

# Contact Allergy to Allergens in the Swedish Baseline Series Overrepresented in Diabetes Patients with Skin Reactions to Medical Devices: A Retrospective Study from Southern Sweden

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**Allergic contact dermatitis is reported among individuals using continuous glucose monitoring systems and insulin pumps. The aim of this study was to describe contact allergy patterns for allergens in the Swedish baseline series and medical device-related allergens among users. Contact allergy to baseline series allergens and isobornyl acrylate was compared between diabetes patients and dermatitis patients patch-tested at the Department of Occupational and Environmental Dermatology during 2017 to 2020. Fifty-four diabetes patients and 2,567 dermatitis patients were included. The prevalence of contact allergy to fragrance mix II and sesquiterpene lactone mix was significantly higher in diabetes patients compared with dermatitis patients. Of the diabetes patients 13.0% and of the dermatitis patients 0.5% tested positive to sesquiterpene lactone mix ( $p < 0.001$ ). Of the diabetes patients 7.4% and of the dermatitis patients 2.3% tested positive to fragrance mix II ( $p = 0.041$ ). Of the diabetes patients 70.4% tested positive to medical device-related allergens. Of the diabetes patients 63.0% and of the dermatitis patients 0.2% were allergic to isobornyl acrylate ( $p < 0.001$ ). In conclusion, not only medical device-related contact allergies, but also contact allergy to baseline series allergens (fragrance mix II and sesquiterpene lactone mix), is overrepresented in diabetes patients who use medical devices.**

*Key words:* allergic contact dermatitis; continuous glucose monitoring; diabetes type 1; insulin pump; isobornyl acrylate; patch-testing.

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In recent years, many cases of contact allergy to substances found in medical devices (MDs), particularly continuous glucose monitoring (CGM) systems and insulin pumps, have been reported. To date, isobornyl acrylate (IBOA) has been a main allergen (1–6). Among IBOA-allergic patients using FreeStyle Libre, a higher-than-expected number of patients has been reported to be sensitized to fragrances and sesquiterpene lactone mix

## SIGNIFICANCE

This study shows an overrepresentation of contact allergy to allergens in the Swedish baseline series (fragrance mix II and sesquiterpene lactone mix) among individuals with diabetes using medical devices. The cause of this overrepresentation of contact allergy to allergens not traditionally associated with the use of medical devices needs to be further elucidated. Preventing further exposure is important to avoid new cases of contact allergy among users as well as to avoid the elicitation of allergic contact dermatitis among sensitized individuals.

(SLM) (7, 8). However, the underlying reason for the concomitant positive reactions is not known, and neither fragrances nor SLM constituents have been identified in the glucose sensors.

MDs are not ingredient-labelled; thus their content is largely unknown. Topical products used to prepare skin sites for the MDs, device removal and treatment of skin reactions also pose potential risks of contact sensitization among users. Knowledge of the contact allergy pattern among users exposed to allergens in MDs and related products is essential for preventive measures.

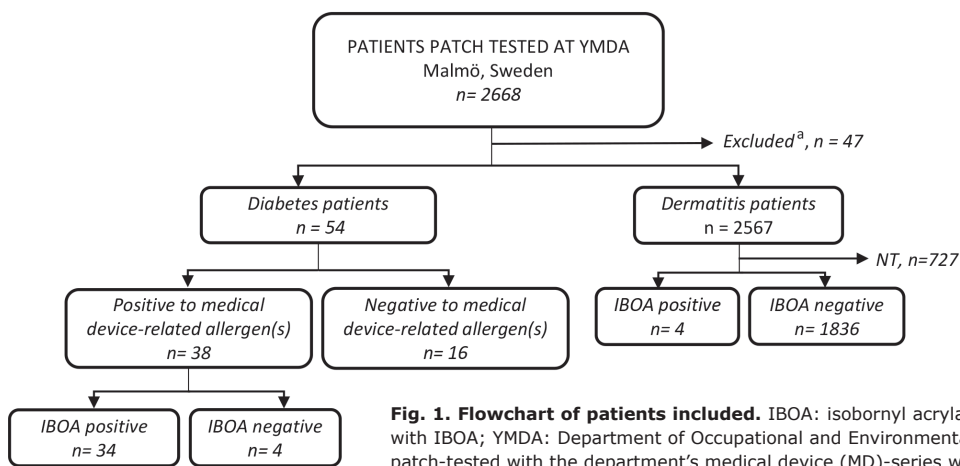
The aim of the current study is to report the contact allergy rates and patterns seen in diabetes patients patch-tested due to suspected allergic contact dermatitis (ACD) to CGM systems and/or insulin pumps, compared with consecutive dermatitis patients patch-tested because of suspected ACD.

## MATERIALS AND METHODS

### Patients and patch-testing

Adult patients referred to and patch-tested due to dermatitis between October 2017 and October 2020 at the Department of Occupational and Environmental Dermatology in Malmö, Sweden (YMDA) or its branch clinics were included. Patch-test results for some of the diabetes patients have been published in detail previously as case reports (5, 9–13). Patients' characteristics, including age, sex, and a history of atopic dermatitis (AD) were recorded.

Diabetes patients patch-tested due to suspected ACD to their CGM systems and/or insulin pumps were grouped as "diabetes patients". Other patients patch-tested with the department's MD series, such as patients with ostomy, were excluded. "Dermatitis patients" refer to all other patients included (Fig. 1). The study



**Fig. 1. Flowchart of patients included.** IBOA: isobornyl acrylate; *n*: number of patients; NT: not tested with IBOA; YMDA: Department of Occupational and Environmental Dermatology, Malmö, Sweden. <sup>a</sup>Patients patch-tested with the department's medical device (MD)-series who were not diabetes patients.

was approved by the Swedish Ethical Review Authority (dnr 2020-02190).

To also assess the potential importance of IBOA as an allergen in other patient groups it has been patch-tested in consecutive dermatitis patients at YMDA at concentrations of 0.1% and 0.3% w/w since 2018 and 2020, respectively (14).

Patch-test results for allergens in the Swedish baseline series (Table II), different variants of the department's MD series (Table III) and for IBOA were retrieved from the department's patch-test registers.

The term "MD-related allergens" refers to allergens included in different variants of "the Department's MD series", IBOA 0.1% and 0.3% in petrolatum (pet.) and to colophonium 20% in pet., respectively. The term "fragrance allergens" refers to the fragrance allergens in the Swedish baseline series (colophonium, fragrance mix (FM) I, II, lichen acid mix, and *Myroxylon pereirae* resin (MP)). The term "preservative allergens" refer to methylchlorisothiazolinone/methylisothiazolinone (MCI/MI), methylisothiazolinone (MI), formaldehyde, paraben mix, diazolidinyl urea, methylidibromoglutaronitrile (MDBGN), and quarternium 15. "Metal allergens" refer to nickel(II)sulphate hexahydrate, cobalt(II)chloride hexahydrate, and potassium dichromate and "rubber allergens" refer to mercapto mix, black rubber mix, and thiuram mix (Table II).

The allergens (Chemotechnique MB Diagnostics AB, Vellinge, Sweden, and for the MD-related allergens also in house preparations (11)) were tested by applying 20 mg petrolatum preparations (40 mg/cm<sup>2</sup>) and 15 µL liquid preparations (30 µL/cm<sup>2</sup>) in either 8-mm Finn Chambers or 8-mm Finn Chambers Aqua (SmartPractice, Phoenix, AZ, USA), or 25 mg petrolatum preparations (39 mg/cm<sup>2</sup>) and 20 µL (31 µL/cm<sup>2</sup>) liquid preparations in IQ Ultra or IQ Ultimate chambers (Chemotechnique MB Diagnostics AB). Patch-test chambers were occluded on the subject's back for 48 h. Patch-test reading is at YMDA, performed on day (D)3 or D4 and D7. The tests were read and scored according to the International Contact Dermatitis Research Group and European Society of Contact Dermatitis criteria (15, 16).

**Table I. Demographic data of patients**

	Diabetes patients <i>n</i> = 54	Dermatitis patients <i>n</i> = 2,567	<i>p</i> -value
Age, year, mean ± SD	45.11 ± 16.21	45.06 ± 16.33	0.98
Sex, <i>n</i> (%)			0.34
Female	40 (74.1)	1,746 (68.0)	
Male	14 (25.9)	821 (32.0)	
Atopic dermatitis, <i>n</i> (%)	7 (13.0)	721 (28.1)	0.014

### Statistical analysis

Statistical analysis was performed using PASW Statistics for Windows (version 23.0; SPSS Inc., Chicago, IL, USA). The clinical data and prevalence of positive reactions to allergens and allergen groups were calculated using a descriptive statistical analysis. Numbers and percentages are reported. Weak (1+), strong (2+), and extreme (3+) positive reactions were grouped as positive. Irritant, negative, and doubtful reactions were grouped as negative. The proportion of patients with contact allergy to allergen in the Swedish baseline series and IBOA was compared between diabetes patients and dermatitis patients. Among the diabetes patients, the proportion of patients with positive reactions to the allergens in the Swedish baseline series was compared between IBOA-positive and IBOA-negative individuals. Two-sided Pearson's  $\chi^2$  test or Fisher's exact test was performed to compare the proportion of patients and number of reactions in 2 different groups. Fisher's exact test was applied when the sample size was small (1 or more expected values are less than 5). When the mean age was compared for 2 groups, independent *t*-test was used. A *p*-value of less than 0.05 was considered statistically significant. Detailed positive reactions to MD-related allergens were also assessed and concomitant positive reactions to other allergens in IBOA-positive patients are reported.

## RESULTS

In total, 54 diabetes patients and 2,567 dermatitis patients were included. In Table I, demographic data are shown. Diabetes patients were significantly less likely to have AD compared with dermatitis patients (13.0% compared with 28.1%, *p* = 0.014).

### Comparison of contact allergies in diabetes patients and dermatitis patients

The proportions of diabetes patients and dermatitis patients with positive reactions to the selected allergens are summarized in Table II. Among the diabetes patients 13.0% were allergic to SLM, compared with 0.5% among the dermatitis patients (*p* < 0.001). Among the diabetes patients 7.4% were allergic to FM II, compared with 2.3% among the dermatitis patients (*p* = 0.041). The proportion of patients with contact allergy to fragrance group of al-

**Table II. Number of diabetes patients and dermatitis patients with contact allergy to allergens in the Swedish baseline series and isobornyl acrylate (IBOA)**

Substance, concentration (%) & vehicle	Diabetes patients		Dermatitis patients		p-value
	Contact allergy D3-4 or 7 n (%)	Tested n	Contact allergy D3-4 or 7 n (%)	Tested n	
Swedish baseline series					
Potassium dichromate, 0.5 petrolatum	1 (1.9)	54	99 (3.9)	2,557	0.72
p-Phenylene diamine, 1.0 petrolatum	0	54	69 (2.7)	2,531	0.40
Thiuram mix, 1.0 petrolatum	0	54	36 (1.4)	2,559	>0.99
Neomycin sulphate, 20.0 petrolatum	0	54	17 (0.7)	2,561	>0.99
Cobalt chloride hexahydrate, 0.5 petrolatum	3 (5.6)	54	99 (3.9)	2,555	0.47
Quaternium 15, 1.0 petrolatum	0	54	20 (0.8)	2,562	>0.99
Nickel(II)sulphate hexahydrate, 5.0 petrolatum	8 (14.8)	54	414 (16.3)	2,537	0.77
Quinoline mix, 6.0 petrolatum	1 (1.9)	54	13 (0.5)	2,562	0.25
Colophonium 20.0 petrolatum	2 (3.7)	54	64 (2.5)	2,557	0.40
Paraben mix, 16.0 petrolatum	0	54	9 (0.4)	2,562	>0.99
Black rubber mix, 0.6 petrolatum	1 (1.9)	54	13 (0.5)	2,561	0.25
Sesquiterpene lactone mix, 0.1 petrolatum	7 (13.0)	54	13 (0.5)	2,560	<0.001 <sup>a</sup>
Mercapto mix, 2.0 petrolatum	0	54	3 (0.1)	2,562	>0.99
Epoxy resin, 1.0 petrolatum	0	54	29 (1.1)	2,558	>0.99
Myroxylon pereiirae, 25.0 petrolatum	7 (13.0)	54	168 (6.6)	2,556	0.063
p-tert-Butylphenol formaldehyde resin, 1.0 petrolatum	0	54	20 (0.8)	2,561	>0.99
Fragrance mix II, 14.0 petrolatum	4 (7.4)	54	60 (2.3)	2,561	0.041 <sup>b</sup>
Formaldehyde, 2.0 aq.	1 (1.9)	54	89 (3.5)	2,559	>0.99
Fragrance mix I, 8.0 petrolatum	2 (3.7)	54	156 (6.1)	2,558	0.77
Phenol formaldehyde resin, 1.0 petrolatum	0	54	19 (0.7)	2,561	>0.99
Diazolidinyl urea, 2.0 aq.	0	54	10 (0.4)	2,561	>0.99
MCI/MI, 0.02 aq.	1 (1.9)	54	95 (3.7)	2,555	0.72
Amerchol L 101, 50.0 petrolatum	0	54	15 (0.6)	2,562	>0.99
Caine mix II, 10.0 petrolatum	1 (1.9)	54	30 (1.2)	2,559	0.48
Lichen acid mix, 0.3 petrolatum	1 (1.9)	54	18 (0.7)	2,561	0.33
Tixocortal-21-pivalate, 0.1 petrolatum	1 (1.9)	54	30 (1.2)	2,562	0.48
Textile dye mix, 6.6 petrolatum	1 (1.9)	54	75 (2.9)	2,556	>0.99
Budesonide, 0.01 petrolatum	1 (1.9)	54	16 (0.6)	2,562	0.30
Methylidibromo glutaronitrile, 0.5 petrolatum	2 (3.7)	54	77 (3.0)	2,562	0.68
Methylisothiazolinone, 0.2 aq.	4 (7.4)	54	97 (3.8)	2,554	0.15
Extended baseline series					
Isobornyl acrylate <sup>c</sup>	34 (63.0)	54	4 (0.2)	1,840	<0.001 <sup>d</sup>
Allergen groups					
Fragrances <sup>e</sup>	11 (20.4)	54	336 (13.2)	2,552	0.123
Metals <sup>f</sup>	11 (20.4)	54	525 (20.7)	2,535	0.951
Preservatives <sup>g</sup>	5 (9.3)	54	253 (9.9)	2,553	0.874
Rubbers <sup>h</sup>	1 (1.9)	54	48 (1.9)	2,558	>0.999

<sup>a</sup>Odds ratio (OR)(95% confidence interval [CI]) 29.41 (11.11–76.92). <sup>b</sup>OR(95% CI) 3.33 (1.17–9.52). <sup>c</sup>Patch-tested with at least 1 concentration of isobornyl acrylate patch-test preparations. <sup>d</sup>OR (95% CI) 780.03 (253.10–2403.85). <sup>e</sup>Colophonium, fragrance mix I, II, lichen acid mix, and Myroxylon pereiirae resin. <sup>f</sup>Nickel(II)sulphate hexahydrate, cobalt(II)chloride hexahydrate, and potassium dichromate. <sup>g</sup>Methylchloroisothiazolinone/methyl isothiazolinone (MCI/MI), methyl isothiazolinone (MI), formaldehyde, paraben mix, diazolidinyl urea, methylidibromoglutaronitrile (MDBGN), and quaternium 15. <sup>h</sup>Mercapto mix, black rubber mix, and thiuram mix. Aq: aqua; D: patch-test reading day; n: number of patients with positive reactions.

allergens was higher among the diabetes patients compared with the dermatitis patients, although the difference was not statistically significant. Almost two-thirds of the diabetes patients (63.0%) were positive to IBOA compared with 0.2% of the dermatitis patients ( $p < 0.001$ ).

#### Comparison of contact allergies in IBOA-positive and IBOA-negative diabetes patients

Among the diabetes patients, 52.9% of IBOA-positive patients and 40.0% of IBOA-negative patients had at least 1 simultaneous reaction to allergens in the Swedish baseline series ( $p = 0.36$ ). Seven of 34 (20.6%) IBOA-positive diabetes patients and none of 20 IBOA-negative diabetes patients were allergic to SLM ( $p = 0.038$ ). For each of the other allergens in the Swedish baseline series, no significant difference in the proportion of patients with positive reactions was seen among IBOA-positive compared with IBOA-negative diabetes patients. All

4 FM II allergic diabetes patients were also allergic to IBOA; however, the difference in the proportion of FM II allergic patients among IBOA-positive compared with IBOA-negative diabetes patients was not significant ( $p = 0.29$ ). In total, 8 of 34 (23.5%) IBOA-positive diabetes patients and 3 of 20 (15%) IBOA-negative diabetes patients were allergic to at least 1 fragrance allergen ( $p = 0.510$ ).

#### Contact allergy to other medical device-related allergens

In 38 of 54 diabetes patients (70.4%), contact allergy to MD-related allergens was found. In 4 of the 38 individuals contact allergy to IBOA was not seen. In these 4 individuals contact allergy to the following MD-related allergens was seen; isophorone diisocyanate (individual 1), *N,N*-dimethylacrylamide (individual 2), 2,4-di-*tert*-butylphenol and butylated hydroxytoluene (BHT) (individual 3), and colophonium (individual 4).

**Table III. The department's medical device-series**

Version October 2017 Substances and patch-test concentration (%)	Version July 2020 Substances and patch-test concentration (%)	Manufacturer
2-Hydroxyethyl acrylate, 0.1	2-Hydroxyethyl acrylate, 0.1	C
Urethane diacrylate, aliphatic, 0.1	Urethane diacrylate, aliphatic, 0.1	C
Isobornyl acrylate, 0.01, 0.1	Isobornyl acrylate, 0.01, 0.1 <sup>a</sup> , 0.3 <sup>a</sup>	S-A <sup>b</sup>
2,4-Di- <i>tert</i> -butylphenol, 1.0	2,4-Di- <i>tert</i> -butylphenol, 1.0	S-A <sup>b</sup>
Butylated hydroxytoluene (BHT), 2.0	Butylated hydroxytoluene (BHT), 2.0	C
Urethane dimethacrylate, 2.0	Urethane dimethacrylate, 2.0	C
Isophorone diisocyanate, 1.0	Isophorone diisocyanate, 1.0	C
Isophorone diamine, 0.1	Isophorone diamine, 0.1	C
4- <i>tert</i> -Butylphenol, 1.0	4- <i>tert</i> -Butylphenol, 1.0	C
<i>N,N</i> -Dimethylacrylamide, 0.1	<i>N,N</i> -Dimethylacrylamide, 0.1, 0.3	S-A <sup>b</sup>
	Ethyl cyanoacrylate, 5.0	C
	Alantolactone <sup>c</sup> , 0.1	S-A <sup>b</sup>
	Costunolide <sup>c</sup> , 0.1	S-A <sup>b</sup>
	Dehydrocostus lactone <sup>c</sup> , 0.1	S-A <sup>b</sup>
	Tetrahydrofurfuryl acrylate, 0.1	S-A <sup>b</sup>
	1,6-Hexanediol diacrylate, 0.1	C
	Ethyl acrylate, 0.1	C
	2-Phenoxyethyl acrylate, 0.1	p <sup>b</sup>
	2-Carboxyethylacrylate, 0.1	S-A <sup>b</sup>
	Hydroabietyl alcohol, 10.0	C
	Abietic acid, 10.0	C
	Colophonium <sup>d</sup> , 60.0	S-A <sup>b</sup>
	<i>N</i> -Vinylcaprolactam, 1.0	S-A <sup>b</sup>
	2-Ethylhexyl acrylate, 0.1	C
	Dipropylene glycol diacrylate, 0.1	T <sup>b</sup>
	2,2'-Methylenebis(6- <i>tert</i> -butyl-4-methylphenol), 1.0	T <sup>b</sup>
	Dilauryl thiodipropionate, 1.0	S-A <sup>b</sup>
	Lauryl acrylate, 0.1	S-A <sup>b</sup>
	2,2'-Methylenebis(6- <i>tert</i> -butyl-4-methylphenol) monoacrylate, 0.1 <sup>e</sup>	CTA <sup>b</sup>

<sup>a</sup>Tested in the department's extended baseline series. <sup>b</sup>Test preparation prepared in-house. <sup>c</sup>Vehicle ethanol (Kemetyl, Haninge, Sweden). <sup>d</sup>Vehicle softisan. <sup>e</sup>Various concentrations from 0.1% and higher.

A: Acros Organics, Geel, Belgium; C: Chemotechnique Diagnostics, Vellinge, Sweden; CTA: Chemtronica AB, Sollentuna, Sweden; EtOH: ethanol (Kemetyl, Haninge, Sweden); P: Polysciences, Inc. Warrington, Pennsylvania; pet.: petrolatum (vaselin, vitt; APL, Stockholm, Sweden): used in all pet. preparations not delivered by C; S-A: Sigma-Aldrich, Steinheim, Germany; T: TCI Europe N.V., Zwijndrecht, Belgium. Vehicle petrolatum unless specified.

## DISCUSSION

Contact allergy to MDs was initially related to IBOA in a single glucose sensor (6). Today, many culprit allergens have been identified in different MDs. The current study found an overrepresentation of contact allergy also to baseline series allergen not traditionally associated with the use of MDs (FM II and sesquiterpene lactones (SLs)) among diabetes patients using CGM and insulin pumps. This makes the magnitude of the problem and the implications for those affected far greater than initially expected.

### *Overrepresentation of contact allergy to sesquiterpene lactones and fragrance mix II*

Contact allergy to FM II was overrepresented in the diabetes patients compared with the dermatitis patients ( $p=0.041$ ; Table II). The prevalence of contact allergy to MP was higher among the diabetes patients compared with the dermatitis patients, although the difference was not statistically significant ( $p=0.063$ ). Both the diabetes patients and the dermatitis patients have dermatitis, and therefore a damaged skin barrier locally, where exposure to fragrances in scented leave-on and rinse-off products can lead to fragrance contact allergy. However, since contact allergy to FM II was overrepresented in the

diabetes patients compared with the dermatitis patients it is likely that the diabetes patients are exposed to FM II from their MDs or related products. Previously, d-limonene has been found in both colophonium-containing and colophonium-free adhesives (tapes/dressings) used by patients with contact allergy to hydroperoxides of limonene, suggesting that the contact allergy could be related to exposure to adhesives in MDs (21). However, the presence of hydroperoxides of limonene in the adhesives has not been confirmed.

Contact allergy to fragrances and SLs has also been found to be overrepresented in patients with AD compared with those without AD (22–24). However, as the prevalence of AD was lower among the adult diabetes compared with dermatitis patients in this study, this cannot explain the higher prevalence of contact allergy to SLM and FM II among the diabetes patients.

### *Low frequency of IBOA allergy among consecutive dermatitis patients*

The prevalence of IBOA allergy was significantly higher among the diabetes patients compared with the dermatitis patients. IBOA has been widely used in high concentrations in glues in MDs (1–4, 6). However, it is also used in other adhesives/glues, coatings, sealants,

paints, and inks. From that point of view, the sensitization rate (0.2%) in the dermatitis patients was lower than expected. One of the 4 dermatitis patients sensitized to IBOA had a history of skin reactions to her insulin pump, which was not the reason for the contact allergy investigation. In the second IBOA-positive dermatitis patient a possible relevant exposure was found as she had positive reactions to different nail polishes, which may contain IBOA. In the other IBOA-positive dermatitis patients no relevant exposure could be found. In previous studies sensitization to IBOA patch-tested at 0.1% concentration was also rare in general dermatitis patients (25, 26). Even though sensitization to IBOA is rare in general dermatitis patients, it has proven a major sensitizer when used in MDs, such as CGMs and insulin pumps, where exposure is prolonged.

#### *Concomitant positive reactions in IBOA-allergic diabetes patients*

In line with previous studies (7, 8, 11) SLM contact allergy was overrepresented among IBOA-allergic diabetes patients. Notably, a recent study (27) reported stronger patch-test reactions to SLM when retesting at the site of a previous positive patch-test reaction to IBOA, suggesting cross-reactivity between the substances. A possible explanation could be rotation of single bonds, allowing IBOA to present itself in a conformation that can mimic the  $\alpha$ -methylene- $\gamma$ -butyrolactone ring that is present in SLs (27).

A previous study (8) has reported a high proportion of IBOA-sensitized patients (11 of 18; 61%) to be co-sensitized to fragrance allergens. In the current study, contact allergy to FM II and fragrance allergens in general was not significantly more common in IBOA-positive diabetes patients compared with IBOA-negative diabetes patients. However, all 4 FM II allergic patients were IBOA-allergic; hence a significant difference between IBOA-positive and IBOA-negative individuals might have been seen in a larger patient population.

#### *Contact allergy to medical device-related allergens over time*

Most of the diabetes patients were allergic to MD-related allergens, indicating that their skin reactions were a manifestation of ACD. The composition of the MDs changes over time and in different batches (9), hence correct diagnosis of the skin reactions and relevance assessment of contact allergies is challenging. During the study period the contact allergy rates for IBOA and *N,N*-dimethylacrylamide (DMAA) (63.0% and 24.2% (unpublished data), respectively) were high among the diabetes patients. Cases of contact allergy to these substances have been reported (6, 13) and efforts have been made by the manufacturers to remove these allergen from their products (28, 29). In patients investigated at YMDA

during the period November 2020 to June 2022 the contact allergy frequencies for IBOA and DMAA decreased to 23.7% and 2.6%, respectively (unpublished data). Simultaneously, new allergens, namely dipropylene glycol diacrylate (DPGDA) and 2,2'-methylenebis(6-*tert*-butyl-4-methylphenol) monoacrylate were identified in MDs (9, 10), at YMDA. High contact allergy frequencies were seen for DPGDA (21.1%) and 2,2'-methylenebis(6-*tert*-butyl-4-methylphenol) monoacrylate (31.6%) in diabetes patients patch-tested due to suspected ACD to MDs during the period November 2020 to June 2022 (unpublished data). Replacing known allergens in the products is an important, but delicate, task with a risk of introducing yet new allergens. Continuous chemical analyses of the products, relevant and up-to-date MD patch-test series, and case reports of contact allergy to new allergens are important for prevention of contact allergy to substances in MDs. In 2017, our department used an MD patch-test series with 11 substances. Further substances have been included and patch-test concentrations adjusted (Table III) (2, 5, 7, 9, 10, 12, 13, 30). To-date, the series consists of 34 different patch-test preparations, and further modifications will be made continuously based on new information on sensitizers in MDs.

#### *Conclusion*

Targetted patch-testing with IBOA, other relevant MD-related allergens, the product, and extracts thereof, is necessary when ACD to MDs is suspected. However, IBOA cannot presently be recommended as a screening allergen in general dermatitis patients. As colophonium is a MD-related allergen and contact allergy to SLs and FM II was overrepresented among the diabetes patients with ACD to MDs, baseline series allergen should also be patch-tested. Contact allergy to SLM is related to IBOA allergy, while no such association was found for FM II.

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The study was approved by the Swedish Ethical Review Authority (dnr 2020-02190).

*Conflicts of interest:* MB is a member of the expert panel for fragrance safety (<http://fragrancesafetypanel.org/>). CS participates in the fragrance study Extended Fragrance Ingredients Surveillance Study (EFISS) performed on behalf of the The International Fragrance Association (IFRA).

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