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The implementation of knowledge dissemination in the prevention of occupational skin diseases

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Abstract

Background Occupational skin diseases (OSD) have a high medical, social, economic and political impact. Knowledge dissemination from research activities to key stakeholders involved in health care is a prerequisite to make prevention effective.

Objectives To study and prioritize different activity fields and stakeholders that are involved in the prevention of OSD, to reflect on their inter-relationships, to develop a strategic approach for knowledge dissemination and to develop a hands-on tool for OSD prevention projects

Methods Seven different activity fields that are relevant in the prevention of OSD have been stepwise identified. This was followed by an impact analysis. Fifty-five international OSD experts rated the impact and the influence of the activity fields for the prevention of OSD with a standardized questionnaire.

Results Activity fields identified to have a high impact in OSD prevention are the political system, mass media and industry. The political system has a strong but more indirect effect on the general population via the educational system, local public health services or the industry. The educational system, mass media, industry and local public health services have a strong direct impact on the OSD 'at risk' worker. Finally, a hands-on tool for future OSD prevention projects has been developed that addresses knowledge dissemination and different stakeholder needs.

Conclusion Systematic knowledge dissemination is important to make OSD prevention more effective and to close the gap between research and practice. This study provides guidance to identify stakeholders, strategies and dissemination channels for systematic knowledge dissemination which need to be adapted to country-specific structures, for example the social security system and healthcare systems. A key for successful knowledge dissemination is building linkages among different stakeholders, building strategic partnerships and gaining their support right from the inception phase of a project.

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Introduction

Producing research evidence alone does not directly result in the provision of ideal health care. Consequently, there is a gap between evidence and decision-making at all levels of health care involving different stakeholders, for instance, healthcare professionals and policy-makers.[1] Thus, the progress in medical research aimed at improving healthcare quality led to an increasing need for knowledge dissemination in the last decades.

Knowledge dissemination can be understood as an active approach of spreading evidence-based interventions, mainly resulting from research activities, to a target audience (key stakeholders) via determined channels using targeted strategies.[2] It is a prerequisite to make prevention effective in real life.[3] Straus *et al.* reviewed theories and frameworks and proposed an action cycle (knowledge-to-action-framework) describing the processes of knowledge creation and the application and implementation of knowledge to practice.[1, 3, 4] They highlight that it is crucial to include the end-users and 'to ensure that the knowledge and its subsequent implementation are relevant to their needs'.[1]

This study deals with the dissemination and implementation of research on the prevention of occupational skin diseases (OSD). OSD, which often have a chronic disease course, are of great medical and socio-economic concern because they impair the well-being and quality of life of affected individuals. They can cause long periods of inability to work, may require job change and can generate high direct and indirect costs.[5, 6]

The EU-funded COST Action TD 1206 StanDerm (Development and Implementation of European Standards on Prevention of Occupational Skin Diseases, www.standerm.eu) was launched to develop strategies for effective prevention of OSD across Europe. These strategies are still lacking despite the significant disease burden of OSD.[5–9] The main objective of this research network consisting of 140 dermatologists, occupational physicians, epidemiologists, health educationalists and toxicologists from 31 European countries, was to coordinate interdisciplinary research to develop evidence-based European standards in the prevention of OSD[7,8] and to move towards a uniform approach on how to manage and prevent OSD in Europe.[9] StanDerm supports the translation of basic research into clinical practice and offers a framework for cooperation and exchange of knowledge between the network members, including experienced and early-stage researchers, for example by organizing Training Schools and Short-Term Scientific Missions.[7,8] The Action focuses on five main areas, namely: aetiology and susceptibility, the development of common European standards, on European OSD intervention studies, including occupational skin cancer, on surveillance, risk assessment and allergens and on knowledge dissemination, all of which were addressed in working groups during workshops and conferences from 2013 to 2017. Against this background, one Action task was to study and prioritize the different activity fields and stakeholders that are involved in the prevention of OSD, to reflect on their inter-relationships, to develop a strategic approach for knowledge dissemination and a hands-on tool (matrix) for future OSD prevention projects that addresses the different stakeholder needs. This study presents the process and results of the analysis undertaken to identify the determining factors for the dissemination of OSD knowledge and interventions into society ('real life'). The study particularly addresses experienced and early-stage researchers, as well as other experts, practitioners and stakeholders who work in the field of OSD prevention and other prevention projects who look for guidance in terms of strategies to disseminate knowledge within the lifetime of a project and beyond. The study aims at raising awareness on the importance of a systematic knowledge dissemination to make OSD prevention more effective.

Materials and methods

Qualitative identification of activity fields and dissemination categories

To develop an approach for systematic knowledge dissemination, an exchange of experiences and discussions of different knowledge dissemination aspects within the StanDerm network was pivotal for the communication and cooperation among its members. To enhance communication, specific networking methods (e.g. World Café) and social media (e.g. LinkedIn, Twitter/standerm_eu) were used. This was supported by the StanDerm website (www.standerm.eu), which entailed information on the members' expertise, Action news, results of the workshops, training courses and publications.

Following a literature search on knowledge dissemination definitions and concepts, a structural model for dissemination was developed consisting of three dissemination levels (experts, stakeholders/multipliers and general population). The leading question through this process was 'How to ensure health and healthy skin at work?' of which three more specific questions derived as follows:

1 What are the main activity fields at societal level to improve prevention and health promotion of OSD?
2 Which stakeholders within these fields need to be addressed, and at what time to improve the dissemination of knowledge on OSD?
3 To which extent do interdependencies between the different activity fields exist?

The Ottawa Charter for Health Promotion[10] suggests that health is not only created and maintained by the health sector and in medical settings but by different areas of society. Based on this statement, critical dissemination categories for the prevention of OSD and a healthy skin at work were derived. These categories were then revised and expanded by taking basic prevention and health promotion literature into account, particularly pertaining to country-specific structures for health promotion at governmental and non-governmental, as well as at local, federal and state level.[10–14] This resulted in identifying five activity fields which influence attitudes and behaviour of the population in general, namely political system, research activities, educational system, industry and local public health services. Two additional areas, mass media and professional networks, were identified to be specifically relevant for the prevention of OSD at a knowledge dissemination workshop by 12 Action members from five countries (Bosnia and Herzegovina, Croatia, Germany, Serbia, Switzerland).

Quantitative impact analysis and StanDerm Action member survey

The qualitative identification of the activity fields for knowledge dissemination was followed by a quantitative approach by applying an impact analysis to gain insight into possible interdependencies between the prevention areas and to identify the leading forces in the prevention system.[15] This insight into the interactions, the cross-linkages within the system and possible leading forces can support a more strategic knowledge dissemination and intervention planning to prevent OSD.

A questionnaire for the impact analysis was developed and a pretest was conducted with 12 StanDerm Action members. During a subsequent Action workshop, 55 Action members from 18 countries completed the final questionnaire (see Appendix S1). They were asked to estimate the influence that every single activity field has on every other field concerning the prevention of OSD in their country on a Likert scale (0 = no impact, 1 = certain impact, 2 = relevant impact, 3 = strong impact; for example, influence of the political system on the educational system). Hence, the participants were asked to rate a total of 56 possible combinations between the activity fields and to name their country and profession.

Statistical analysis

Data were first described using mean and standard deviation (SD) of each data matrix item. The general agreement among raters, overall and in strata of country and occupation, was produced, based on two-way absolute single and average measure intraclass correlation coefficient (ICC). The single measure ICC (A,1) quantifies the absolute agreement between raters, while the average measure ICC (A,k) quantifies how much each rater agrees with the average of all raters. The latter was used to judge when an aggregate measure, based on the average of different rankings, was acceptable or not (poor agreement). ICC can be interpreted as follows: 0–0.2 indicates poor agreement; 0.3–0.4 indicates fair agreement; 0.5–0.6 indicates moderate agreement; 0.7–0.8 indicates strong agreement; and >0.8 indicates almost perfect agreement.[16]

Survey results were then analysed by means of Edmonds' maximum spanning tree (MST) algorithm,[17] computed on the overall average ranking matrix. The directed graph produced represents the best connection among variables in the matrix based on their maximal reciprocal ranking. Each connection is shown along with a number (weight) corresponding to the average ranking between elements of the matrix, in the direction dictated by the graph. The final MST of the data matrix was computed after adjusting average rankings by country. Adjustment was performed by means of random effect models.

The maximum flow algorithm[18] was moreover applied to discover the most important links pointing to attitudes and behaviours of the general population. Starting from the hierarchical structure of the country adjusted MST graph, the algorithm found the maximum feasible flow from a source (e.g. the political system) to a final sink (e.g. the general population). The original weights of matrix were the capacities of the system and numbers on arrows in the graph represented the calculated maximum flow across the network. Analysis was carried out using MATLAB v.7.8 (MathWorks, Natick, MA, US).

Results

Study participants

Fifty-five Action members participated in the survey. The 18 countries represented by these Action members were Germany (n = 7), Denmark (n = 5), Italy (n = 4), Croatia (n = 3), Belgium, Finland, France, Macedonia, the Netherlands, Romania, Sweden, Switzerland, United Kingdom (each country: n = 2), Norway, Poland, Portugal, Czech Republic and Turkey (each country: n = 1). Most Action members were dermatologists (n = 18), followed by other specialized physicians (n = 15, e.g. occupational medicine) and other scientific fields of expertise (n = 10, e.g. health educationalist). All have in common that they are active and specialized in the field of OSD.[8]

Descriptive results and items agreement

Table 1 reports summary statistics for each data matrix item. Items with a mean rating ≥2 (relevant/strong impact) were the influence of the political system on the educational system (2.26), industry (2.00) and local public health services (2.31), as well as the influence of mass media on attitudes and behaviour of the general population (2.42). By contrast, 13 items showed a mean rating <1 (no/small impact), for example the influence of mass media on research activities (0.82). The political system, mass media and industry were the three activity fields with the highest overall impact in the survey (sum for means of row A/political system: 13.20, row F/industry: 10.41, row B/mass media: 9.95). In contrast, the activity field attitudes and behaviour of the general population were mainly affected by other fields (sum for means of column H: 10.80).

Table 2 shows the general agreement among raters on all questionnaire items, overall and in strata of the main countries involved and occupations. Although there was a poor absolute agreement, the overall average agreement was high (0.93). Countries with a minimal acceptable average agreement ($ICC_{(A,k)} \geq 0.3$) such as Croatia, Denmark, France, Italy, Sweden, Finland, Germany and the Netherlands were included in the subsequent analysis.

Maximum spanning tree and maximum flow graph

Figure 1 shows the summary results of the survey based on MST algorithm on the average ranking matrix adjusted by country. The directed graph starts from the political system as the main source connecting other elements based on a hierarchical structure. The political system directly influences local public health

Table 1 Overall impact analysis of the activity fields for knowledge dissemination on OSD (n = 55 StanDerm Action members)

Activity field		A Political system	B Mass media	C Professional networks and associations	D Research activities	E Educational system	F Industry	G Local public health services	H Attitudes and behavior of the general population	Sum (m) of row
A	**Political system** (e.g. national legislation, national health system, EU regulations)		1.81 (0.99)	1.75 (0.85)	1.81 (0.91)	2.26 (0.87)	2.00 (0.93)	2.31 (0.91)	1.26 (0.71)	**13.20**
B	**Mass media** (print media: e.g. journals, newspapers, poster, flyer; audiovisual media: TV, radio, movies; internet / webpages)	1.89 (0.88)		1.33 (0.70)	0.82 (0.75)	0.96 (0.72)	1.29 (0.74)	1.24 (0.79)	2.42 (0.69)	**9.95**
C	**Professional networks and associations** (national and international networks, e.g. EADV etc., employers' and workers´ associations)	1.27 (0.78)	1.22 (0.66)		1.98 (0.76)	1.31 (0.72)	1.24 (0.82)	1.20 (0.76)	1.11 (0.71)	**9.33**
D	**Research activities** (e.g. regarding diagnostic, therapy, barrier impairment, epidemiology, workers' education)	0.93 (0.74)	1.07 (0.74)	1.84 (0.83)		1.35 (0.84)	1.58 (0.85)	1.29 (0.88)	1.02 (0.71)	**9.08**
E	**Educational system** (e.g. the national school system: secondary schools, vocational schools; curricula for teachers, curricula at universities)	0.84 (0.86)	0.76 (0.72)	1.25 (0.84)	1.49 (0.94)		0.95 (0.70)	1.09 (0.78)	1.84 (0.92)	**8.22**
F	**Industry** (e.g. pharmaceutical industry, cosmetics industry, manufacturers of personal protective equipment)	1.80 (0.87)	1.67 (0.79)	1.58 (0.81)	1.71 (0.81)	0.87 (0.58)		1.18 (0.82)	1.60 (0.83)	**10.41**
G	**Local public health services** (e.g. therapy and/or counseling provided by dermatologists, occupational physicians)	0.80 (0.78)	0.85 (0.89)	1.18 (0.94)	1.09 (0.84)	0.85 (0.73)	0.85 (0.76)		1.55 (0.81)	**7.17**
H	**Attitudes and behavior of the general population** (e.g. the individual worker with hazardous skin exposure at workplace)	1.24 (0.94)	1.25 (0.91)	1.16 (0.71)	0.96 (0.77)	0.89 (0.66)	1.18 (0.82)	1.42 (0.71)		**8.10**
	Sum (m) of Column	**8.77**	**8.63**	**10.09**	**9.86**	**8.49**	**9.09**	**9.73**	**10.80**	

Scale: 0 = no impact, 1 = certain impact, 2 = relevant impact, 3 = strong impact.
Each table cell reports the mean (standard deviation) of the scores.

Table 2 General agreement among raters on all questionnaire items, overall and in strata of main countries involved and occupations

	*N**	ICC $_{(A,1)}$ (95% CI)	ICC $_{(A,k)}$ (95% CI)
Overall	55	0.20 (0.15, 0.28)	0.93 (0.90, 0.96)
Country			
Croatia	3	0.21 (0.06, 0.39)	0.45 (0.15, 0.66)
Denmark	5	0.36 (0.23, 0.50)	0.74 (0.60, 0.83)
Macedonia	2	−0.06 (−0.30, 0.19)	−0.13 (−0.85, 0.32)
Switzerland	2	−0.03 (−0.09, 0.08)	−0.05 (−0.21, 0.14)
France	2	0.41 (0.18, 0.61)	0.59 (0.30, 0.76)
Italy	4	0.14 (0.02, 0.28)	0.38 (0.09, 0.61)
Romania	2	0.04 (−0.09, 0.21)	0.09 (−0.20, 0.35)
Sweden	2	0.40 (0.15, 0.60)	0.57 (0.26, 0.75)
Finland	2	0.28 (0.04, 0.50)	0.44 (0.08, 0.67)
Germany	7	0.30 (0.20, 0.43)	0.75 (0.64, 0.84)
United Kingdom	2	0.08 (−0.07, 0.27)	0.15 (−0.16, 0.42)
The Netherlands	2	0.31 (0.06, 0.53)	0.48 (0.11, 0.69)
Occupation			
Dermatologist	18	0.20 (0.14, 0.29)	0.82 (0.74, 0.88)
Other physician	15	0.16 (0.11, 0.25)	0.75 (0.64, 0.83)
Other scientific occupation	10	0.22 (0.13, 0.32)	0.73 (0.61, 0.83)

ICC, intraclass correlation coefficient; CI, confidence interval.
ICC (A,1): Two-way random absolute single measure ICC (it measures how much each rater agrees with another one).
ICC (A,k): Two-way random absolute average measure ICC (it measures how much each rater agrees with the average of all raters)
*Countries with only one questionnaire were excluded from the stratified analysis, as well as questionnaires with missing information on rater origin or occupation.
ICC can be interpreted as follows: 0–0.2 indicates *poor* agreement; 0.3–0.4 indicates *fair* agreement; 0.5–0.6 indicates *moderate* agreement; 0.7–0.8 indicates *strong* agreement; and >0.8 indicates *almost perfect* agreement.

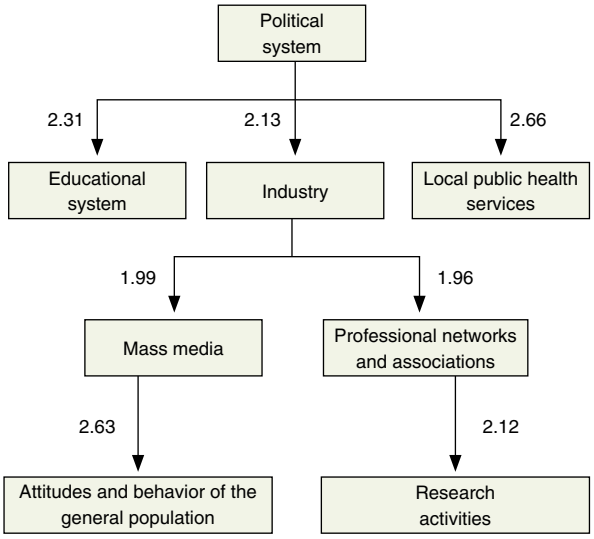

Figure 1 Maximum spanning tree of the average ranking matrix adjusted by country. Adjustment was performed by means of random effect models. Countries with poor agreement (ICC $_{(A,k)}$ < 0.3), as well as questionnaires with missing information on rater origin, were excluded from the analysis. The graph represents the best connection among variables in the matrix based on their maximal reciprocal ranking. Each connection is shown along with a number (weight) corresponding to the average ranking between elements of the matrix, in the direction dictated by the graph.

services (average ranking = 2.66), the industry (2.13) and the educational system (2.31). On a secondary level, the industry influences both mass media (1.99) and professional networks and associations (1.96). At the final level, mass media influences attitudes and behaviour of the general population (2.63), while professional networks and associations influence research activities (2.12).

To discover the most important links pointing to attitudes and behaviours of the general population, the maximum flow algorithm was applied (Fig. 2). Starting from the political system (source), the algorithm found that the maximum flow is conveyed through mass media, educational system, industry and local public health services, although other elements also play a role. Mass media seems to be the most important node in the diagram, with several incoming connections from important elements. Other elements such as research activities and professional networks and associations have a minor role in this process as indicated by the lower numbers (flows) in the graph. The political system is also poorly directly connected with attitudes and behaviour of the general population; its overall influence is played through a complex network of connections with other elements in the system.

Hands-on tool for knowledge dissemination

Based on the results of the impact analysis, a matrix was developed to be used as a hands-on tool for knowledge dissemination activities in the field of OSD (Table 3). It was discussed with 64 Action members from 23 countries and tested using retrospective data on the progress of an OSD prevention programme in Norway. The feedback of this exchange resulted in a further improvement of the tool in terms of usability, user-friendliness and practical applicability in research and intervention projects.

The matrix is intended to be used for knowledge dissemination throughout the lifetime of a research project (definition, implementation and evaluation). It may give guidance on identifying appropriate stakeholders and time points of knowledge dissemination activities.

Discussion

Occupational skin diseases (OSD) have a high medical, social, economic and political impact. As effective prevention strategies

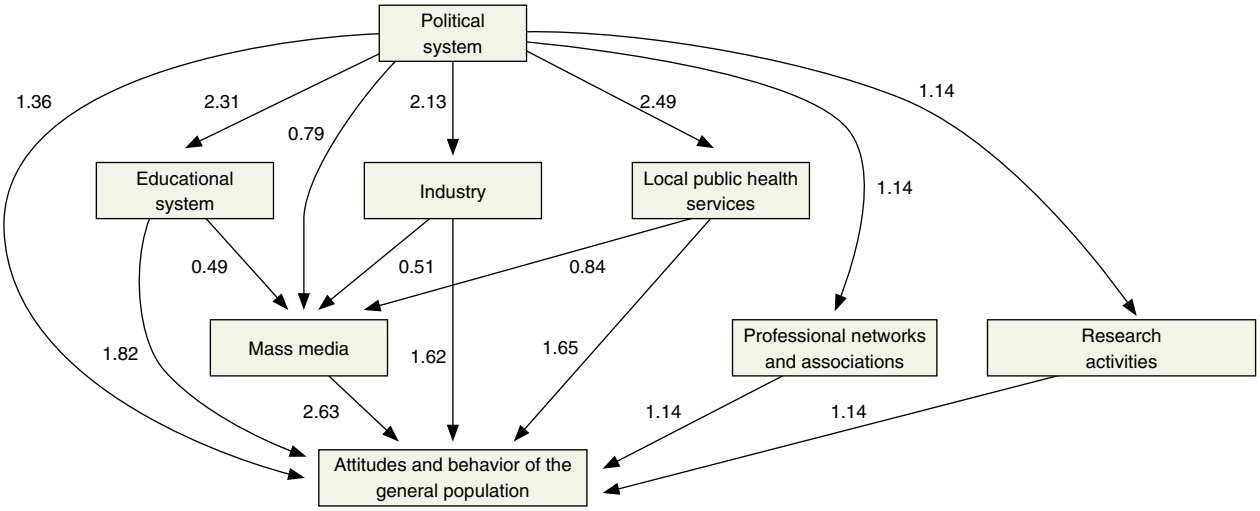

Figure 2 Maximum flow from 'political system' to 'attitudes and behaviour of the population in general' based on average ranking matrix adjusted by country. The graph represents the best flow from a starting source (political system) to a final sink/target (attitudes and behaviour of the population in general), based on the hierarchical structure derived from maximum spanning tree adjusted by country. Original weights in the adjusted matrix are the capacities of the system and numbers on arrows represents the calculated maximum flows across the network.

are urgently needed, many OSD research projects with varying approaches in terms of prevention have been conducted in the last decades all around the world producing scientific evidence. As there is often a gap between OSD research projects and the subsequent implementation of their results, this study's objective was to identify the most relevant knowledge dissemination categories and their interactions as well as to develop a strategic approach for knowledge dissemination. This is of utmost importance as OSD research on prevention requires time and efforts involving human and financial resources. Therefore, integrating knowledge dissemination in the whole process of prevention projects seems a logic consequence. Based on StanDerm experts' ratings, the main results are as follows:

1 Activity fields identified to have a high overall impact on OSD prevention are the political system, mass media and industry.
2 The political system has a strong but more indirect effect on attitudes and behaviour of the general population via other activity fields such as the educational system, the local public health services or the industry.
3 The educational system, mass media, industry and local public health services have a strong direct impact on the OSD 'at risk' worker.
4 A hands-on tool for knowledge dissemination has been developed.

The three activity fields with the highest overall impact on other activity fields (as shown by the sum of the rows in Table 1) seem particularly promising for future OSD prevention approaches. In the following, they are briefly discussed to illustrate successful examples of OSD prevention and knowledge dissemination.

Political system

Targeted legislation and regulation can have a significant impact on healthy skin at work. In Germany, powdered natural rubber latex (NRL) gloves were banned and technical regulations on the use of low-allergen, powder-free NRL were implemented resulting in a steady decline of reported cases of suspected NRL allergy.[19, 20] The introduction of chromate-reduced cement and the implementation of the EU directive 2003/53/EC, which was supported by the industry as well, led to a decrease in chromate allergy in construction workers.[21–23]

Voss *et al.*[24] demonstrate how the underlying health care and insurance systems and procedures affect disease notification, patient management and compensation of OSD cases. These might also affect underreporting of OSD cases which is a huge and common problem in many European countries.[25–28]

Industry

In line with recent observations, the industry (e.g. cosmetic or pharmaceutical industry, manufacturers of working materials, personal protective equipment) was found to play an important role in the prevention of OSD.[29–34] Because of the high incidence

Table 3 Hands-on tool for knowledge dissemination

Matrix: How to improve knowledge dissemination of your OSD prevention project								
	Dissemination categories / **Tasks**	**Political system** (e.g. national legislation, national health system, EU-regulations, social partners)	**Industry** (e.g. pharmaceutical industry, cosmetics industry, manufacturers of personal protective equipment)	**Mass media** (print media: e.g. journals, newspaper, poster, flyer; audiovisual media: TV, radio, movies; internet / webpages)	**Professional networks and associations** (national and international networks, e.g. EADV, employers' and workers´ associations)	**Research activities** (e.g. regarding diagnostic, therapy, barrier impairment, epidemiology, workers' education)	**Educational system** (e.g. the national school system: secondary schools, vocational schools; curricula for teachers, curricula at universities)	**Local public health services** (e.g. therapy and/ or counseling provided by dermatologists, occupational physicians)
1	Name the most relevant stakeholders and partners of your project within each category. List the appropriate contact person(s).							
2	Describe the special needs of your stakeholders and partners of your project within the most relevant/all categories.							
3	Put the main issue of your project in a nutshell to address the most relevant/ all categories.							
4	Describe the benefit of your project for the stakeholders and partners within the most relevant/all categories.							
5	Describe the evidence of your project for the most relevant/all categories. What is the potential of your project? What "makes the difference" and brings new solutions/ new approaches to tackle the issue of OSD prevention?							
6	Describe the means/tools for the dissemination of your project results.							
7	Describe the supportive factors and the barriers for your dissemination activities. How to overcome potential barriers?							
8	Describe the outcome of your project and how to measure it.							

of skin sensitizations to glyceryl monothioglycolate in hairdressers, manufacturers and the hairdressers' employers' association agreed on removing this allergen from permanent wave solutions and to withdraw it from the German market, leading to a steady decreasing number of sensitizations[29–32] and finally a ban of the allergen.[33] The introduction of chromate-reduced cement was also supported by the corresponding industrial branches.[21,22]

There are other examples demonstrating how industrial branches have contributed to the development of appropriate skin care, skin cleansing as well as distinct types of gloves to improve protection against mechanical and chemical exposures.[34–36]

Mass media

The central role of mass media in OSD prevention is reflected by its position in the maximum flow graph as it may have a strong direct impact on the individual worker and/or the general population.

Among the examples of campaigns and intervention projects geared towards mass media (print media, poster, TV, radio, websites),[37–40] we want to highlight the national 'Healthy Skin Campaign' in Germany (2007–2008) under the slogan 'Your skin. The most important 2 m^2 of your life'. Under the auspices of the statutory accident insurance and the statutory health insurance, poster campaigns at public places, marathon events and multiple 'skin days' at workplaces had been organized resulting in an increased OSD awareness, particularly by workers and dermatologists. Hence, during and after the campaign, the number of reported OSD cases increased. This led to a reduction of otherwise underreported OSD cases.[34, 39, 41]

As part of the pan-European campaign 'Healthy skin@work', led by the European Academy of Dermatology and Venereology (EADV) since2009, various national awareness-raising activities have been initiated over the past seven years in a number of European countries. These activities are partly directed to the public.[37, 38, 40, 42]

The EU-funded projects 'SafeHair 1.0' and 'SafeHair 2.0' developed an Internet-based 'SafeHair Skin & Beauty Toolbox' (www.safehair.eu) that addresses hairdressers (employers, employees, trainees) and vocational teachers and provides information and materials in seven languages.[42, 43]

The above-mentioned examples illustrate some determining factors to make OSD prevention more effective. OSD research projects shall take into account:

- the interdependencies between the different activity fields identified in this study,
- the interaction and cooperation between stakeholders from the different fields,
- the need for a strategic approach to close the gap between research and practice.

It is often a missed opportunity of (research) projects in general to use the appropriate dissemination channels available because they were not identified accordingly. A key for successful knowledge dissemination is therefore building linkages and strategic partnerships with and among stakeholders and gaining their support right from the inception phase of a project.[40] This will help improve healthy workplaces by means of continuous knowledge dissemination activities. Successful examples reveal cooperation between policy (e.g. by banning allergens), industry (e.g. by voluntary usage of less potent allergens), research (e.g. in view of the epidemiology and potency of allergens) and the educational system (e.g. by incorporating information on OSD prevention in curricula of vocational education).

To translate our results of the impact analysis into practice, namely OSD prevention programs, we developed a tool to help implementing knowledge dissemination throughout the whole process of a prevention project (Table 3). This tool has been discussed and evaluated by 64 Action members regarding comprehensibility and applicability and tested using retrospective data on the progress of an OSD prevention program in Norway.

As laws and regulations, patient management pathways[44] and educational systems greatly differ throughout Europe, both figures and the tool intend to provide guidance to identify strategies and approaches for systematic knowledge dissemination, OSD prevention and stakeholders in different activity fields which need to be adapted to the country-specific social security system, healthcare provision and educational system.

The different work experiences of the StanDerm network members and the country-specific differences may explain the heterogeneity between many raters (interrater agreement) as shown in Table 1 and Table 2.

Indeed, implementation and dissemination research has so far not gained strong evidence on the effectiveness of targeted strategies and tools. A systematic review by Flodgren *et al.*[45] focused on the effectiveness of tools developed and disseminated by guideline producers to improve the uptake of their clinical practice guidelines. Only four randomized controlled trials were included in this review, and the tools targeted healthcare professionals. In one study, the tool comprised two short face-to-face educational workshops tailored to barriers; in three studies, the intervention consisted of the provision of paper-based materials (e.g. educational materials, order forms or reminders). The authors conclude that implementation tools developed by recognized guideline producers probably lead to improved healthcare professionals' adherence to guidelines. They state however that there are no studies evaluating the effectiveness of interventions targeting the organization of care (e.g. benchmarking tools, costing templates,) or for mass media interventions. Another review on strategies to improve the implementation of healthy eating, physical activity and obesity prevention policy, practices or programs by childcare services stated that current research provides weak and inconsistent evidence of the effectiveness of different

implementation strategies (e.g. educational materials, meetings, audit and feedback, opinion leaders, small incentives or grants, educational outreach visits) in ten included trials.[46]

Altogether, the StanDerm approach seeks to contribute to a more holistic dissemination strategy. In the sense of Rutten and Gelius,[47] our approach to knowledge dissemination is based on a multi-level model of the interaction of structure and agency in prevention and health promotion which is connected to central claims of the Ottawa Charter,[10] namely 'build healthy public policy', 'create supportive environments', 'strengthen community actions' and 'develop personal skills'. Such approach may be even more difficult to evaluate than a tool focusing on only one dissemination aspect.

A next application field to test and evaluate the approach and tool applied for (enhanced) knowledge dissemination in our study is non-melanoma skin cancer (NMSC). NMSC results from long-term exposure to natural UV radiation (approximately 75% of working time spent outside) and is currently on the rise among outdoor workers.[48, 49] Despite sufficient scientific evidence, there is no uniform approach in European countries with regard to registration, notification, legal recognition, compensation, patient care and prevention measures to reduce outdoor workers' exposure to UV radiation.[50] Thus, a number of national and international research projects are to be expected in future aimed at preventing NMSC through the different activity fields of prevention, such as implementation/change in legislation and regulation, industrial improvements of protective equipment, targeted safety and health measures, mass media campaigns and workers' education at the workplace and at vocational schools. Our results and hands-on tool may be of help when it comes to the identification of tailored, country-specific prevention strategies and to consider relevant stakeholders and their needs for NMSC prevention.

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Supporting information

Additional Supporting Information may be found in the online version of this article:

Appendix S1. Questionnaire for the impact analysis: Prevention of occupational skin diseases (OSD)