

ORIGINAL ARTICLE

Pilot study on a new concept of documenting the clinical relevance of patch test results in contact dermatitis patients

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Background: Assessment of the clinical relevance of patch test reactions is an essential part of the diagnostic work-up of patients with (occupational) contact dermatitis. However, final diagnostic information, particularly the clinical relevance of allergic patch test reactions, has hitherto been ill-represented in clinical documentation systems (patch test software) and surveillance registries based on these.

Objectives: To develop, implement as a pilot study, and analyse concerning feasibility and contents a new concept of representing the full scope of diagnostic information utilized in the diagnosis of patients with (occupational) contact dermatitis.

Methods: On the basis of a European working group discussion on items to document and catalogue lists to use for this purpose, an online documentation system to collect data was set up, followed by pilot use involving 9 dermatology departments across Europe.

Results: Data on 176 patients with suspected occupational hand dermatitis were included; among these, work-relatedness was confirmed in 150, and in 53 non-occupational aetiology was the sole or a contributory cause. Data were further analysed with regard to occupations, product categories, substances (haptens), source of information on which the evaluation was based, and various combinations of these factors, to illustrate the usefulness of the proposed data representation.

Conclusions: An improved method of data collection is presented that more accurately links allergen to exposure and to clinical disease and patient history, and thus better represents clinical relevance. This enables more precise analysis of the causation of contact dermatitis, occupational or non-occupational, and thereby better targeting of prevention. The development of future databases should incorporate the above considerations to record the results of investigation.

KEYWORDS

allergic contact dermatitis, diagnosis, documentation, epidemiology, hand eczema, occupational skin disease

1 | INTRODUCTION

Occupational contact dermatitis is the most common occupational skin disease, and represents approximately 90% to 95% of cases.¹ The annual incidence of occupational contact dermatitis has been estimated to be 0.5 to 1 cases per 1000 workers in Europe,^{2,3} which might be an underestimation, because the number of unreported cases is presumed to be high^{1,4}. In order to establish a diagnosis of occupational contact dermatitis, one needs to consider not only patch test results but also a detailed patient history, the anatomical site(s) and clinical features of the dermatitis, and information on the patient's work and the substances and materials that the patient is exposed to at work and non-occupationally, and to summarize all of the relevant information into a logical and convincing conclusion concerning the actual cause(s) of the patient's dermatitis. Evidently, this also holds true for non-occupational contact dermatitis.

A few years ago, the standards for the diagnosis of contact allergy in patients with suspected allergic contact dermatitis (ACD) by patch testing were summarized in a European Society of Contact Dermatitis guideline.⁵ This guideline covers the full range of necessary information, from selection, storage and application of test haptens (contact allergens) to morphological classification and interpretation of patch test reactions, and, ultimately, the assessment of clinical relevance. From several perspectives, the aspect of relevance assessment is particularly complex, as discussed in the guideline.⁵ A pragmatic and useful approach had been implemented by the North American Contact Dermatitis Group by requiring a positive use or patch test result with the suspected item(s) for "definite" relevance, and verification of the presence of the allergen in known skin contactants, and consistent clinical presentation, for "probable" clinical relevance see.⁶ As a particular problem, information such as "allergen X being currently relevant" or "allergen Y being previously occupationally relevant" is often not linked with an exact description of the type and location of dermatitis that the allergens have presumably caused. However, valid and precise assessment of the clinical relevance of patch test reactions is a crucial part of the diagnostic work-up of patients with suspected occupational dermatitis, and is also of great practical importance in the management and counselling of patients with non-occupational contact dermatitis. Moreover, beyond individual patient care, when surveillance of occupational dermatitis with the objective of designing effective prevention strategies is addressed, it is necessary to collect detailed information on not only the mere numbers of contact-allergic patients, with their occupations and patch test reactions, but also on, for example, sources of allergen exposure, irritant exposures, and the relevance

of contact allergies and irritant exposure regarding past and present episodes of dermatitis.⁷

On this background, inspired by efforts of the Modernet COST action consortium⁸ to adequately represent sufficiently detailed diagnostic information for more meaningful surveillance of occupational diseases, Working Group IV of the COST action StanDerm (see Acknowledgements) further developed a concept of how to represent all relevant information generated at the final evaluation of patients after patch testing in a way that is, hopefully, practicable and informative. As an experimental extension to routine documentation (eg, as offered by patch test software such as WINALLDAT/IVDK or WINALLDAT/ESSCA⁹), this concept was put into practice for a pilot study. The objective of the present analysis was to evaluate the usefulness of this type of data collection.

2 | METHODS

During the study period (May 2016 to May 2017), successive patients with suspected work-related hand dermatitis (eczema), irrespective of aetiology, were eligible for inclusion if they had been patch tested. Eligibility of patients was not limited to only those with a formal "occupational" contract, or only those aged ≥ 18 years. However, housewife/husband and pure leisure-time activities were not considered to be "occupational" activity. For documentation, paper forms were mainly used. After completion of the evaluation of a patient, considering all patch test results, obtaining further information on product ingredients, etc., the data were transferred to the study server (see below). The extended documentation was anonymous. It was envisaged that each participating department (see list of authors) should contribute at least 20, but ideally 30, patients to achieve a useful sample size. The study was undertaken on the basis of an audit of clinical practice.¹⁰

Online documentation via the https protocol on a web-server hosted at IMBE with department-specific strong authentication was implemented with an institutional license of SoSci (<https://www.soscisurvey.de/index.php?page=home&l=eng>). The form used combines information already collected in traditional documentation, but combines this in a new way to form a new type of combination of data, the array of information described below forming a so-called tuple (more precisely, a septuple or 7-tuple, including the 7 items of information listed below [Figure 1]):

- Time: whether the condition described in the tuple was current or previous
- Diagnosis: the standard list of diagnoses used in the European Surveillance System on Contact Allergies (ESSCA) documentation

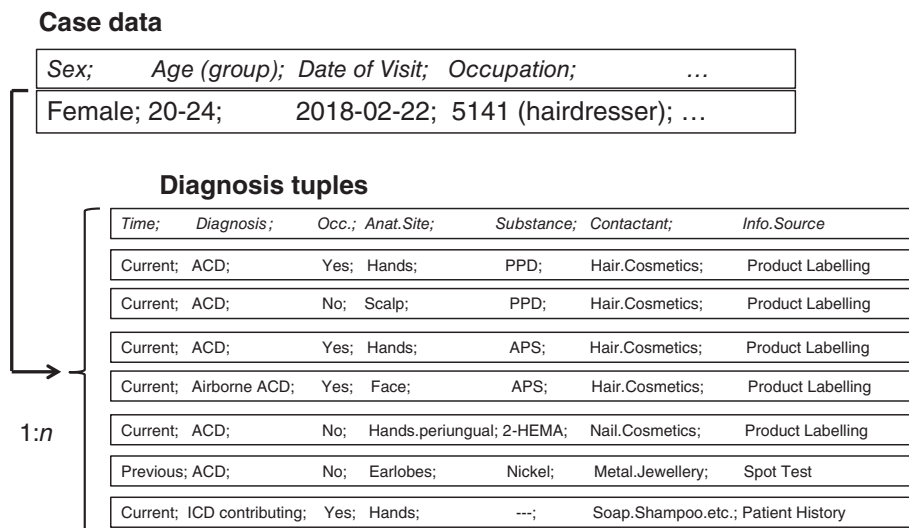


FIGURE 1 Schematic of the new representation of final evaluation data in relation to other case data with an illustrative example, a young female hairstresser with multiple contact allergies and a component of irritant contact dermatitis (ICD) of the hands. It is of note that no specific substance causing irritation can be identified (hence the “—” for “substance”), whereas shampoo has been identified as the main irritation factor. Anat.Site, Anatomical site; APS, ammonium persulfate; 2-HEMA, 2-hydroxyethyl methacrylate; Info.Source, Information source; Occ., occupational causation; PPD, *p*-phenylenediamine

(Figure S1); in this documentation, ACD and variants thereof evidently predominated. However, it is theoretically possible to also accommodate other exogenous dermatoses, such as irritant contact dermatitis

- Occupational causation: choices were “yes” (fully), “yes, partly,” “no”, and “unknown”
- Anatomical site affected by dermatitis: the hierarchical list of ESSCA standard anatomical sites was used (Figure S1)
- Allergen (specific substance or sometimes natural extract): the substance that caused a positive (allergic) patch test reaction (+, ++, or +++)
- Contactant: type of product in which the above substance has caused allergic (or, if applicable, irritant) contact dermatitis; the ESSCA list of contactants was used (Figure S1)
- Evaluation of the relevance of the allergen based on: (1) patient history; (2) patch test with the product; (3) use test with the product; (4) ingredient labelling; (5) material safety data sheet (MSDS); (6) workplace visit; and (7) chemical analysis

Specifically, an $n : n : n : n : n : n$ 6-tuple relationship (assuming just one source of information the respective evaluation is based on; otherwise, an $n : n : n : n : n : n : n$ 7-tuple relationship) allows multiple combinations and, with this, repetitions of single items. For instance, 1 allergen can be responsible for both foot and hand dermatitis, possibly through different contactants, or 1 allergen can be the cause of previous dermatitis (possibly at a different site) and of current dermatitis (possibly work-related), or 1 contactant may contain several allergens leading to allergic contact dermatitis (with the same site[s]), and so on; see the hypothetical example shown in Figure 1 and also in the Discussion. After export of data from the SoSci server, further data management and analysis were performed with the statistical software R (version 3.4.3 [http://www.R-project.org/]¹¹).

3 | RESULTS

Altogether, 176 patients with hand dermatitis suspected to be caused by occupational exposure who had been patch tested were included in this analysis; this number was slightly lower than in the analysis of the same study sample focusing on irritant exposures,¹⁰ owing to missing diagnostic information. The numbers per department ranged from 6 in Barcelona to 37 in Zagreb; the average number per department was 19.6, and thus largely within the target range. Of the included patients, in 115 only work-related hand dermatitis had been diagnosed, in 18 hand dermatitis was considered not to be work-related, in 35 both work-related and non-occupational components of dermatitis were observed, and in 8 this information was missing. Some important characteristics of the patients are shown in Table 1. Data concerning irritant exposures have been published separately.¹⁰ Missing data are mostly attributable to technical difficulties in linking data captured via the online system, and via other systems used for routine documentation (see Discussion).

Overall, 406 diagnosis tuples were documented; the mean number was 2.3. The term “diagnosis tuples” here refers to combinations of the 7-tuples outlined in Methods, that is, in brief, unique combinations of these factors for 1 patient, but with possible repetition of 1 (or more) element(s) of that tuple. The distribution of the number of diagnosis tuples is shown in Figure 2. Altogether, 78 patients had just 1 diagnosis, that is, 44.3% of all included patients. One or 2 diagnoses (the standard offered by WINALDAT software) were documented in 67.6% of patients. It is of note that, beyond the number of diagnoses, the link between diagnosis and the other items of information still yields added information value as compared with conventional documentation, meaning that the depth of information and potential usefulness have been increased even in such “simple” cases.

The diagnosis tuples, stratified for previous or current conditions, are shown in Table 2. In accordance with the fact that patients

TABLE 1 Characteristics of the clinical sample of hand dermatitis patients obtained in 9 departments in 8 European countries; percentages were calculated on the basis of on non-missing data (missing data were assumed to be missing at random)

	n	%
Male sex	71/176	40.3
Atopic dermatitis	48/121	39.7
Occupational group		
Healthcare workers ^a	30/157	19.1
Office workers ^b	16/157	10.2
Hairdressers (code 5141)	14/157	8.9
Cleaners, household ^c	13/157	8.3
Metalworkers ^d	15/157	9.6
Construction workers ^e	15/157	9.6
Food handlers ^f	10/157	6.4
Service NEC ^g	11/157	7
Agriculture ^h	11/157	7
Plastics, rubber and related ⁱ	11/157	7
	Median	Q1 to Q3
Age (years)	42	27-52

Abbreviations: NEC, not elsewhere classified.

^a Comprising ISCO-08: group 2200 and group 3200.

^b Comprising ISCO-08: 1000-2160; 2300-3150; 3300-3410; 3500-4400.

^c Comprising ISCO-08: 5150; 7133; 9110-9120.

^d Comprising ISCO-08: 7210-7234; 8121.

^e Comprising ISCO-08: 3120; 7110-7132; 9310-9313.

^f Comprising ISCO-08: 5120; 7511-7516; 8160; 9410.

^g Comprising ISCO-08: 0; 5130; 5160; 5200-5400; 8300-9120; 9330; 9510-9620.

^h Comprising ISCO-08: 6111-6130; 9210-9214.

ⁱ Comprising ISCO-08: 8130-8159.

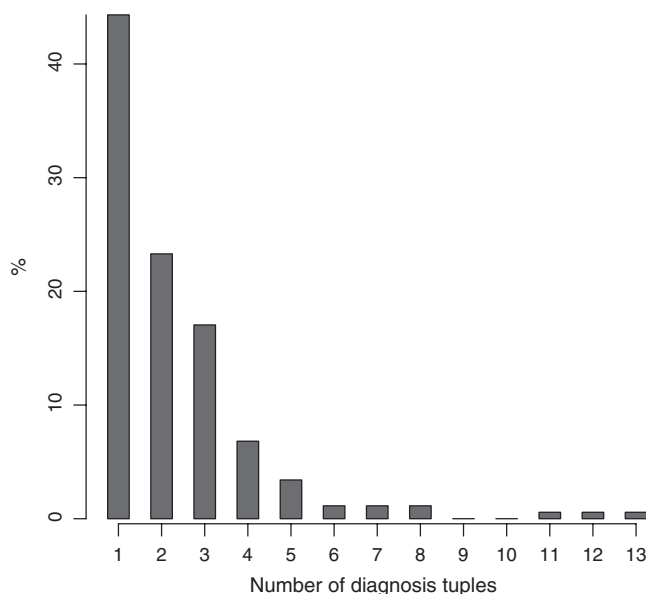


FIGURE 2 The number of diagnosis tuples per patient

presented for patch testing with apparently ongoing hand dermatitis, the majority of diagnosis tuples are of current importance ($n = 320$) and only 82 refer to previous conditions. Regarding occupational causation, overall, 259 diagnosis tuples were clearly occupationally related, and 52 were at least partly occupationally related; in 73 diagnosis tuples, occupational causation was clearly negated, and in 8 this

TABLE 2 Final diagnoses in the present clinical sample of patients with occupational hand dermatitis made after the patch test (as based on the level of diagnosis tuples, multiple diagnoses, or repetitions with different anatomical sites, contactants or allergens possible)

Code number	Current		Previous	
	n/155	%	n/54	%
1—Allergic contact dermatitis, not elsewhere classified	33	21.3	21	38.9
1001—Allergic contact dermatitis, exclusively	83	53.5	14	25.9
1002—Allergic contact dermatitis, predominantly	55	35.5	2	3.7
1003—Allergic contact dermatitis, contributing	43	27.7	24	44.4
2—Irritant contact dermatitis, not elsewhere classified	30	19.4	8	14.8
2001—Irritant contact dermatitis, exclusively	24	15.5	7	13
2002—Irritant contact dermatitis, predominantly	8	5.2	3	5.6
2003—Irritant contact dermatitis, contributing	27	17.4	1	1.9
13—Contact urticaria, not elsewhere classified	5	3.2	0	0
13001—Contact urticaria, immunological	2	1.3	1	1.9
13002—Contact urticaria, non-immunological	2	1.3	0	0
15—Airborne dermatitis, not elsewhere classified	0	0	1	1.9
15001—Airborne dermatitis, contact-allergic	5	3.2	0	0
Atopic eczema/dermatitis syndrome	2	1.3	0	0
Hyperkeratotic (tylotic) eczema	1	0.6	0	0

Current: current diagnosis (in 155 patients). Previous: diagnosis referring to a previous event (in 54 patients). The qualifiers “exclusively”, “predominantly” and “contributing” enable the weighing of different multiple diagnoses in 1 patient for importance, where this is possible and meaningful.

was unclear. Note that these numbers refer to diagnosis tuples and not to patients; the co-occurrence of previous and current dermatitis, occupational and non-occupational dermatitis, or allergic and irritant contact dermatitis in 1 patient is possible, and can be fully represented in the present data structure.

The sites affected were evidently the hands (possibly different regions, documented according to the catalogue as shown in Figure S1), as this was an inclusion criterion for the present study. In addition to the hands, the following sites (possibly related to a different aetiology) were documented in the diagnosis tuples: face ($n = 31$), elsewhere on the head ($n = 7$), neck ($n = 11$), trunk ($n = 7$), arm(s), mostly forearms ($n = 20$), leg(s) ($n = 5$), and foot/feet ($n = 1$).

On restriction of further analysis to those diagnosis tuples in which current ACD had been diagnosed ($n = 214$), in, altogether, 77 patients with current occupational ACD, the allergens shown in Table 3 were identified (only the top 30 haptens out of 103 different substances diagnosed as occupational allergens in total are shown). For comparison, the haptens found to be related to non-occupational exposure (or for which it was unknown whether exposure was

TABLE 3 Top 30 contact allergens that elicited positive patch test reactions in the present clinical sample of patients with occupational hand dermatitis, including those for which current clinical relevance for occupational allergic contact dermatitis had been found (middle column) compared with those for which the relationship with occupational exposure was unknown or negated (right column)

Allergen	Occupational ACD		Non-occupational ACD	
	<i>n</i> positive	% positive	<i>n</i> positive	% positive
Epoxy resin	12	15.6	0	0
Methylchloroisothiazolinone/methylisothiazolinone	9	11.7	2	10
Nickel(II) sulfate hexahydrate	9	11.7	2	10
Epoxy resin, bisphenol F type	8	10.4	0	0
Thiuram mix	8	10.4	0	0
Carba mix	6	7.8	0	0
Methylisothiazolinone	6	7.8	1	5
1,4-Butanediol-diglycidyl ether	5	6.5	0	0
Phenylglycidyl ether	5	6.5	0	0
2-Hydroxyethyl methacrylate	4	5.2	0	0
Formaldehyde	4	5.2	0	0
<i>p</i> -Aminodiphenylamine (CI 76085)	4	5.2	0	0
<i>p</i> -Phenylenediamine (CI 76060)	4	5.2	1	5
Tetramethylthiuram monosulfide	4	5.2	0	0
Cobalt(II) chloride hexahydrate	3	3.9	1	5
Potassium dichromate	3	3.9	1	5
Tetraethylthiuram disulfide (disulfiram)	3	3.9	0	0
Tetramethylthiuram disulfide	3	3.9	0	0
1,3-Diphenylguanidine	2	2.6	0	0
Compositae mix	2	2.6	0	0
Dipentamethylene thiuram disulfide	2	2.6	0	0
Mercapto mix (MBT, CBS, MBTS, MOR)	2	2.6	0	0
Methylene-bis(methyloxazolidine)	2	2.6	0	0
<i>p</i> -Aminodiphenylamine-HCl	2	2.6	0	0
Quaternium 15	2	2.6	0	0
1,4-Butanediol dimethacrylate	1	1.3	0	0
1,6-Hexanediol-diglycidyl ether	1	1.3	0	0
4,4'-Diaminodiphenylmethane	1	1.3	1	5
Amyl cinnamal	1	1.3	0	0
Aluminium chloride	1	1.3	0	0

Abbreviations: ACD, allergic contact dermatitis; CBS, N-Cyclohexyl benzothiazylsulfenamide; MBT, Mercaptobenzothiazole; MBTS, Dibenzenothiazylsulfide; MOR, Morpholinyl mercaptobenzothiazole. Multiple occurrence of 1 given patient is possible. % positive is related to 77 patients in whom current occupation-related allergic contact dermatitis was diagnosed in at least 1 tuple, and those in whom non-occupational ACD had been diagnosed (*n* = 20), respectively.

occupational or non-occupational) are shown in the rightmost column of Table 3, based on 20 patients.

The contactants, that is, product categories used to characterize the source of contact with a certain allergen—with the possibility of denoting >1 contactant for 1 allergen in the present structure—were of interest; the top 20 entries, stratified for being the cause of occupational vs non-occupational ACD, respectively, as found in the sample of patients with ACD, past or current, are shown in Table 4.

Finally, an important aspect is the source of information on which a certain judgement is based, represented in a diagnosis tuple. Most often, in the present study and again based on the level of a diagnosis tuple, this was the patient's history (*n* = 203), followed by a (positive) patch test reaction to the culprit product containing the substance (*n* = 66), ingredient labelling (*n* = 46), scrutiny of a safety data sheet (*n* = 37), a workplace visit (*n* = 16), and, in 1 case, a positive use test

result with the incriminated product. In the present sample, chemical analysis was not used.

The analyses presented so far are mostly univariate or slightly stratified analyses. However, in principle, further analyses utilizing the information in the diagnosis tuples to, for example, create profiles of allergens (in terms of sites affected, products incriminated, currency of dermatitis, and occupational relationship of dermatitis, but, evidently, also characteristics from the basic patient documentation, such as age, sex, and occupation) are conceivable. As the sample size of the present pilot or feasibility study is modest, this approach cannot be explored seriously. The 3 subanalyses presented below, answering prototypical research questions, serve only as illustrative case studies:

- “What is the spectrum of allergens with relevance to current occupational ACD attributable to nail cosmetics?” These were

TABLE 4 Top 20 contactants in patients with allergic contact dermatitis (ACD) stratified for patients with occupational ACD and non-occupational ACD in 85 patients with occupational ACD and in 42 patients with non-occupational ACD, respectively, where contactants were documented

Contactant	Occupational ACD		Non-occupational ACD	
	n positive	% positive	n positive	% positive
Gloves (various materials)	33	38.8	0	0
Plastics	25	29.4	0	0
Soap, shampoo (rinse-off products)	16	18.8	7	16.7
Other chemicals	12	14.1	1	2.4
Rubber (other)	11	12.9	0	0
Cosmetics, creams (leave-on products)	9	10.6	9	21.4
Metal (worked with)	9	10.6	1	2.4
Nail cosmetics, artificial nails	9	10.6	0	0
Paints, lacquers	9	10.6	1	2.4
Glues	8	9.4	0	0
Hair cosmetics	8	9.4	5	11.9
Cleaning agents (detergents)	7	8.2	4	9.5
Cutting fluids (water-based)	7	8.2	0	0
Not classified	7	8.2	3	7.1
Disinfectants	6	7.1	0	0
Food (additives), skin contact	4	4.7	0	0
Metal (other, such as coins)	4	4.7	3	7.1
Building material	2	2.4	1	2.4
Dental prostheses	2	2.4	0	0
Plants (not food)	2	2.4	0	0

methyl acrylate ($n = 1$), methyl methacrylate ($n = 1$), nickel(II) sulfate hexahydrate ($n = 1$), 2-hydroxyethyl methacrylate (2-HEMA) ($n = 2$), Bis-GMA ($n = 1$), and benzoyl peroxide ($n = 1$), based on the analysis of the 4 patients in whom the above condition applies; the mention of nickel as an allergen in this context apparently refers to the use of metal tools by the nail technician.

- "In which product categories does methylisothiazolinone (MI) in patients in whom current ACD (occupational or non-occupational) has been diagnosed occur?" In the 7 patients concerned, the following product categories were mentioned: soap, shampoo (rinse-off products) ($n = 4$), cleaning agents (detergents) ($n = 2$), cutting fluids (water-based) ($n = 1$), with 1 product category each. In principle, several product categories could be mentioned, for example, occupational contact with cutting fluid causing hand dermatitis, and non-occupational contact with newly painted rooms causing airborne (face) dermatitis.
- "Which are the allergens most often diagnosed in hairdressers?" Hairdressing was documented as the current profession in 14 patients in the present sample. The allergens documented to be responsible for current contact dermatitis include

p-phenylenediamine ($n = 4$), *p*-aminodiphenylamine ($n = 3$), *p*-aminophenol ($n = 2$), *p*-aminodiphenylamine-HCl ($n = 2$), Disperse Yellow 3 ($n = 1$), 4,4'-diaminodiphenylmethane ($n = 1$), cobalt(II) chloride hexahydrate ($n = 1$), nickel(II) sulfate hexahydrate ($n = 1$), toluene-2,5-diamine sulfate ($n = 1$), pyrogallol ($n = 1$), resorcinol ($n = 1$), 2-HEMA ($n = 1$), MI ($n = 1$), *Evernia prunastri* ($n = 1$), and methylchloroisothiazolinone/MI ($n = 1$), without being further filtered according to other criteria.

4 | DISCUSSION

The present analysis of a new concept for combining all necessary information generated during the final evaluation of a patient after patch testing has been subjected to a test trial in a European multicentre study. In the following, several aspects of the approach and the results achieved and possible perspectives will be discussed.

4.1 | Feasibility

Two aspects have to be distinguished: (1) the feasibility of using the concept itself (only this is of interest to be discussed for the reader-ship); and (2) experiences with the actual pilot shape system used to enter data. Just briefly addressing the latter, it was felt to be useful for the collection of data after a patient had been seen, and results had been preliminarily documented on paper forms, but it was not regarded as particularly user-friendly. Hence, for any future use, better integration into the clinical workflow with associated electronic documentation is mandatory.¹⁰ The time needed to enter data will, even in the most user-friendly of implementations, depend on the complexity of the case, mostly the number of contact allergies diagnosed. Owing to the pilot character of the study, and some limitations imposed by the very basic online system, the time needed to enter data was not analysed in the present study. According to experience, with some practice, between 5 and 15 minutes seems to be realistic. In general, the users felt the concept to be logical and flexible. Specifically, the approach enabled standardized documentation to be used, and helped to identify the exposure factors involved, to interpret patch test results in terms of clinical relevance, and to appreciate the role of an individual's contactants in allergic ACD. The tool was felt to be simple and easy to use, and is hoped to help dermatologists to better document and later analyse important data.

4.2 | Content

The concept presented here relies on well-established items of information used for making a diagnosis, including the assessment of clinical relevance,⁵ such as the anatomical site of dermatitis, the actual aetiological/morphological diagnosis, the causative substance (usually in terms of an allergen), work-relatedness, and whether dermatitis is current or previous. The only addition has been the "source of information" on which a diagnostic decision was based (which was mostly the patient's history), which has previously been addressed in terms of analysing the value of MSDSs.¹² The novelty of the concept lies in the way in which these items of information are combined to achieve a

precise as possible representation of the patient's morbidity, while still allowing a relatively easy analysis of data—in contrast to, for example, medical letters or medico-legal opinions, which (should) also represent the patient's problem precisely and fully, but cannot be analysed epidemiologically, as the representation of information is not sufficiently structured.

It is hoped that the example in Figure 1 and the additional illustrative hypothetical case report below can give an impression of the scope and potential of the suggested system:

- A male patient, aged 52 years, suffered from severe hand dermatitis during his former job as a construction worker, which is why he started working as a porter. Although the hand dermatitis cleared over the years, except for recurrences, sometimes involving the face, when the patient indulged in boat building (his hobby), he developed dermatitis of the feet 1 year ago. Extensive patch testing showed contact allergy to chromium and epoxy resin; there was no hand dermatitis on consultation. The diphenyl-carbazide test gave positive results with 2 pairs of his currently worn "private" shoes. This will yield the following diagnosis tuples (given here as text for better readability):
- Previous occupational ACD of the entire hands caused by chromium in building material (cement), according to the history (and the additional knowledge that cement exposure occurred before chromium regulation)
- Current non-occupational ACD (exclusively) of the feet caused by chromium in leather shoes, according to a positive spot test result ("chemical analysis")
- Previous non-occupational ACD (predominantly) of the entire hands caused by epoxy resin systems used for building boats, according to scrutiny of the MSDS
- Previous non-occupational ACD (predominantly) of the face caused by epoxy resin systems used for building boats, according to scrutiny of the MSDS

Thereby, it can be made clear (on the basis of this hypothetical example) that: (1) epoxy resin contact allergy was currently and non-occupationally relevant (as the patient had not worked with epoxy resin systems as a construction worker); (2) epoxy resin contact (airborne or by accidental exposure) was the only factor related to face dermatitis; and (3) chromium allergy acquired as construction worker still caused non-occupational dermatitis on the feet.

Concerning the sources of information on which the evaluation was based, the vast majority of judgements on the relevance of allergic patch test reactions were based on the patient's history. If patient recall is adequate, this can be regarded as sufficient; however, in cases of uncertainty, the less used, but also less convenient, sources of information, including even the effort of a workplace visit, should be considered by the clinician, possibly in cooperation with occupational physicians or hygienists.

4.3 | Future perspectives

In the present pilot study, it was not possible to accommodate >20 diagnosis tuples (which is deemed to be sufficient for the purpose of

the present pilot study in retrospect, in view of the observed maximum of 13 such combinations; Figure 2). In principle, with the use of a fully normalized relational data structure, it is possible to accommodate an unlimited number of such combinations. Additional case data, such as age, sex, occupation, and previous history, relate to all of the diagnosis tuples of that case in a 1 : *n* manner (Figure 1). Future implementations of this approach of documenting the final evaluation should try to provide the best possible user-friendliness, for example, by clicking graphical symbols for anatomical site of dermatitis or type of information, selecting substances only from those haptens that the patient had been diagnosed as being allergic to, and adding these items of information to 1 diagnosis tuple item in a "drag and drop" manner. Our study was merely intended to examine and demonstrate the conceptual usefulness of this approach.

Furthermore, fuller integration of the suggested concept into clinical routine might include elements of decision support, and certainly of quality assurance, in the sense that, during final evaluation, during the discussion with the patient, checklists may help the clinician not to overlook sources of exposure, and provide the clinician with definitions, and possibly even algorithm-driven queries individualized to the particular patient's history. If used in a multicentre setting, for example, in a European network for the surveillance of occupational contact dermatitis and allergy such as the ESSCA network,¹³ a unified tool is expected to aid standardization and, thereby, meaningful comparative analyses. It is of note that the suggested system is considered to be helpful not only for work-related contact dermatitis, but also for fully documenting contact dermatitis in a non-occupational context. Irritant exposures should ideally be documented in a structured way, as previously suggested.¹⁰ It is usually not possible to pinpoint irritant contact dermatitis caused by a certain chemical agent, as in the case of haptens. Nevertheless, "clinical relevance" in the sense that certain contactant(s), that is, product types, are assumed to cause or contribute to irritant contact dermatitis could be accommodated in the documentation system as well, to make the diagnosis of irritant contact dermatitis more specific, where feasible.

5 | CONCLUSION

An improved method of data collection is presented that more accurately links allergen to exposure, clinical disease, and patient history, and thus better represents clinical relevance. This enables more precise analysis of causation of occupational skin disease, and thereby better targeting for prevention. The development of future databases should incorporate the above considerations to record the results of investigation.

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Conflict of interest

A.G.A.: Medical Advisor for Uriach Pharma, Genentech, Novartis, FAES, and GSK, has received research grants from Uriach Pharma, Novartis, and Instituto Carlos III-FEDER, and has performed educational activities for Uriach Pharma, Novartis, Genentech, Menarini, LEO-Pharma, GSK, MSD, and Almirall. W.U.: has accepted travel reimbursement and honoraria for presentations given to cosmetic industry associations, and received a lecture fee from mixed dermatopharmaceutical sponsors for an educational lecture on contact allergy. M.P.: has received a lecture fee from Leo Pharma and the Finnish Cosmetic, Toiletry and Detergent Association. The other authors declare no potential conflict of interests.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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ESSCA history – suspected contact allergy

Family name: _____ First name: _____ Date of Birth: _____ (Maiden name): _____ Street: _____ ZIP-code/city: _____ Telephone (work) _____ (home) _____	Sex: female ☐ Male ☐ Date of Examination: / / Hospital-ID _____ Ward _____
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Atopy

Atopic eczema	☐ yes	☐ no	☐ unclear
Allergic rhinoconjunctivitis	☐ yes	☐ no	☐ unclear
Allergic asthma	☐ yes	☐ no	☐ unclear

Occupation

Current occupation		 years, ... months
Previous occupation		 years, ... months
(Current occupation II)		 years, ... months
(Previous occupation II)		 years, ... months
Comments:		

Duration of current symptoms	 months
Clinical Pattern	☐ Photosensitive ☐ exposed sites ☐ airborne pattern ☐ palms/soles
Primary (initial) site (to Diag. 1)	[.....](For list p.t.o.)
Secondary spread	☐ yes ☐ no ☐ unclear

Diagnosis

Final Diagnosis 1 (For list p.t.o.)	[.....]	Site(s) for Diagnosis 1	[.....] [.....] [.....]
Final Diagnosis 2 (For list p.t.o.)	[.....]	Site(s) for Diagnosis 2	[.....] [.....] [.....]
Other diagnosis:			
Occupational factor(s)	☐ Yes ☐ No ☐ Partly ☐ Unknown		
Endogenous factor(s)	☐ Yes ☐ No ☐ Partly ☐ Unknown		
Other exogenous factor(s)	☐ Yes, n. s. ☐ Yes, leisure activity ☐ Yes, environmental ☐ No ☐ Unknown		
Leisure activities	For list p.t.o. [.....]	[.....]	[.....]
Contact categories	For list p.t.o. [.....]	[.....]	[.....]

Relevance of positive test reactions

After the final reading of the patch test each allergen causing a potentially allergic reaction has to be evaluated in terms of clinical relevance. A respective list is compiled by the computer. It is suggested to comment on relevance at the margin or bottom of the draft sheet with test readings, considering the following aspects for each of these allergens; at least the grey shaded essential one.

Relevance:

☐ Certain ☐ Probable ☐ Possible ☐ Unlikely, not } → ☐ current relevance ☐ past relevance ☐ unknown relevance ☐ cross reaction ☐ not allergic (irritant) ☐ active sensitisation { ☐ occupational ☐ non-occupational
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Additional comments on the contact category of an allergen containing product, and some information in free text form can, but need not be, entered.

Physician in charge:

List of Diagnoses:

1	Allergic contact dermatitis, not elsewhere classified	L23.9
2	Irritant contact dermatitis, not elsewhere classified	L24.9
3	Atopic eczema / dermatitis syndrome	L20.9
4	Seborrheic dermatitis	L21.9
5	Nummular dermatitis	L30.0
6	Stasis dermatitis	I83.1
7	Photoallergic Dermatitis	L56.8
8	Phototoxic Dermatitis	L56.8
9	Burn, thermal or chemical	T20-T32
10	Psoriasis	L40.0
11	Mycosis	B35-B49
12	Parasitosis	B85-B89
13	Contact urticaria, not elsewhere classified	L50.6
14	Urticaria	L50.9
15	Airborne dermatitis, not elsewhere classified	L23.8
16	Atopic (palmo)(plantar) eczema	L20.8
17	Dyshidrotic eczema, pompholyx	L30.1
18	Stomatitis, contact allergic	K12.1
19	Stomatitis, irritant/toxic	K12.1
20	Cheilitis, contact allergic	K13.0
21	Cheilitis, irritant	K13.0
22	Cheilitis, not further specified	K13.0
23	Protein contact dermatitis	L23.8
24	Xerotic eczema (exsiccation)	L30.8
25	Exanthem (non urticarial)	R21
26	Amalgam allergy, to be excluded	Z01.5

27	Denture allergy, to be excluded	Z01.5
28	Eczema / Dermatitis, not further specified	L30.9
29	Drug intolerance	L27.0
30	Contact allergy, to be excluded	Z01.5
31	Glossodynia	K14.6
32	Hyperkeratotic (tylotic) eczema	L24.9
33	Lichen ruber	L43
34	Perioral dermatitis	L71.0
35	Prurigo	L28.2
36	Pruritus sine materia	L29.9
37	Contact allergy, no clinical correlate	T78.4
99	"other" diagnosis, not elsewhere classified	
1001	Allergic contact dermatitis - exclusively	
1002	Allergic contact dermatitis - predominantly	
1003	Allergic contact dermatitis - contributing	
2001	Irritant contact dermatitis - exclusively	
2002	Irritant contact dermatitis - predominantly	
2003	Irritant contact dermatitis - contributing	
13001	Contact urticaria, immunological	
13002	Contact urticaria, non-immunological	
15001	Airborne dermatitis, contact allergic	
15002	Airborne dermatitis, irritant	
9901	other diagnosis - exclusively	
9902	other diagnosis - predominantly	
9903	other diagnosis - contributing	

List of Sites:

101	Hand, not specified
102	Hand, entire hand
103	Hand, back of hand
104	Hand, palm- not specified
105	Hand, palm- centralized
106	Hand, palm- peripheral
107	Hand, finger- not specified
108	Hand, finger- palmar
109	Hand, finger- side
110	Hand, finger- interdigitally
111	Hand, finger- dorsally
112	Hand, finger- fingertip
201	Head, not specified
202	Head, face
203	Head, periorbital
204	Head, mouth- lip
205	Head, oral mucosa
206	Head, periorbital lid
207	Head, scalp- not specified
208	Head, scalp- margin

209	Head, scalp- centre	504	Arm, lower arm
210	Head, ear- not specified	505	Arm, elbow flexure
211	Head, ear- ear canal	506	Arm, wrist- entire
212	Head, ear- earlobe	507	Arm, wrist- extensor
213	Head, mouth- perioral	508	Arm, wrist- flexor
301	Neck, not specified	601	Leg, not specified
302	Neck, front	602	Leg, upper leg
303	Neck, back	603	Leg, popliteal fold
304	Neck, side	604	Leg, knee
401	Trunk, not specified	605	Leg, lower leg
402	Trunk, back	701	Foot, not specified
403	Trunk, front	702	Foot, toe
404	Trunk, groin	703	Foot, dorsum
405	Trunk, axilla	704	Foot, sole
406	Trunk, ano-genital	801	Flexures, not specified
407	Trunk, ano-genital perianal	802	Flexures, elbow flexure
408	Trunk, ano-genital genital	803	Flexures, popliteal fold
501	Arm, not specified	900	Generalized
502	Arm, upper arm		
503	Arm, elbow		

List of leisure activities (preliminary):

1	Do-it-yourself
2	Pottery
3	Gardening
4	Animals

List of contact categories:

1	clothing, textiles
2	house dusts
3	shoes, boots
4	cosmetics, creams(leave on products)
5	soap, shampoo (rinse off products)
6	hair cosmetics
7	nail cosmetics, artificial nails
8	perfume, deodorant
9	food (additives), skin contact!
10	drugs, external
11	drugs, internal
12	medical mat. (sutures, gel, ..)
13	desinfectants

14	metal (worked with)
15	metal jewellery
16	metal implants
17	metal (other, like coins)
18	tools (metal, wood, plastic)
19	dental filling (e.g. amalgam)
20	dental prostheses
21	cutting fluids (water based)
22	neat oils, greases
23	solvents
24	"other" chemicals
25	cleaning agents (detergents)
26	building material

27	woods
28	plants (not food)
29	pesticides, herbicides, ...
30	paints, laquers
31	glues
32	gloves (various materials)
33	leather (other)
34	rubber (other)
35	plastics
36	office material
37	"not classified"