to the occupational skin surveillance scheme (EPIDERM), which is part of THOR. EPIDERM was set up in 1993, and its methodology for reporting/analysis of case reports has been described previously.^{15–17} In summary, EPIDERM reporters are asked to report new cases of work-related skin disease that they see in their clinical practice, within an allocated reporting period. Data collected for each case include demographic information, diagnosis, employment (job and industrial sector) and suspected agent(s).

EPIDERM data were analysed for the period January 1996 to December 2007 inclusive. This time period was chosen to exclude the pilot period for EPIDERM (1993 to 1995 inclusive), and to allow 5 years after the date of the Court of Appeal (Civil Division) Decision.¹² The case reports were classified by diagnosis. Additionally, scrutiny of the suspected agent(s) allowed identification of cases where 'latex' and/or gloves (or agents found in gloves) were cited, which allowed them to be separated from case reports associated with all other agents. Cases associated with other agents were considered as non-latex 'controls', as their incidence would not be affected by this intervention. Agents included within the 'latex' category included rubber (unspecified), natural rubber latex, synthetic rubber, agents within a standard patch test series equivalent to rubber/gloves in an occupational setting (thiuram/thiuram mix, carba/carba mix, mercapto/mercapto mix), and rare allergens within a rubber patch test series equivalent to rubber/gloves (cyclohexyl thiophthalimide, hexamethylene tetramine).

Occupational groups are coded in EPIDERM using Standard Occupational Coding (SOC2000).¹⁸ Case reports were grouped according to suspected agents ('latex' or other agents), and occupation (HCWs or non-healthcare workers (non-HCWs)). The definition of who was/was not classified as a HCW, based on UK Standard Occupational Classification (SOC 2000) codes is shown in table 1.

Table 1 Classification of healthcare workers by SOC2000 codes

Healthcare workers' job titles	SOC2000 code
Medical practitioner	2211
Psychologist	2212
Pharmacist/pharmacologist	2213
Ophthalmic optician	2214
Dental practitioner	2215
Nurse	3211
Midwife	3212
Paramedic	3213
Medical radiographer	3214
Chiropodist	3215
Dispensing optician	3216
Pharmaceutical dispenser	3217
Medical and dental technicians	3218
Physiotherapist	3221
Occupational therapist	3222
Speech and language therapists	3223
Therapist (not elsewhere classified)	3229
Nursing auxiliary/nursing assistant	6111
Ambulance staff (excluding paramedic)	6112
Dental nurse	6113
Hospital porter	9221

Three time periods were defined on the basis of mandatory advice issued by the Medical Devices Agency (June 1998) and an Appeal Court decision (November 2002) as:

- Time 1=before the intervention (Jan 1996 to June 1998)
- Time 2=the transition period (July 1998 to Nov 2002)
- Time 3=the post intervention period (Dec 2002 to Dec 2007)

The statistical analysis aimed to estimate change in incidence in Time 2 and Time 3, using Time 1 as the reference period. Data were analysed using a two-level 'random effects' negative binomial regression model with β distributed random effects, which was implemented using the STATA V9 xtnbreg procedure.¹⁹ The dependent variable was the number of cases, including zeros, per reporter per month. The main predictor of interest, time period, was represented by two 0/1 variables for Time 2 and Time 3. Other covariates included month of year, type of reporter that is, reporting every month ('core' reporting), or for one randomly allocated month in 12 ('sample' reporting), and whether the reporter was reporting for the first time. These covariates were included as time-varying predictors: month of year (relating to season), and indicator variables representing the first month as a new reporter and as a new 'core' reporter (to allow for a possible excess of cases initially due to inclusion of prevalent, rather than incident, cases). The rationale for this has been described in detail previously.²⁰ The 'random' effects model allows for variation in incidence between reporters at a given time point, which is important for correct SEs; also it implicitly adjusts results for changes in numbers of reporters in EPIDERM from Time 1 to Time 3 (from 184 to 208 reporters). The model included as an 'offset' the size of the UK working population, or of the healthcare or non-healthcare populations as appropriate, for each year. The incidence rate ratios (IRRs) for Time 2 and Time 3 relative to Time 1, and their 95% CIs, were then found from the regression model parameters for Time 2 and Time 3. The true sizes of the working populations covered by each reporter are unknown; however, what matters for correction estimations of rate ratios in one time period compared with

another are the relative changes in population size, not the absolute sizes. By inclusion of these offsets, it is assumed that the relative changes in the reporter populations are the same as in the UK as a whole.

Cases of contact urticaria (CU) and contact dermatitis (CD) were analysed separately. For each diagnosis IRRs in the transition and post-intervention periods were calculated separately for cases where 'latex' was mentioned and for cases associated with other exposures. To test the hypothesis that any downward shift in CU, for example, would be greater among the cases associated with 'latex' than for control (non-'latex') exposures, all cases of CU were included in a model which included the time variables, whether 'latex' was cited, and interaction terms for 'latex' and each time variable. The null hypothesis p values are given by the tests for whether the interaction terms were zero.

Comparisons between IRRs for cases associated with 'latex' and cases associated with control (non-'latex') other exposures were carried out separately for HCWs and non-HCWs. To test the hypothesis that reductions over time in cases associated with 'latex' would be greater for HCWs and non-HCWs, again models with interaction terms were fitted and interpreted as above.

Multicentre Research Ethics Committee approval has been granted for THOR (MREC 02/8/72).

RESULTS

Between January 1996 and December 2007 (inclusive) there were 13 858 actual case reports received in EPIDERM. Of these, 11 174 (81%) were contact dermatitis (CD) diagnoses; 5471 (49%) were in men, 5683 in women (51%), 20 had unspecified gender. CD was reported as allergic (ACD), irritant (ICD), mixed allergic/irritant (MCD) and unclear (UCD). Contact urticaria resulted in 722 (5%) reports, while the remaining diagnoses included dermatological neoplasia (1760;13%), and (202;1%) 'other diagnoses' (folliculitis/acne, infective skin disorders, mechanical phenomena and nail lesions), as shown in table 2. EPIDERM does not capture all UK cases, hence UK incidence rates were not calculated.²¹

HCWs made up around 5% of the UK's working population.²² For CD diagnoses overall, the proportion of cases reported in HCWs was 18.5% (2043/11 174). In comparison, for CU diagnoses, approximately equal proportions of cases were reported in HCWs (48%) and non-HCWs (52%). For each diagnostic category of CD and for CU, case reports in female HCWs exceeded those reported in the male counterparts, reflecting the gender distribution of the workforce in the healthcare sector.²² For employees working outside the healthcare sector (ie, non-HCWs), case reports in men exceeded those reported in women for ACD, ICD and UCD diagnoses, equal proportions of men and women with MCD were reported, and there were fewer case reports of CU in men than women.

Men appeared to be older than women for all categories of CD; however, for CU the opposite was observed. The age and gender distribution of cases did not differ between the three defined time periods (Time 1, Time 2 and Time 3); for example the mean ages for reported cases of ACD were 39.0 (SD 12.9) years in Time 1, 39.8 (SD 13.2) years in Time 2, 39.5 (SD 13.4) years in Time 3.

Up to 6 suspected causal agents can be reported in cases returned to EPIDERM. However, cases may have a dual diagnosis (eg, CU and CD), and a reporter may not always specify which agent is associated with which diagnosis. Only 3% ACD and 2% ICD cases were co-diagnosed with CU, therefore all specified agents associated with these cases were classified as causal for CD diagnoses. The majority of CU reports had a sole diagnosis (434/722; 60% of all CU case reports). Most CU diagnoses (79%) were associated with 'latex', or foods/ingredients (18%), with the remainder being associated with a variety of agents such as animal excreta (in animal handlers) and materials used in the construction industry.

For all CU diagnoses as a whole, a post intervention downward trend was observed (IRR=0.76, 95% CI 0.61 to 0.95), as shown in table 3. IRRs in the whole workforce for CU cases associated with 'latex' and CU associated with other agents that is, control (non-'latex') exposures are shown as Groups 1 and 2. The IRR for the post intervention period was 0.80, 95%

Table 2 Demographic analysis of contact dermatitis (CD) and contact urticaria (CU) case reports in EPIDERM (1996–2007)

Number of cases by diagnosis (N)		Allergic CD N=4380	Irritant CD N=4869	Mixed CD N=1745	Unspecified /Unclear CD N=180	CU N=722
Industry	HCW	588 (13%)	1141 (23%)	287 (16%)	27 (15%)	349 (48%)
	Non-HCWs	3792 (87%)	3728 (77%)	1458 (84%)	153 (85%)	373 (52%)
Gender by industry (M=male; F=female)		N (%)	N (%)	N (%)	N (%)	N (%)
All		M=2198 (50%) F=2169 (50%) No data=13	M=2395 (49%) F=2468 (51%) No data=6	M=776 (44%) F=968 (55%) No data=1	M=102 (57%) F=78 (43%) No data=0	M=194 (27%) F=527 (73%) No data=1
HCWs		M=98 (17%) F=489 (83%) No data=1	M=178 (16%) F=962 (84%) No data=1	M=43 (15%) F=244 (85%) No data=0	M=2 (7%) F=25 (93%) No data=0	M=42 (12%) F=307 (88%) No data=0
Non- HCWs		M=2100 (55%) F=1680 (44%) No data=12	M=2217 (60%) F=1506 (40%) No data=5	M=733 (50%) F=724 (50%) No data=1	M=100 (65%) F=53 (35%) No data=0	M=152 (41%) F=220 (59%) No data=1
Age by industry (years)		Mean (SD) N	Mean (SD) N	Mean (SD) N	Mean (SD) N	Mean (SD) N
All		39.5 (13.2) N=4356	36.1 (12.8) N=4860	36.7 (13.2) N=1742	40.6 (12.3) N=174	33.5 (10.6) N=719
Males		42.6 (12.3) N=2183	38.7 (12.6) N=2389	40.8 (12.5) N=774	43.0 (12.2) N=98	32.9 (10.2) N=193
Females		36.3 (13.4) N=2161	33.7 (12.5) N=2465	33.3 (12.7) N=967	37.6 (11.8) N=76	33.7 (10.7) N=526
No data		N=12	N=6	N=1	—	—

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Table 3 Incidence rate ratios (IRRs) for Contact Urticaria (CU) in the transition and post intervention periods

Group number and description		Number of cases in Time 1	Transition period IRRs (95% CI) and number of cases	Post intervention IRRs (95% CI) and number of cases
All CU		N=157	0.88 (0.71–1.09) N=285	0.76 (0.61–0.95) N=280
Group 1	CU 'latex' reported	N=118	0.95 (0.74–1.23) N=231	0.80 (0.61–1.04) N=222
Group 2	CU 'latex' not reported	N=39	0.71 (0.46–1.09) N=54	0.68 (0.44–1.05) N=58
Test that IRR 1=IRR 2 (p value)			0.17	0.37
Group 3	CU in HCWs 'latex' reported	N=70	0.94 (0.69–1.28) N=138	0.72 (0.52–1.00) N=120
Group 4	CU in HCWs 'latex' not reported	N=2	1.81 (0.37–8.70) N=9	2.13 (0.47–9.79) N=10
Test that IRR 3=IRR 4 (p value)			0.42	0.17
Group 5	CU in non-HCWs 'latex' reported	N=48	1.01 (0.69–1.47) N=91	0.89 (0.60–1.30) N=102
Group 6	CU in non-HCWs 'latex' not reported	N=37	0.63 (0.40–0.98) N=45	0.60 (0.38–0.95) N=48
Test that IRR 5=IRR 6 (p value)			0.11	0.08
Group 3	CU in HCWs 'latex' reported	N=70	0.94 (0.69–1.28) N=138	0.72 (0.52–1.00) N=120
Group 5	CU in non-HCWs 'latex' reported	N=48	1.01 (0.69–1.47) N=91	0.89 (0.60–1.30) N=102
Test that IRR 3=IRR 5 (p value)			0.85	0.17

'latex', 'latex and rubber glove allergens'; HCW, health care worker.

'CI: 0.61 to 1.04 for 'latex', but smaller for CU in control (non-latex) exposures, IRR=0.68, 95% CI: 0.44 to 1.05, although the difference was not statistically significant. When the comparison was restricted to HCWs, a marginally significant fall in 'latex' associated cases (Group 3 IRR=0.72, 95% CI: 0.52 to 1.00) in the post intervention period was found; however, there were too few control (non-'latex') exposure cases among HCWs (Group 4) for a meaningful comparison. Downward trends in IRRs among non-HCWs were seen post intervention; for cases associated with 'latex' exposures (Group 5 IRR=0.89, 95% CI

0.60 to 1.30) the downward trend was smaller than that for control (non-'latex') agents (Group 6 IRR=0.60, 95% CI 0.38 to 0.95), but the difference was not statistically significant. Although there was a larger downward trend in cases associated with 'latex' among HCWs (Group 3) compared with non-HCWs (Group 5), the difference was not statistically significant (p=0.17).

For ACD diagnoses taken as a whole, there was a statistically significant fall post intervention (IRR=0.67, 95% CI 0.61 to 0.74), as shown in table 4. In the whole workforce, there was

Table 4 Incidence Rate Ratios (IRRs) for Allergic Contact Dermatitis (ACD) in the transition and post intervention periods

Group number and description		Number of cases in Time 1	Transition period IRRs (95% CI) & number of cases	Post intervention IRRs (95% CI) and number of cases
All ACD		N=996	0.88 (0.81–0.97) N=1773	0.67 (0.61–0.74) N=1611
Group 1	ACD 'latex' reported	N=273	0.86 (0.73–1.02) N=470	0.64 (0.54–0.77) N=418
Group 2	ACD 'latex' not reported	N=723	0.89 (0.80–1.00) N=1303	0.69 (0.61–0.77) N=1193
Test that IRR 1=IRR 2 (p value)			0.93	0.81
Group 3	ACD in HCWs 'latex' reported	N=104	0.67 (0.51–0.89) N=141	0.47 (0.35–0.64) N=128
Group 4	ACD in HCWs 'latex' not reported	N=40	1.00 (0.67–1.50) N=82	0.85 (0.57–1.28) N=93
Test that IRR 3=IRR 4 (p value)			0.19	0.02
Group 5	ACD in non-HCWs 'latex' reported	N=169	0.99 (0.81–1.21) N=329	0.75 (0.61–0.93) N=290
Group 6	ACD in non-HCWs 'latex' not reported	N=683	0.89 (0.80–1.00) N=1221	0.68 (0.60–0.77) N=1100
Test that IRR 5=IRR 6 (p value)			0.39	0.59
Group 3	ACD in HCWs 'latex' reported	N=104	0.67 (0.51–0.89) N=141	0.47 (0.35–0.64) N=128
Group 5	ACD in non-HCWs 'latex' reported	N=169	0.99 (0.81–1.21) N=329	0.75 (0.61–0.93) N=290
Test that IRR 3=IRR 5 (p value)			0.07	0.07

'latex', 'latex and rubber glove allergens'; HCW, health care worker.

Table 5 Incidence Rate Ratios (IRRs) for Irritant Contact Dermatitis (ICD) in the transition and post intervention periods

Group number and description		Number of cases in Time 1	Transition period IRRs (95% CI) and number of cases	Post intervention IRRs (95% CI) and number of cases
All ICD		N=996	0.91 (0.83–1.00) N=1837	0.78 (0.71–0.86) N=1867
Group 1	ICD 'latex' reported	N=100	1.15 (0.88–1.49) N=229	1.23 (0.94–1.59) N=304
Group 2	ICD 'latex' not reported	N=1065	0.88 (0.80–0.98) N=1608	0.73 (0.66–0.81) N=1563
Test that IRR 1=IRR 2 (p value)			0.03	<0.001
Group 3	ICD in HCWs 'latex' reported	N=44	1.69 (1.18–2.42) N=147	1.47 (1.02–2.13) N=173
Group 4	ICD in HCWs 'latex' not reported	N=103	1.31 (1.02–1.70) N=279	1.36 (1.06–1.76) N=395
Test that IRR 3=IRR 4 (p value)			0.39	0.73
Group 5	ICD in non-HCWs 'latex' reported	N=56	0.77 (0.54–1.11) N=82	1.03 (0.73–1.46) N=131
Group 6	ICD non-HCWs 'latex' not reported	N=962	0.82 (0.74–0.92) N=1329	0.65 (0.58–0.72) N=1168
Test that IRR 5=IRR 6 (p value)			0.97	<0.001
Group 3	ICD in HCWs 'latex' reported	N=44	1.69 (1.18–2.42) N=147	1.47 (1.02–2.13) N=173
Group 5	ICD in non-HCWs 'latex' reported	N=56	0.77 (0.54–1.11) N=82	1.03 (0.73–1.46) N=131
Test that IRR 3=IRR 5 (p value)			0.001	0.08

'latex', 'latex and rubber glove allergens'; HCW, health care worker.

very little difference between the corresponding IRRs for cases associated with 'latex' (Group 1 IRR=0.64, 95% CI 0.54 to 0.77) and control (non-'latex') cases (Group 2 IRR=0.69, 95% CI 0.61 to 0.77). However, when this comparison was restricted to HCWs, a statistically significant ($p=0.02$) difference was seen between Group 3 cases associated with 'latex' (IRR=0.47, 95% CI 0.35 to 0.64) and control (non-'latex') Group 4 cases (IRR=0.85, 95% CI 0.57 to 1.28). IRRs among non-HCWs were smaller post intervention, both for cases associated with 'latex' exposures (Group 5 IRR=0.75, 95% CI 0.61 to 0.93), and for control (non-'latex') agents (Group 6 IRR=0.68, 95% CI 0.60 to 0.77), but the difference was not statistically significant. A less strong downward trend in cases associated with 'latex' was seen for non-HCWs (Group 5), compared with HCWs (Group 3) but the difference was not statistically significant ($p=0.07$).

ICD diagnoses taken as a whole showed a statistically significant reduction post intervention (IRR=0.78, 95% CI 0.71 to 0.86), as shown in table 5. However, the patterns over time for the whole workforce were different for cases associated with 'latex' where a non-significant increase was found post intervention (Group 1 IRR 1.23, 95% CI 0.94 to 1.59), and for control (non-'latex') cases where a decrease was seen (Group 2 IRR=0.73, 95% CI 0.66, 0.81). Among HCWs only, there were similar and statistically significant increases over time both in cases associated with 'latex' and in control (non-'latex') cases (Group 3 IRR=1.47, 95% CI 1.02 to 2.13 and Group 4 IRR=1.36, 95% CI 1.06 to 1.76); control (non-'latex') exposures were mainly water/wet work/washing, soaps/detergents and sterilising/disinfecting agents). There was no increase in cases associated with 'latex' among non-HCWs (Group 5 IRR=1.03, 95% CI 0.73 to 1.46), while a decreased IRR was found post intervention for cases associated with control (non-'latex') agents among non-HCWs (Group 6 0.65, 95% CI 0.58 to 0.72). The difference between HCWs and non-HCWs (Groups 3 and 5) in cases associated with 'latex' was not statistically significant ($p=0.08$).

DISCUSSION

This study aimed to investigate effects of interventions intended to reduce workers' exposures associated with natural rubber glove use. In order to do this, an analysis was undertaken of data collected by a UK-wide surveillance scheme for occupational skin disease (EPIDERM), which is based on voluntary incident case reporting by clinical specialists in dermatology.^{15 17}

A key question was whether, following the interventions, there was a difference in contact urticaria reporting (type I hypersensitivity) and/or allergic contact dermatitis reporting (type IV hypersensitivity) for cases associated with 'latex' exposure compared with control (non-'latex') exposed cases. Analysis of the workforce as a whole showed post intervention downward trends in IRRs in both CU and ACD diagnoses where cases were associated with 'latex' (Group 1), and also for other exposures (Group 2). However, a post intervention comparison of cases exposed to 'latex' and control (non-'latex') cases did not show a difference for either CU or ACD reporting. This may be because, coincidental to the intervention being assessed in this study, there may be changes in patterns of use and exposure to non-'latex' workplace agents that also cause CU and ACD. Additionally, interventions aiming to reduce other workplace exposures have been introduced, for example a significant decline in the UK incidence of chromate attributed ACD has been associated with the implementation of European Union legislation, which was implemented on 1 January 2005.²³

Of particular interest was whether the interventions aimed at reducing occupational exposure to 'latex' were effective in HCWs (Groups 3 and 4). In HCWs diagnosed with CU, for cases with 'latex' exposure a post intervention reduction in IRR was found, but there were insufficient control (non-'latex') cases to allow a meaningful comparison to be made. For HCWs with ACD, post intervention IRRs were significantly lower for cases associated with 'latex' exposure than for control (non-'

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latex' cases). However, ACD that is associated with 'latex' is likely to relate to exposure to rubber accelerators, so the post intervention IRRs are probably reflecting a change from using latex to non-latex gloves, rather than from continuing latex glove use (but using non-powdered rather than powdered gloves).

Analysis according to industrial sector (HCWs or non-HCWs) may give further indications about compliance with the interventions. For both CU and ACD cases associated with 'latex' exposure (Groups 3 and 5) the timing of the interventions coincided with a trend towards decreased case reporting; this was more obvious, especially for ACD (although not statistically significant when Groups 3 and 5 were compared) in HCWs than for those employed in other occupations. A greater post intervention decline for HCWs than non-HCWs might be expected, as HCWs are mainly employed within the National Health Service, which has better access to occupational health medical specialist advice and service provision than other workers.⁹ Post intervention results for non-HCWs for both 'latex' and control (non-'latex') cases (Groups 5 and 6) are generally encouraging; these findings may be because of interventions aimed at 'latex' or other workplace exposures,²³ or as a result of specific campaigns by enforcement agencies including the Health and Safety Executive, which have been aimed at Small and Medium Sized Employers (eg, Bad Hand Day aimed at the hairdressing industry, launched in 2006).²⁴

For ICD diagnoses, the timing of the interventions corresponded with upward trends in IRRs for the workforce as a whole for cases that were associated with 'latex' (Group 1), and decreased IRRs for control (non-'latex') cases (Group 2); the difference in post intervention IRRs for Groups 1 and 2 was statistically significant. For HCWs with ICD, post intervention IRRs were significantly higher both for cases associated with 'latex' exposure and for control (non-'latex' cases), with no difference found on comparison of IRRs for Groups 3 and 4. In comparison, for non-HCWs with ICD, the intervention appeared to have little impact on ICD cases that were associated with 'latex' (Group 5), whereas IRRs for control (non-'latex') cases (Group 6) were reduced; a comparison of non-HCWs' cases by exposure showed a significant difference between IRRs for Groups 5 and 6. Additionally, for ICD cases where 'latex' was cited as a causal agent, although the post intervention IRR was larger for HCWs than for non-HCWs, the difference was not statistically significant (Groups 3 and 5).

As latex is not reported to cause ICD,^{25 26} these findings are likely to be a reflection of the equal emphasis that is applied to agents reported to EPIDERM; for example in a worker reported as having ICD, the suspected causal agents may be cited as 'wet work' and 'latex gloves'; however, any occlusive personal protective equipment (eg, gloves) may contribute to the aetiology of ICD, while composition of the gloves (eg, latex) is incidental. The introduction of measures for reducing health-care associated infection transmission have included infection control strategies and risk assessment, but have also highlighted employees' practice and behaviour (including an emphasis on hand washing and glove use, and the introduction of new agents such as alcohol gels).²⁷ As an example of this, analysis of the ICD cases in EPIDERM within the time period covered by this study showed a three-fold increase in reporting (pre intervention 0.47 cases/month; post intervention 1.82 cases/month) where case reports included handwashing, washing, soaps, scrubs and hand cleansers as suspected agents; for the remaining ICD cases that were reported as associated with

other agents there was little change in pre and post intervention reporting (2.87 and 3.16 cases/month respectively). It is therefore important that any infection control strategies should also take hand care into consideration. As these measures coincided with the period covered by this study, it is likely that the results for ICD (at least) reflect events which were not related to the introduction of interventions aiming to reduce exposure to latex. In addition, analysis of ICD was not part of the original hypothesis, and the time periods specified had no a priori expected results for ICD; investigating annual changes in ICD incidence may well provide a better method when analysing this diagnosis.

As this study investigated effects of exposure to 'latex', the accuracy of information from reporters when assigning a diagnosis and describing an individual's job / industry is paramount. Diagnoses such as CU and CD sub-groups are classified for each case by the reporting physician, who is a clinical specialist in dermatology, and has the option of using patch testing at his/her disposal. Although EPIDERM reporting does not require a reporter to have confirmation of a diagnosis (eg, of ACD or ICD) by specific clinical investigations, analysis of EPIDERM data has shown that at least 96% of reporters use patch testing. Although most EPIDERM reporters opt for a specific diagnosis (such as ACD or ICD) rather than mixed or unclear CD the possibility of misclassification of cases is accepted; however, guidance for case reporting to EPIDERM is provided to participating physicians.¹³ Additionally, only specific diagnoses (of ACD or ICD) were used in the IRR analyses, and jobs were classified fairly easily into HCWs and other workers.

A more difficult issue relates to attributing the impact of the causal agents associated with each case. In EPIDERM, up to six suspected agents can be reported per case and equal emphasis is applied for causality of each agent; however, this may not necessarily be what a clinical specialist would do in practice. For example, patch testing results may identify a range of agents as potentially sensitising exposures, but some may be much more likely to be causal in reality (such as in the workplace) than others. EPIDERM's methodology might therefore be improved if ranking of the likelihood of causality of agents was introduced, even if actual (proportionate) risk per agent cannot easily be established.

It is recognised that not all cases in the UK are captured by EPIDERM. Recent analysis of THOR data has been undertaken to estimate the number of additional cases not captured in 2005–2007, focusing on respiratory and skin diagnoses.²¹ It was found that 98% of eligible physicians had been approached to report to EPIDERM, and that dermatologists' participation rates were high (65%); overall it was estimated that 62% cases were captured by EPIDERM. However, incomplete case capture (and indeed some misclassification of cases) should not bias comparisons over time within EPIDERM. Furthermore, estimates from the random effects models may be viewed as measures of within-reporter change.²⁸ However, if there are changes in disease recognition, or completeness over time, then these would introduce bias.

Development of more recent methodology has also allowed investigation of time trends in the incidence of work-related disease in the UK (including EPIDERM reporting),²⁰ but there is little other information available on time trends for occupational dermatoses. However, time trends for occupational asthma (OA), based on compensation data from 298 cases, have been reported.²⁹ For latex-induced OA there was an

apparent increase for latex-induced OA between 1993 and 2002; however, after categorising claims by year of asthma onset (rather than year of claim submission) a decline in incidence in latex-induced OA was found from 1998 onwards.

The impact of intervention strategies, involving the use of low protein powder free natural rubber latex gloves, has been assessed in other studies, with a decline in the number of suspected cases of occupational contact urticaria reported post intervention in German HCWs.³⁰ However, a cross-sectional latex symptom survey undertaken in the USA showed that HCWs, even those with skin symptoms, chose to use more allergenic powdered latex gloves over non-powdered alternatives—highlighting the need for education and training of a workforce in addition to introducing substitution measures.³¹ Introduction of secondary individual prevention courses has been shown to be effective in a 1 year follow up study, where there were improvements in skin lesions and fewer reports of quality of life impairment for workers in the German health-care sector.³²

This study showed how trends in incidence for occupational dermatoses can be investigated in terms of interventions that aimed to reduce exposures to agents known to cause work-related ill-health. Importantly, other coincidental events need to be taken into account when interpreting results; examples relevant to this study include the introduction of European Union legislation to reduce exposure to chromate in cement,²³ and specific campaigns by enforcement agencies.²⁴ Additionally, as some estimated changes in incidence based on volunteer reporting may be biased by reporter fatigue, apparent downward trends need to be interpreted cautiously.²⁸ However, the methodology can be applied to other diagnosis (dermatological and beyond) where there are available data covering relevant time periods. Importantly, different occupational groups can be studied, allowing investigation of problems that may be shifting between industrial sectors or workforces, and adds to an overall evidence base that can be used to improve employees' health.

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