

IN-DEPTH REVIEW

Strategies for prevention: occupational contact dermatitis

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Abstract The economic consequence of occupational contact dermatitis (OCD) is considerable and impacts on an individual's quality of life. There are a range of prevention strategies, which include: elimination or substitution of harmful exposures; technical control measures; personal protection; identification of susceptible individuals; and education, training and health surveillance. Each one has been shown to have varying degrees of success in reducing OCD, but further work is required to evaluate the effectiveness of preventive measures in the workplace. OCD is not considered a high priority in most affected industries and therefore the development of health and safety policies to reduce its prevalence should be encouraged, although guidance and assistance would be required, because all employees are entitled to a safe working environment.

Key words Absenteeism; allergens; irritants; occupational contact dermatitis; prevention; work-related.

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Introduction

The economic impact of occupational contact dermatitis (OCD) is considerable and has an appreciable impact on the quality of the sufferer's life [1] (Figures 1 and 2). Dermatological problems have, on average, accounted for 20% of all work-related health problems reported to UK occupational physicians and consultant dermatologists [2–4]. Approximately 4 million working days are estimated to be lost every year due to absenteeism resulting from work-related skin diseases [4]. It has been estimated that 20–25% of affected workers lose time from work, with an average of 10–11 lost workdays per case [5] costing UK industry an estimated £200 million. Given this impact, prevention of OCD is an obvious priority and its prevention has been identified as an area of research both in the US [6] and the UK [2,7].

OCD may be induced by a variety of hazards (chemical, physical and biological) and can be influenced by a combination of exposure characteristics (exposure to wet work, friction, handling of chemicals and working

practices) as well as individual susceptibility. Skin contact with irritants and/or allergens is usually required, but the probability and severity of a reaction depend on the type and intensity of exposure.

Occupational studies have found that OCD symptoms tend to decrease when subjects were away from work, especially printers [8] and recurring symptoms in working populations vary between 35 and 80% [9]. As patients with OCD have a poor prognosis for clearing their skin diseases [9], primary prevention of OCD is most important. There are a range of prevention strategies for OCD that are recommended and shown in Figure 3.

Elimination or substitution of harmful exposures

In any prevention strategy, the highest priority should be given to measures 'at the source', such as the elimination or substitution of harmful substances. This may be achieved by using less noxious substances that are still suitable for the task [10]: for example, the use of propylene glycol in water-cooling systems has been successfully replaced with less sensitizing agents such as

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Figure 1. Irritant contact dermatitis affecting the palmar surface in a printer. (Colour versions of all the figures are available as supplementary data at *Occupational Medicine Online*.)



Figure 2. Secondarily infected irritant contact dermatitis in a chef.

zinc borate [10]. Scandinavian countries have added ferrous sulphate to cement to inhibit potentially sensitizing chromate and have successfully reduced the prevalence of allergic contact dermatitis (ACD) [11–13]. These countries have legislation that limits hexavalent chromium in cement to 2 p.p.m. [14]. Prolonged contact with water, especially with the simultaneous effects of washing and cleaning substances, is the major cause for a large proportion of the OCD cases observed. For this

1. Elimination or substitution of hazardous substances, e.g. chromate.
2. Technical control measures, e.g. damp dusts, ventilation extraction.
3. Personal protection, e.g. gloves, barrier creams, emollients, personal hygiene.
4. Identification of susceptible individuals, e.g. pre-employment health questionnaires, patch tests.
5. Education/training and health surveillance, e.g. induction, surveillance programmes.

Figure 3. Occupational contact dermatitis: strategies for prevention.

reason, Germany introduced legislation to regulate activities during which employees are exposed to wet work [15]. Legislation can be an effective tool in the prevention of OCD [16], and this is particularly true for many of the contact allergens that are chemical substances in various types of product. Examples of legislation include the directives against nickel [17], cosmetics [18], dangerous substances [19] and dangerous preparations [20].

In the printing industry, SUBSPRINT is a Europe-wide project aimed at reducing health risks and environmental pollution from the use of organic solvents by using vegetable-oil-based cleaning agents (VCA). These have been successfully introduced into a number of countries, but not, as yet, the UK [21]. The effectiveness of replacing organic solvents with VCAs for cleaning offset lithographic printing presses [22] has been evaluated. However, although they functioned adequately and had a lower environmental impact than the organic solvents, suitable protective equipment is still required as they cause irritation.

Technical control measures

The use of technical control measures to enclose, contain, or isolate potential skin irritants depends on their physical form and route of exposure [23,24]. Exposure to dusts and their contents have long been known to produce physical effects, primary irritant eruption and allergic skin reactions [25]. Dermatitis from cement dust is dry and lichenified, primarily because of its alkalinity, hygroscopic properties and abrasive effects. Sawdust from teak, mahogany, redwood and rosewood may contain sensitizers that produce a dry dermatitis, particularly among carpenters and woodworkers. Similarly, paper dust produces a dry dermatitis, especially among workers in finishing areas in the printing industry [8]. The installation of ventilation and extraction controls may be sufficient to reduce the chance of dust exposure. However, there appear to have been no studies that have examined the impact of these measures on the incidence of OCD.

Personal protection

Gloves

Gloves are important in the prevention of OCD and are effective against most irritants [24,26,27]. However, they may contribute to an increased risk of OCD [28]. Non-specific irritation can occur from sweat entrapment and friction of the clothing against the skin; accidental occlusion of chemical irritants and allergens beneath the protective clothing can occur, thus enhancing cutaneous absorption and substance toxicities; and contact allergy can develop due to additives in protective clothing.

The HSE [29] state there are four basic requirements that must be met for any protective glove to be suitable:

- it must be appropriate for the risk(s) and conditions where it is used;
- it must take into account the ergonomic requirements and state of health of the wearer;
- it must fit the wearer correctly; and
- it must prevent or control the risk involved without increasing the overall risk.

The HSE have also provided guidance tables for the selection of gloves for individuals working with chemicals [29] and in particular the printing industry [30].

There have been studies on the effectiveness of gloves to various laboratory tests, using laboratory equipment on patches of glove material [31–35]. Few studies have examined the effects of chemicals on the intact glove or under the normal working conditions where the glove is being worn.

A recent survey of trainee hairdressers observed glove use to be poor [36] and in those who did not wear them the odds of developing hand dermatitis increased [37]. Similarly, among bakers, confectioners and employees in the catering trades, relatively few of those diagnosed with hand disease regularly wore protective gloves [38], or wore them before the introduction of skin protection measures [39]. A recent survey of printers in the UK observed that 67% stated they wore gloves [8], the percentage of workers wearing gloves varying between the different process areas. However, although printers stated that they wore gloves, observations in a subsequent study found this not always to be true [40]. The level of acceptance of protective gloves has been observed to be considerably lower than that of other protective measures [41], although a significant improvement in their uptake was observed after their benefit was demonstrated to bakers [39] and automobile engineers [42].

Protective creams

Protective or 'barrier' creams/gels are designed to provide a protective layer between the skin and noxious substances [43]. They are one of the classical means of

skin protection against chemicals from the environment and have existed for 50 years. It is recommended that they are only to be used for non-toxic, non-carcinogenic and non-sensitizing low-grade irritants such as water, detergents and cutting fluids [44]. They are generally formulated to repel either oil, grease, paint and solvents (e.g. oil-based creams), or water-based products such as weak acids, alkalis and metalworking fluids (e.g. silicone-based creams). They should be used only on normal skin as they may occasionally cause secondary aggravation of dermatitis if applied to inflamed skin.

Studies have shown them to be protective against various substances [45–47], including epoxy resins [48], metals [49], metal salts [50], metal powders, paints and cutting oils [51], and against standard irritants (10% sodium lauryl sulphate, 1% sodium hydroxide, 30% lactic acid, toluene) [52–56]. They have also been demonstrated to be helpful in preventing hand irritation and dermatitis in various occupations, including health care workers [57], textile dyeing and printing plant workers [58], hairdressers [59] and workers in the food processing industry [56].

Although several studies have shown barrier creams to have some protective effect against the acute irritative and locally toxic actions of solvents [60,61], some have not [62], and for more extended exposure times they do not seem to be effective [52,63]. The barrier properties of some creams against the systemic absorption of solvents also appeared to be no more effective than bare skin [64,65]. Studies have also shown them to be ineffective against cutting fluids [66].

Despite experimental data demonstrating the efficacy of barrier creams, their potential value is still viewed with scepticism [67]. In a survey of international experts in OCD, 98% believed that barrier creams were no more effective than bland emollients in the prevention of hand dermatitis [68]. There is also some discrepancy between promising experimental efficacy data and the doubt about the practical benefit of barrier creams. One problem is the effective application of the creams: they must be applied frequently, in adequate amounts and to all skin areas that need protection. Studies have observed that, in various occupations, many areas of skin to which creams should have been applied, were missed [69], but, with education and training, significant improvements in coverage were seen [70]. Some studies have shown that barrier creams may cause problems and could concentrate the irritant skin response [54]. Others have postulated that irritants and allergens may adhere to the barrier cream and thus be transferred into the skin [71].

Emollients

In addition to protective creams, there are also emollient creams and ointments that can be used during and after work. These are designed to be effective in preventing

OCD of the irritant type, but the epidemiological evidence for this is scarce [28]. Their mode of action is not based upon shielding the skin, but in restoration of the horny layer of the epidermis [67] by forming a semi-occlusive protective layer that prevents the evaporation of water from the skin, thereby accelerating the healing process [72]. However, it has been suggested their long-term use on normal skin progressively reduces the barrier efficiency of the stratum corneum [73,74] and therefore increases the susceptibility of the skin to irritants.

Randomized controlled trials have shown that eczematous skin heals faster when treated for several days with a moisturiser compared with untreated, symmetrical, control skin [37,47,57,74–79]. The more lipid-rich moisturizers tended to improve barrier restoration more rapidly than the less lipid-rich moisturizers. These and other moisturizing creams are gaining credibility in skin protection, and their regular and thorough application may be an important guard in the secondary prevention of OCD [80].

Moisturizers have been advocated for the treatment of irritant contact dermatitis [72]. A recent review concluded that emollients do have their associated problems, and much effort will be necessary to develop products that will give consistent barrier regeneration and fewer side-effects [81]. Efficacy and cosmetic acceptance are important qualities of products, but user knowledge of correct use is a basic condition for efficacy. However, their benefit in the prevention of OCD has to be evaluated in reliable studies yet to be undertaken, especially in the workplace.

Cleansers and personal hygiene

There are several basic requirements for an 'efficient' skin cleanser. Dependent on the grade of contamination, a range of skin cleansers that allow adequate skin cleansing is necessary [82]. Prompt rinsing with water or washing with mild soap is enough to remove many allergens and irritants from the skin, but abrasive soaps and waterless hand cleansers are sometimes necessary. Appropriate information on skin-cleansing products is not always provided to people at risk and more effort should be made to teach workers the best way to use appropriate skin cleansing agents [83].

Personal hygiene should include regular washing or cleaning of protective clothing, as inadvertent skin contact often occurs when clothing is put on or removed, or when clothing becomes excessively soiled [24]. Workers should also be responsible for environmental hygiene [24]. The need for good housekeeping can easily be overlooked in any occupation and failure may increase the likelihood for OCD by causing high concentrations of harmful materials or products and thereby increasing the exposure of the worker to such agents.

Identification of susceptible individuals

Patch testing

Patch testing for specific chemicals of new recruits to the pharmaceutical [84] and metalworking [85] industries has identified individuals sensitive to the chemicals used. However, other authors do not recommend the testing of healthy people, in accordance with guidance by the World Health Organization [86]. Patch tests are unreliable and sensitization may occur as a result of testing [87,88]. In a study of furriers, several workers patch tested positive for the dye paraphenylenediamine, dichromates and formaldehyde, but continued to work without difficulty [89].

Pre-employment screening questionnaires

It has been suggested that the introduction of standard pre-employment screening procedures could eliminate the more negative viewpoints of patch testing [90]. In general, the number of registered cases of OCD is increasing, which, it has been suggested, indicates the need to include patch testing in the pre-employment examination of persons prior to employment in occupations involving the risk of contact sensitization [84]. However, rather than carrying out patch testing *en masse*, some authors have suggested the use of questionnaires to assess whether individuals have a history of dermatitis [88,91]. Those with a positive history would be patch tested to confirm sensitization, alerting the individual to avoid further exposure to specific agents in future, if necessary.

Education, training and health surveillance

Half of all OCDs have been observed to appear in the first 2 years of employment [92], when a lack of awareness of any potential health hazards may lead to complacency in the workplace. Job training should promote early signs and symptoms of OCD, proper use of protective clothing and creams, and personal and environmental hygiene. Education may involve the use of a variety of educational tools, including instructional pamphlets, videotapes and lectures [24]. Ideally, these should be initiated before placement in jobs with potential exposure to irritants and sensitizers.

Studies have examined the effects of educational programmes on the prevalence of OCD in many industries and shown them to be effective, including the manufacture of fine chemicals [93], and amongst student auxiliary nurses [94], hairdressers [37,88], caterers [38], bakers' apprentices [41,95], wet work employees [96] and the metalworking industry [97].

These studies show the benefits of simple education

programmes and have demonstrated them to be cost-effective [97]. They have shown health education to be an effective tool in the primary (whilst as a trainee/apprentice), secondary (whilst at work) and tertiary (when suffering the condition) prevention of skin disorders. It has been stressed that education during apprenticeship or initial training are most important [98,99].

A skin protection programme must include occupational health (OH) support, including hazard identification, risk management and provision of information [100]. It can also include modification of work activities, provision of training on OH-related issues, measurement of workplace hazards and monitoring of health trends. However, only ~15% of all UK companies provide some sort of OH service [100], and these are more likely to be larger companies [101]. This has been recognized by the HSE and they have begun to promote the use of NHSPlus. NHSPlus is part of the UK Department of Health's drive to make services affordable and accessible to all sizes of business providing access to the OH department of local hospitals (<http://nhsplus.nhs.uk>).

Health surveillance

The HSE recommend regular skin checks are carried out by a qualified physician or trained employee where there is exposure to potential skin irritants or sensitizers [102]. These would raise the awareness by identifying early signs of the problem and suggesting measures to prevent the problem from spreading or recurring. However, no studies have been published to support these hypotheses.

Summary

Introduction of preventative strategies in the workplace is important in the prevention of OCD, though they are still not considered a major priority for most industries. Each strategy must encompass all, or some, elements of the measures described above and require the cooperation of individuals at all levels, including dermatologists, government physicians, employers, employees, trade unions, insurance companies, manufacturers and legislative authorities. The development of a preventative strategy within a health and safety policy should be encouraged for all industries, although many would require guidance and assistance [103,104]. Well-designed prevention programmes may eliminate most skin problems and companies should be reminded of the importance of employee welfare. All workers are entitled to a safe working environment and one that reduces the risk of acquiring occupational skin disease.

There is a general consensus among the scientific community that there are insufficient formal intervention studies which evaluate the effectiveness of preventive

measures in the workplace for the reduction of OCD [9,96,105–109].

Supplementary data

Colour versions of the figures are available as supplementary data at *Occupational Medicine* Online.

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