Acta Derm Venereol (Stockh) 1998; 78: 358–363

Contact Allergies in Healthcare Workers. Results from the IVDK*

A. SCHNUCH[1], W. UTER[1,2], J. GEIER[1], P. J. FROSCH[3] and T. RUSTEMEYER[3]

[1]*IVDK-Zentrale/Department of Dermatology, University of Göttingen,* [2]*Department of Dermatology, University of Osnabrück and* [3]*Department of Dermatology, Dortmund and University of Witten/Herdecke, Germany*

Healthcare workers often suffer from occupational skin disease frequently caused by allergic sensitization. Therefore the patch-test results and important patient history items of 31,849 patients recorded between 1992 and 1995 in the 24 allergy departments participating in the Information Network of Departments of Dermatology (IVDK) were evaluated. Significantly increased sensitization rates common to the healthcare sector as a whole were found for the vaccine preservative thiomersal (12.6% vs. 4.9%), the surface and instrument disinfectants glutardialdehyde (9.9% vs. 2.6%), formaldehyde (3.6% vs. 2.1%) and glyoxal (4.2% vs. 1.4%), and for the compounds of the thiuram mix (6.7% vs. 2.6%) present in protective gloves. Formaldehyde seems to lose its importance, but glyoxal must be added to the list of occupational allergens in the healthcare sector. In addition, occupation-specific sensitization was observed, with fragrances in massage therapists (16.1% vs. 10.6%) and nurses (13.8% vs. 11.4%), as well as with methacrylates in dental technicians. The often assumed importance of drugs as type-IV allergens was not confirmed, at least in terms of quantity. The identification of subgroups of increased risk and of occupation-specific allergens could be the basis of targeted preventive action in the healthcare sector. ***Key words: allergic contact dermatitis; biocides; clinical epidemiology; dental technicians; dentists; disinfectants; nurses; occupational skin disease; rubber.***

(Accepted February 27, 1998.)

Acta Derm Venereol (Stockh) 1998; 78: 358–363.

A. Schnuch, IVDK/University Skin Hospital, von Siebold Str 3, DE-37075 Göttingen, Germany.

There are many causes of occupational skin disease in healthcare workers (1–4); the prevalence is suggested to be about 30% (2). In 1995, the German occupational insurance systems spent nearly DM 100 million on compensation claims (4). The list of different occupations includes mainly nurses, physicians and paramedical professionals (like masseurs, laboratory workers and dieticians), although other occupations can be found, too (such as clerical workers, cleaners, carpenters and other technical support staff). Nurses are most often affected by hand eczema. The prevalence has been estimated to be about 30% (5), and the incidence has been found to be 7.8 in a retrospective study (6) and 14.5 per 100 person-years in a prospective study (7). Eczema may be irritant or allergic, neither of which has been assessed in detail in the studies mentioned. Knowledge about the agents causing occupational contact dermatitis is based mostly on the analysis of case reports and small clinical studies (8), seldom on a larger sample of patients (4). Rubber chemicals, disinfectants and drugs are listed as important allergens (8), and sometimes nickel (9) and chromium (10) are mentioned. Dental technicians are often sensitized to their specific working material, especially to methacrylates (11).

For individual diagnostic purposes as well as preventive action it is important to know not a historical but the current spectrum of allergens. So, in order to improve the scientific database on the spectrum of allergens encountered in healthcare, we evaluated the patch test results with relevant allergens obtained by departments joining the Information Network of Departments of Dermatology (IVDK) (12).

PATIENTS AND METHODS

Patch-test results and important patient history items (e.g. occupational background, suspected allergen exposure, personal data (age, sex, geographical origin), clinical data (present skin disease[s], atopic diseases) were continuously recorded in the 24 allergy departments participating in the IVDK (12, 13). A flexural eczema or eczema in other parts of the body in patients with an unequivocal history of atopy was classified as atopic dermatitis, mostly in accordance with definitions by Hanifin & Rajka (14).

Patients

For the present study we evaluated the data of patients ($n = 31{,}849$) registered between January 1992 and December 1995. Data concerning the following occupational subgroups of the general IVDK data pool were analysed further: nurses, nurse auxiliaries, theatre nurses, receptionists, dental nurses, laboratory workers, dental technicians, masseurs, surgeons, physicians and dentists. The remainder (i.e. patients not belonging to any of the groups mentioned) served as a control group. The majority (86%) of patients working in one of the medical professions were women (receptionists 99%, physicians 60%, surgeons 35%). Atopic dermatitis (past or present) was suspected more often (25%) than in the control group (18%), except for theatre nurses (11%). Compared with the control group, occupational dermatitis was suspected more often in patients from the healthcare sector (38% vs. 13%), namely in theatre nurses in 59%, dental nurses in 55%, and dental technicians in 70% of cases. In most cases the site of eczema was the hands (49% vs. 28%) (in dental laboratory workers 77% and theatre nurses 68%), whereas leg dermatitis was rarely found (2% vs. 8%). Patients were generally younger (70% < 40 years of age) than the control group (42%), and often co-factors like wet work (46% vs. 37%) and gloves (34% vs. 11%) were mentioned explicitly.

*IVDK: Information Network of Departments of Dermatology. The study was performed in cooperation with the German Contact Dermatitis Group (DKG). The following departments of Dermatology participated: Berlin Charité (B. Laubstein), Berlin Rudolf Virchow (J. Grabbe), Berlin Benjamin-Franklin (B. Tebbe), Dortmund (P. J. Frosch, B. Pilz), Dresden (G. Richter), Duisburg (J. Schaller, M. Fuchs), Erlangen (K.-P. Peters, T. L. Diepgen), Essen (H. M. Ockenfels), Göttingen (Th. Fuchs), Graz (W. Aberer, B. Kränke), Halle (B. Lübbe, G. Gaber), Hamburg (M. Kiehn, D. Vieluf), Heidelberg (A. Schlulze-Dirks, J. Zimmermann), Homburg/Saar (F. A. Bahmer, P. Koch), Jena (M. Gebhardt), Kiel (J. Brasch, T. Henseler), Lübeck (K.-P. Wilhelm, J. Kreusch), Mainz (D. Becker), München LMU (F. Enders, F. Rueff), München Schwabing (M. Agathos, R. Breit), München TU (J. Rakoski, C. Szliska), Osnabrück (W. Uter, J. Schwanitz), Tübingen (G. Lischka), Wuppertal (O. Mainusch, J. Fränken).

 ISSN 0001-5555

Table I. *The most frequent allergens in women with medical occupations compared to a control group (without medical occupations)*

Substance	Concentration %	Vehicle	Medical occupations		Control group	
			No. tested[1]	Age stand. rate[2] %	No. tested	Age-stand. rate %
Miscellaneous:						
Nickel sulfate	5	Pet.	2187	23.6	18857	23.2
Fragrance mix	8	Pet.	2192	12.4	18855	11.4
Cobalt	1	Pet.	2198	5.9	18973	5.9
Balm of Peru	25	Pet.	2197	**4.9***	18898	6.7
Benzoylperoxide	1	Pet.	914	8.8	6358	8.6
p-Phenylendiamine	1	Pet.	2204	4.4	18891	5.3
Potassium dichromate	0.5	Pet.	2212	3.2	19029	4.0
Colophony	20	Pet.	2206	2.9	18928	3.5
Biocides:						
Thimerosal	0.1	Pet.	2174	**12.6***	18502	4.9
Glutaraldehyde	1	Pet.	1194	**9.9***	3985	2.6
Formaldehyde	1	Aqu	2234	**3.6***	18964	2.1
Isothiazolinone (MI/MCI)	0.01	Aqu	2110	2.5	18470	2.4
Phenyl mercuric acetate	0.01	Aqu	1349	4.0	10486	3.7
Ammoniated mercury	1	Pet.	2169	2.2	18679	2.6
Dibromogluatronitril/PE	0.5	Pet.	2148	1.9	18361	1.7
Glyoxal	1	Aqu	774	**4.2***	1895	1.4
Benzalkonium-Cl	0.1	Pet.	1406	2.0	10274	1.6
Rubber:						
Thiuram-mix	1	Pet.	2197	**6.7***	18928	2.6
Tetramethylthiurammonosulfide	0.25	Pet.	827	9.1	2166	6.0
Tetraethylthiuramdisulfide	0.25	Pet.	821	8.1	2164	6.4
Tetramethylthiuramdisulfide	0.25	Pet.	813	6.1	2133	4.0
Dipentathiuramdisulfide	0.25	Pet.	824	4.9	2169	3.1

[1]Number of patients tested.
[2]Rates standardized by age (two groups, <40 and ≥ 40).
The figures show percentage of positive and total number tested. Significant differences with asterix ($*p < 0.05$).

Methods

Patch tests were performed in accordance with the recommendations of the ICDRG (15) and the DKG (the German Contact Dermatitis Group). Finn-Chambers-on-Scanpor were used in 19 departments, other systems (Leukotest, Hal, Curatest, Haye) in 5 departments. The test substances were delivered by Hermal/Reinbek (Germany). Nine of 24 centres applied patch tests for 24 h, the remainder for 48 h. Results of 24 h and 48 h applying centres were pooled, as it is still not clear which of the application times yields the best results (16, 17). Readings were done until at least 72 h after application of the test chambers. For this study, only readings at 72 h were considered. Different standard allergens and several special allergens were selected for evaluation if they attracted attention with higher rates of sensitization or if they differed considerably between subgroups. The proportions of sensitized were calculated for the control group and for the subgroups mentioned above. Standardization of data was done following the recommmendation on PAFS (Population Adjusted Frequency of Sensitization) (18), standardization of age on the basis of two equally sized age groups (<40 and >39 years of age), standardization of sex on the standard distribution of 35% men and 65% women. Relative risks and, in order

Table II. *Leading allergens in healthcare personnel. I: Sensitization rates*

Allergens	Nurses (f)	Receptionists (f)	Med. Lab. Workers (f)	Dental Nurses (f)	IVDK total (f)	Dental Techn. (f+m)	Dentists (f+m)	Physicians (f+m)	Masseurs (f+m)	IVDK total (f+m)
Nickel	24.9/1054	29.3/240	21.7/256	23.2/143	23.2/18857	15.6/156	14.1/64§	12.1/287	18.7/175	17.1/29930
Fragrance	13.8/1063	12.0/240	10.1/251	9.8/144	11.4/18855	6.5/153	8.1/62§	9.5/285	16.1/180	10.6/29870
Thiomersal	13.5/1059	5.0/241	12.7/251	12.8/140	4.9/18502	6.3/153	25.0/60§	15.0/279	10.6/174	4.7/29266
Thiuram	7.3/1063	5.0/241	3.8/253	4.6/143	2.6/18928	3.8/155	12.5/64§	8.0/288	4.5/179	2.4/29962
Glutardialdehyde	11.6/649	9.2/111	4.5/115	26.3/89	2.6/3985	6.5/31§	6.5/31§	1.6/122	2.7/73§	2.5/6460
Glyoxal	5.8/444	5.2/77§	3.2/62§	7.3/55§	1.4/1895	0.0/16	0.0/24	0.0/75	0.0/63	1.2/2881
Formaldehyde	4.3/1088	2.4/246	4.2/255	1.5/145	2.1/10274	2.6/156	1.6/64§	1.2/291	4.2/179	2.0/30019
Benzalkonium	2.4/703	0.6/159§	1.2/164§	3.3/92§	1.6/10274	0.0/23	2.4/41§	2.0/159§	0.9/106§	1.6/15751

Standardized (or crude (§)) sensitization rates of the most important allergens in different medical and paramedical occupations. The figures show percentage of positive reactions and total number of patients tested. IVDK total (control group): Results in patients without medical occupations tested in the departments belonging to the IVDK (see Methods); f = female; m = male.

Table III. *Leading allergens in healthcare personnel. II: Relative risks of sensitization in different occupations. The "occupational pattern" of an allergen is given in the rows, the "sensitization pattern" in the columns.*

Allergens	Nurses (f)	Receptionists (f)	Med. lab. Workers (f)	Dental Nurses (f)	Dental Techn. (f+m)	Dentists (f+m)	Physicians (f+m)	Masseurs (f+m)
Nickel	1.1	**1.3***	0.9	1.0	0.9	0.9§	**0.7***	1.1
	0.98 – 1.23	1.04 – 1.62	0.7 – 1.16	0.74 – 1.36	0.64 – 1.27	0.47 – 1.7	0.5 – 0.97	0.8 – 1.5
Fragrance	**1.2***	1.1	1.0	0.9	0.6	0.8§	0.9	**1.5***
	1.05 – 1.43	0.76 – 1.57	0.67 – 1.48	0.55 – 1.47	0.3 – 1.2	0.3 – 1.9	0.6 – 1.3	1.04 – 2.16
Thiomersal	**2.8***	1.02	**2.6***	**2.6***	1.3	**5.3***§	**3.2***	**2.3***
	2.4 – 3.3	0.65 – 1.59	1.85 – 3.66	1.72 – 3.93	0.69 – 2.42	3.19 – 8.8	2.28 – 4.49	1.43 – 3.7
Thiuram	**2.8***	**1.9***	1.5	**1.8***	1.6	**4.8***§	**3.1***	1.9
	2.16 – 3.63	1.1 – 3.3	0.8 – 3.6	1.02 – 3.19	0.72 – 3.57	2.39 – 9.6	2.07 – 4.65	0.85 – 4.24
Glutardialdehyde	**4.5***	**3.5***	1.7	**10.1***	2.6§	2.6§	0.6	1.1§
	3.31 – 6.13	1.97 – 6.23	0.69 – 4.17	6.12 – 16.66	0.65 – 10.43	0.65 – 10.43	0.19 – 1.88	0.27 – 4.44
Glyoxal	**4.1***	**3.7***§	**2.3***§	**5.2***§	–	–	–	–
	2.35 – 7.15	1.3 – 10.57*	1.4 – 3.9	1.82 – 14.86				
Formaldehyde	**2.0***	1.1	**2.0***	0.7	1.3	0.8§	0.6	**2.1***
	1.29 – 3.09	0.49 – 2.46	1.09 – 3.64	0.26 – 1.87	0.42 – 4.04	0.1 – 5.69	0.22 – 1.6	1.0 – 4.42
Benzalkonium	**1.5**	0.4§	0.8§	2.1§	–	1.5§	1.3§	0.6§
	0.92 – 2.44	0.07 – 2.86	0.2 – 3.23	0.67 – 6.58		0.21 – 10.68	0.4 – 4.1	0.1 – 4.3

Standardized Relative Risks (RR) calculated on the basis of the RR of subgroups (defined by age and sex), RR (not standardized) (§) and confidence intervals in different medical and paramedical occupations. The reference values (RR = 1.0) were taken from the figures of the control group ("IVDK total" – see text table II). The RR (with asterix) was considered to be significantly (on the 95% level) increased if the lower limit of the confidence interval was >1.0, and significantly decreased if the upper limit of the CI was <1.0. f = female; m = male.

to control for age and sex, pooled summary relative risks were calculated from the RR of the respective subgroups accompanied by their asymptotic 95% confidence intervals. Statistical analysis was performed using the SAS system (SAS Institute, Cary, NC) on the IBM host computer of the Department of Medical Informatics of the University of Göttingen.

RESULTS

The sensitization rates (standardized by age) of the most important allergens for women (>85% of the study population) working in the healthcare sector and for women of the remaining patch-test population are presented in Table I. There are three groups of substances with higher sensitization rates in the medical professions: Different biocides (from the standard series and from the preservative series), rubber compounds and, less marked, the fragrance mix. On the other hand, some allergens of the standard series led to allergic reactions less often, namely balm of Peru, paraphenylenediamine and potassium dichromate. A further analysis of rates of the most important allergens with respect to specific occupations (Table II) reveals quite homogeneous increases for certain allergens (e.g. rates of thiomersal and thiuram mix were higher than in the control group in nearly every profession), whereas the pattern of other more specific occupational allergens turns out to be quite heterogeneous (e.g. glutardialdehyde and glyoxal increased in nurses and dental nurses, fragrances in nurses and massage therapists). The relative risk to be sensitized to certain allergens of someone working in a specific medical profession is often significantly increased (Table III), yielding a "sensitization pattern" of the respective occupation (e.g. physicians and dentists were significantly affected by thiomersal and thiuram sensitizations only, whereas nurses were additionally sensitized to several biocides (disinfectants), and in massage therapists the fragrance mix was the leading allergen. The sensitization pattern and the exposure to working material of dental technicians differ considerably from the other professions (Table IV).

The most common final diagnosis was allergic contact dermatitis (ranging from 27% in dentists to 40% in dental laboratory workers) followed by irritant contact dermatitis (ranging from 14% in dental assistants to 33% in theatre nurses). Atopic dermatitis was rarely diagnosed in theatre nurses (2%), but more often in massage therapists (19%). Contact urticaria was rarely (in less than 1%) found in the general patch-test population, but was present more commonly in theatre nurses (11%), dental assistants (5%) and physicians (4%).

DISCUSSION

This study on a large sample of patch-test patients working in healthcare revealed typical sensitization patterns, which appear quite obviously occupation-related. Both sensitization common to the health sector as a whole (Table I) (e.g. sensitization to rubber ingredients or thiomersal) and allergens confined to certain specific occupations (e.g. certain disinfectants, preservatives, occupation-specific working materials) were found (Table III), with different (general vs. specific) consequences for diagnostic procedures and prevention. Furthermore, the subgroups were quite heterogeneous with regard to age, sex, occupational cause of dermatitis, atopic dermatitis and other demographic characteristics. Females dominated, and patients of the study group were much younger than patients of the control group. Therefore data evaluation concentrated on females, and standardization by age was employed for better comparison of sensitization rates between study and control group.

Although judgements on the "relevance" of patch-test reactions were generally recorded (as the assessment of relevance is considered to be important for individual diagnostic and pre-

Table IV. *Sensitization to (meth-)acrylates in dental technicians (women and men)*

Substance	Dental technicians		
	No. tested[1]	No. positive[2]	Rate positive[3] (%)
Ethyleneglycol-dimethacrylate	119	32	22.7
2-Hydroxyethylmethacrylate (HEMA)	115	27	23.5
Methylmethacrylate	143	18	12.6
Hydroxypropylmethacrylate	65	12	18.5
Ethylmethacrylate	110	10	9.1
Triethyleneglycol-dimethacrylate (TEGDMA)	137	7	5.1
Ethylacrylate	109	4	3.7
Pentaerythritol-triacrylate (PETA)	61	4	6.6
Butanedioldimethacrylate	137	3	2.2

[1]Number of patients tested. [2]Number of positively reacting patients. [3]Proportion of sensitized (%).
Pentaerythritol-triacrylate (PETA).

ventive reasons), data on this item were not evaluated. We considered the quality of this information (i.e. the level of evidence), at least in our data material, to be too heterogeneous to be suitable for further statistical evaluation. In addition, concepts of relevance are still under discussion (19–21), and they are far from being used uniformly. Therefore, in the present study, we concentrated on sensitization rates.

In the total study group (only women considered), the most important allergens were rubber chemicals, thiomersal and biocides. *Rubber allergy* was to be expected, as exposure to rubber and consequently rubber allergies has increased during the last 10 years due to the increased use of protective rubber gloves (22, 23). Thiurams are used as rubber vulcanization accelerators. Testing with the thiuram mix proved to be a good indicator of sensitization to the single compounds of the mix, in contrast to mercapto mix or carba mix (24). The highest rates of thiuram sensitization (data not shown) was found in surgeons (8/51), dentists (8/64) and theatre nurses (6/46). The fact that especially in the latter group contact urticaria (as a sign of type-I-allergy caused by latex (22)) was often diagnosed further supports the assumption that the wearing of rubber gloves increases the risk of rubber allergy (type-I and type-IV) considerably. Pre-existing irritant skin damage due to frequent and vigorous hand washing may increase the risk of sensitization.

Sensitization to *thiomersal* is significantly more common in healthcare employees due to its use in vaccine preparations (25). One example is the high prevalence of sensitization found in Graz/Austria (12%) (26), where many people are vaccinated against tick-borne virus encephalitis (25). In a recent analysis we reported a frank increase in sensitization to thiomersal for both women and men in the last 5 years (26). Nevertheless, higher rates to thiomersal in dental nurses and especially in dentists may be due to amalgam exposure as well, although the link between the sensitization to inorganic mercury compounds and to thiomersal is not very close (27).

Sensitization rates to *biocides* differed depending on their use: Biocides used as instrument and surface disinfectants caused a considerable, significantly high proportion of sensitizations, whereas contact allergies to biocides used to preserve cosmetics or external drugs (MI/MCI and methyldibromoglutaronitril) were generally *not* increased (Table I). This underlines the unequivocal occupational background, even if an exposure to, for example, glutardialdehyde or formaldehyde from a non-occupational setting cannot fully be excluded (28). *Glutardialdehyde* was the most important allergen, with significantly increased risk for nurses, receptionists and dental nurses. Glutardialdehyde was introduced partly to substitute formaldehyde, and was reported to be an occupational skin (and airway)-sensitizer in the healthcare sector (29). *Glyoxal* is not generally mentioned as an occupational allergen. Considering, however, a relatively high frequency of sensitization (Table II) and significantly increased risks (Table III) in nurses, receptionists, medical laboratory workers and dental nurses, glyoxal must be added to the list of occupational allergens (30), although confined to workers charged with the disinfection of surfaces and instruments.

By contrast, *formaldehyde* seems to have lost its importance as an allergen in the healthcare sector compared to previous decades (31). However, nurses, medical laboratory workers and masseurs are still at risk. A recently published analysis (31) showed that formaldehyde allergy is probably due to its use as a disinfectant and not as a preservative (it is in fact completely banned from the cosmetics market). On the other hand, the higher proportion in masseurs could reflect a high exposure to preservatives (i.e. formaldeyhde releaser (32)), as in this group of workers other preservatives (but not the other disinfectants) were often identified as sensitizers (data not shown). Insofar, co-sensitization may be a useful tool for describing exposure fields otherwise not clearly identified (31).

Benzalkonium chloride (33), a quaternary ammonium cationic detergent, is widely used as a preoperative skin disinfectant and surface and instrument disinfectant. It is also used in ophthalmic medications, but may be present as a preservative in cosmetic products, too. Sensitization to topically applied quaternary ammonium compounds are thought to give rise to systemic allergic cross-reactions to systemically applied quaternary ammonium drugs, e.g. neuromuscular blocking agents. Benzalkonium chloride is a rare allergen in general. Many reactions are irritant, with a reaction index of -0.2, and the majority of the "allergic" reactions are "+" reactions, as shown in a previous study (34). Nevertheless, its rate seems increased in nurses and dental nurses (Tables II and III). Reactions to biocides like hexachlorophen, chlorhexidine or chloramin T were rare.

In addition to these overall healthcare-related allergens, all of which should be tested in healthcare workers, certain special aspects of other allergens should be mentioned. Although *fra-*

grances are rarely considered to be an occupational allergen, the greater proportion in nurses is worth mentioning. Again, the analysis of co-sensitization may offer an explanation. In nurses, a sensitization of 5.1% (data not shown) to the preservative alkylaminobenzoate (benzoates of aliphatic fatty amines, preponderantly of the chain length C11 to C14) is conspicuous. It is contained in udder ointments which are used more and more often as an "alternative" cream. One may conclude that nurses often apply preserved dermatological preparations and use heavily perfumed liquid soaps and hand disinfectants, and are at increased risk of being sensitized due to inflamed, broken skin irritated by wet work and disinfectants (combination effect). Fragrances have to be considered as even more of an occupational allergen in massage therapists (Table III) (35). Again, the typical occupation-related pattern of co-sensitizations to several preservatives (like MI/MCI (4.9%), MDBGN (4.0%), chloroxylenol (3.2%) and Bronopol (3%) (data not shown)) points at the probable exposure (preserved external preparations, plant-derived essential oils).

Dental technicians merit a separate evaluation. They differed from the other healthcare occupations insofar as they were not at increased risk of being sensitized to any of the common allergens (Table III). However, the incidence of occupational skin disease is high in dental technicians (11), and although occupational hand eczema is often considered to be irritant, sensitization to methacrylates is of the utmost importance (11, 36). Major sensitizers include ethyleneglycol dimethacrylate (EGDMA), 2-hydroxyethyl methacrylate (HEMA), methyl methacrylate (MMA) and hydroxypropyl methacrylate (2-HPMA) (Table IV). Reactions to acrylates with longer middle chains (e.g. triethylenglycol dimethacrylate (TEGDMA) or butandiol dimethacrylate (BUDMA) were less frequent. According to Rustemeyer & Frosch (11) these compounds should be used more frequently in dental laboratories, because of their presumably lower sensitizing potential.

The most common allergen in the female study population was *nickel* (23.6%). However, there was no difference with regard to the control group (23.2%). Nevertheless, it cannot be dismissed completely that exposure to various nickel containing materials (e.g. surgical instruments) may pose a risk for healthcare personnel (9), especially in combination with the exposure to disinfectants, cleansing agents and wet work. Using the dimethylglyoxime spot test, several objects gave positive results (9). However, primary sensitization to nickel is thought mainly to be due to a non-occupational source, e.g. cheap jewellery. A higher proportion in receptionists and a lower in physicians (Tables II and III) may indicate the role of sociological factors (26).

CONCLUSION

This study analysed sensitization patterns of healthcare workers in different occupations. Not every possible allergen was considered, only those which are regarded as important in terms of quantity. In general this "occupational sensitization pattern" consists of thiurams (rubber compounds), thiomersal (vaccine preservative) and several biocides (surface and instrument disinfectants). In addition to confirming this known pattern, the analysis revealed a shift from formaldehyde (formerly by far the most important allergen in nurses) to glutardialdehyde and glyoxal as important allergens, showing that one evil was cured with an even worse evil. No longer can glyoxal be considered a rare sensitizer (1, p. 202). On the other hand, substances commonly listed as (important) allergens in healthcare workers do not appear to be important from our study, namely medicaments (like penicillins, cephalosporins, antineoplastic agents or chlorpromazine) (2). Even in dentists we diagnosed only few cases of sensitization to local anaesthetics. Because of this restricted importance, together with a high risk of active sensitization, the routine testing of medicaments in for example nurses cannot be recommended. However, there still seem to be some allergens characteristic for specific occupations like methacrylates in dental technicians, and fragrances in nurses and, most importantly, in massage therapists. Finally, one important issue in occupational dermatoses in healthcare workers is multiple exposure to allergenic and irritant compounds. The risk of sensitization is increased in pre-existing hand dermatitis, which may be due to wet work, irritants, atopic dermatitis or allergic contact dermatitis. This possibility of combination effects stresses the need of preventive actions against each of the single factors, including exposure to allergens.

REFERENCES

1. Foussereau J. Guide de dermato-allergologie professionnelle. Paris: Masson, 1991.
2. Hogan DJ. Contact dermatoses in health care workers. In: Menné T, Maibach HI, eds. Exogenous dermatoses: environmental dermatitis. Boca Raton: CRC Press/Boston: Ann Arbor, 1991: 389 – 400.
3. Stingeni L, Lapomarda V, Lisi P. Occupational hand dermatitis in hospital environments. Contact Dermatitis 1995; 33: 172 – 176.
4. Rustemeyer Th, Pilz B, Frosch PJ. Kontaktallergien in medizinischen Berufen. Hautarzt 1994; 45: 834 – 844.
5. Smit HA, Burdorf A, Coenraads PJ. The prevalence of hand dermatitis in different occupations. Int J Epidemiol 1993; 22: 288 – 293.
6. Smit HA, Coenraads PJ. A retrospective cohort study on the incidence of hand dermatitis in nurses. Int Arch Occup Environ Health 1993; 64: 541 – 544.
7. Smit HA, van Rijssen A, Vandenbroucke JP, Coenraads PJ. Individual susceptibility and the incidence of hand dermatitis in a cohort of apprentice hairdressers and nurses. In: Smit HA. Work-related hand dermatitis – epidemiological studies in occupational dermatology. Proefschrift Rijksuniversiteit Groningen 1992: 97 – 120.
8. Rudzki E. Occupational dermatitis among health service workers. Dermatosen 1979; 27: 112 – 115.
9. Schubert HJ. Nickel dermatitis in medical workers. Dermatol Clin 1990; 8: 45 – 47.
10. Rudzki E, Rebandel P, Grzywa Z. Patch tests with occupational contactants in nurses, doctors and dentists. Contact Dermatitis 1989; 20: 247 – 250.
11. Rustemeyer T, Frosch PJ. Occupational skin diseases in dental laboratory technicians. (I). Clinical picture and causative factors. Contact Dermatitis 1996; 34: 125 – 133.
12. Schnuch A, Lehmacher W. Epidemiologische Überwachung des Kontaktekzems – Darstellung des Projektes "Informationsverbund Dermatologischer Kliniken" (IVDK) in Anlehnung an die "Guidelines for Evaluating Surveillance Systems" des Center of Disease Control (CDC). Dermatosen 1992; 40: 177 – 189.
13. Uter W, Diepgen TL, Arnold R, Hillebrand O, Pietrzyk PM, Stüben O, Schnuch A. The Informational Network of Departments of Dermatology in Germany – a Multicenter Project for Computer-assisted Monitoring of Contact Allergy – Electronic Data Processing Aspects. Dermatosen 1992; 40: 142 – 149.

14. Hanifin JM, Rajka G. Diagnostic features of atopic dermatitis. Acta Derm Venereol Suppl (Stockh) 1980; 92: 44 – 47.
15. Fregert S. Manual of contact dermatitis, 2nd ed. Copenhagen: Munksgaard, 1981.
16. Schnuch A, Martin V. Der Epikutantest. In: Korting HC, Sterry W (Hrsg). Diagnostische Verfahren in der Dermatologie. Berlin: Blackwell Wissenschafts-Verlag, 1997: 99 – 116.
17. Brasch J, Geier J, Henseler T. Evaluation of patch-test results by use of the reaction index – an analysis of data recorded by the Information Network of Departments of Dermatology (IVDK). Contact Dermatitis 1995; 33: 375 – 380.
18. Schnuch A. PAFS – Population adjusted frequency of sensitization (I) – Influence of sex and age. Contact Dermatitis 1996; 34: 377 – 382.
19. Bruze M. What is a relevant contact allergy? Contact Dermatitis 1990; 23: 224 – 225.
20. Ale SI, Maibach HI. Clinical relevance in allergic contact dermatitis. An algorithmic approach. Dermatosen 1995; 43: 119 – 121.
21. Lachapelle J-M. A proposed relevance scoring system for positive allergic patch-test reactions: practical implications and limitations. Contact Dermatitis 1997; 36: 39 – 43.
22. Fuchs Th. Gummi und Allergie. München-Deisenhofen: Dustri-Verlag, 1995.
23. von Hintzenstern J, Heese A, Koch HU, Peters K-P, Hornstein OP. Frequency, spectrum and occupational relevance of type IV allergies to rubber chemicals. Contact Dermatitis 1991; 24: 244 – 252.
24. Geier J, Gefeller O. Sensitivity of patch tests with rubber mixes: results of the Information Network of Departments of Dermatology from 1990 to 1993. Am J Contact Dermat 1995; 6: 143 – 149.
25. Aberer W, Reiter E, Ziegler V, Gailhofer G. The importance of including thimerosal, an increasingly frequent allergen in Europe, in standard screening series for allergic contact dermatitis. Am J Contact Dermat 1991; 2: 110 – 112.
26. Schnuch A, Geier J, Uter W, Frosch PJ, Lehmacher W, Aberer W, et al. National rates and regional differences in sensitization to allergens of the standard series. Population adjusted frequencies of sensitization (PAFS) in 40,000 patients from a multicenter study (IVDK). Contact Dermatitis 1997; 37: 200 – 209.
27. Enders F, Przybilla B, Ring J. Quecksilberkontaktallergie und die Beziehung zur Thiomersalkontaktallergie. Allergologie 1990; 13: 319.
28. Jaworsky C, Taylor JS, Evey P, Handel D. Allergic contact dermatitis to glutaraldehyde in a hair conditioner. Cleve Clin J Med 1987; 54: 443 – 444.
29. Geier J, Schnuch A. Glutardialdehyd – Berufsspektrum eines Allergens. Dermatosen 1995; 43: 30 – 31.
30. Elsner P, Pevny I, Burg G. Occupational contact dermatitis due to glyoxal in health care workers. Am J Contact Dermat 1990; 1: 250 – 253.
31. Schnuch A, Geier J. Formaldehyd-Allergie: Aktuelle Trends im internationalen Vergleich. Auswertungen der IVDK-Daten der Jahre 1992 – 1995. Allergologie 1997; 20: 205 – 214.
32. Geier J, Lessmann H, Schnuch A, Fuchs Th. Kontaktallergien durch Formaldehyd abspaltende Biozide. Allergologie 1997; 20: 215 – 224.
33. Schnuch A. Benzalkonium Chlorid. Dermatosen 1997; 45: 179 – 180.
34. Brasch J, Henseler T, Frosch PJ. Patch-test reactions to a preliminary preservative series – a retrospective study based on data collected by the Information Network of Dermatological Clinics (IVDK) in Germany. Dermatosen 1993; 41: 71 – 76.
35. Taraska V, Pratt M. Contact dermatitis in massage therapists. Am J Contact Derm 1997; 8 (1): 63 (Nr. 19).
36. Kanerva L, Estlander T, Jolanki R. Allergy Caused by Acrylics: Past, Present and Prevention. in: P Elsner, J M Lachapelle, J E Wahlberg, H I Maibach (Eds), Prevention of Contact Dermatitis (Current Problems in Dermatology, Vol 25), Karger, Basel 1996: 86 – 96.