FACTORS CONTRIBUTING TO THE DEVELOPMENT OF OCCUPATIONAL CONTACT DERMATITIS AND OCCUPATIONAL CONTACT URTICARIA

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Foreword

The *Australian Work Health and Safety Strategy 2012-2022* (the Australian Strategy) identifies occupational contact dermatitis, the most common type of occupational skin disease, as one of the five national priority work-related disorders for the first five years of the Australian Strategy. This was based on the number of workers estimated to be affected by occupational contact dermatitis and the existence of known prevention options.

In 2012 Safe Work Australia published a number of research reports relating to occupational contact dermatitis. These included a research report summarising 18 years of data collected at the Occupational Dermatology Research and Education Centre (ODREC) and research reports on chemicals from the National Hazard Exposure Worker Surveillance (NHEWS) Survey. Together, these reports identified common irritants and allergens associated with occupational contact dermatitis and at-risk occupations and industries.

This research report presents findings of a follow-up research study on occupational contact dermatitis, conducted by ODREC. This research aimed to identify key factors contributing to the development of occupational skin disease among workers. Face to face interviews with 44 workers with occupational skin disease and telephone interviews with 29 employers of these workers were conducted. In addition to examining irritants and allergens associated with contact dermatitis diagnoses, the study explored provision and appropriateness of control measures provided in the workplace, awareness of skin irritants and skin allergens and adequacy of training on skin hazards among workers. Information on the most useful sources of work health and safety information nominated by workers and employers was also collected to help determine the most effective routes for disseminating work health and safety information.

While acknowledging that the findings are based on a small study of workers and employers, the report provides an insight into the causes and factors contributing to contact dermatitis among workers. A number of suggestions for future initiatives to reduce occupational contact dermatitis are put forward. These will be considered by Safe Work Australia and state and territory health and safety authorities when developing policies and programs to reduce the incidence of occupational contact dermatitis in Australia.

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Executive Summary

Background

Occupational contact dermatitis is one of the most common and preventable occupational diseases affecting between 11-86 per 100 000 workers per year. This is despite the advent of work health and safety legislation and the availability of preventative measures and guidance on the implementation of the hierarchy of controls. It is especially common in the hair and beauty, healthcare, food, construction and mechanical industries. Occupational contact urticaria (OCU) is less common than occupational contact dermatitis and the incidence ranges from an estimated 0.3 to 6.2 per 100 000 workers per year.

Occupational contact dermatitis can be further classified as allergic contact dermatitis (ACD) or irritant contact dermatitis (ICD) depending on the underlying cause.

Objectives

The Occupational Dermatology Research and Education Centre (ODREC) aimed to identify the reasons why workers are still developing occupational contact dermatitis and OCU to determine whether there are gaps in control measures, workplace training or work health and safety practices contributing to this and to identify targets for the development of evidence based strategies that will prevent occupational contact dermatitis and OCU.

Methods

Workers attending the Occupational Dermatology Clinic at the Skin and Cancer Foundation, Carlton, Victoria, from January to August 2013 inclusive with a primary diagnosis of significantly work related contact dermatitis or contact urticaria participated in a standardised questionnaire administered by the researchers. Their employers also participated in a standardised questionnaire. This dialogue with both workers and employers examined the likely reasons why the workers had developed their skin conditions.

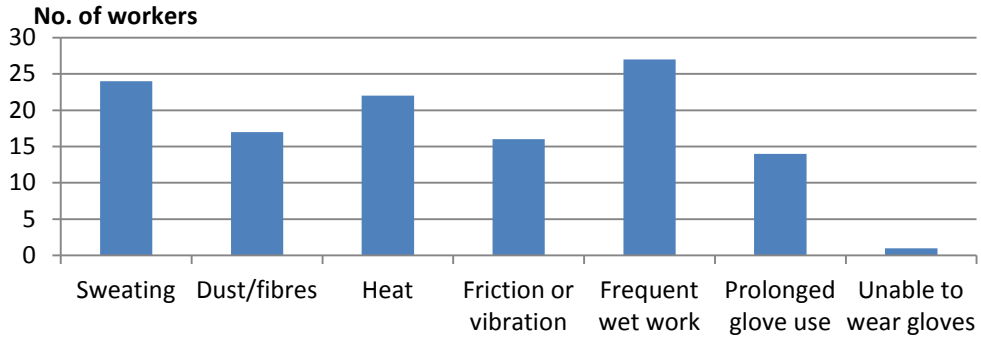
Results

Four key contributing factors were identified in the development of occupational contact dermatitis and OCU:

1. lack of education—many workers lacked education regarding skin hazards and were unaware of the possibility of developing allergies. Chemical spills onto unprotected skin and exposure to known allergenic chemicals were important factors in developing allergic contact dermatitis (ACD)
2. inadequate and inappropriate personal protective equipment (PPE) for the task including inappropriate use of latex gloves resulted in numerous preventable cases of latex allergy from the use of powdered disposable latex gloves occurring principally outside the healthcare sector
3. exposures to hard-to-avoid allergens like substances found in gloves and skincare products—these allergens also contributed to ACD. It is possible that the prior development of irritant contact dermatitis (ICD) from exposure to wet work and other skin irritants facilitated the development of ACD. Despite considerable education regarding hand hygiene in healthcare workers there was little understanding of the role of skincare in preventing ICD in healthcare, and
4. atopy— 70% of individuals with ICD in this study were atopic. However 59% of all the individuals in the study were not atopic. It is important that ALL individuals are educated about skin protection at the start of their careers. This education should include the fact that atopics are at greater risk of developing skin conditions at work, as well as strategies for the prevention of OCD in all high risk areas.

Common irritants in the workplace that could contribute to the development of ICD included wet work, sweating, heat, dust/fires, friction and prolonged glove use (see Figure E.1).

Figure E.1: Irritants at work



ACD was associated with exposure to avoidable allergens and hard-to-avoid allergens. Avoidable allergens are known skin allergens and included acrylates, epoxy resins, potassium dichromate in cement and p-phenylenediamine (PPD, permanent hair dye). Skin contact to these allergens can be avoided by using engineering controls and by the correct use of PPE; thus cases of ACD caused by exposures to these allergens could have been prevented. The most common hard-to-avoid allergens in this study were the isothiazolinone preservatives which included methycholoroisothiazolinone (MCIT) and methylisothiazolinone (MIT). These preservatives are commonly used in water based products such as hand washes, shampoos and conditioners, moisturising creams and moist wipes.

Employers were usually supportive of their workers but some were ignorant about skin hazards. Even when employers were aware many did not consider skin diseases as serious. Only five out of 29 employers provided training on dermatitis prevention. Of those who did not provide training on dermatitis prevention 13 (54%) reported that their workplace was too small to provide training on dermatitis prevention. The most common sources of work health and safety information for employers were industry associations and suppliers and 50% of employers indicated that they provided regular work health and safety updates to their workers. This means provision of work health and safety information through industry associations and suppliers may help in improving awareness about skin hazards among employers and may also help in raising awareness about skin hazards among their workers.

Conclusions

The findings emphasise the great need for better training in workplaces for workers; the need for more plain language information or guidance regarding chemical hazards and especially the need to promote appropriate skincare in workplaces. Specific suggestions include:

- supplementing hand hygiene programs provided to healthcare workers with an educational program on the prevention of ICD and appropriate skin care
- reducing the availability of powdered disposable latex gloves in Australia
- addressing the increased prevalence of allergic reactions to the preservative methylisothiazolinone (MIT)
- targeting the important occupations of tradespersons and labourers, healthcare workers and hair and beauty workers, and
- stimulating a dialogue on the merits of adding ferrous sulphate to wet cement to reduce ACD to chromate in workers who use wet cement or cement products—European Union legislation to reduce chromate in cement has led to significant declines in ACD among European workers.

Future initiatives could focus on preventing skin contact with skin irritants or allergens (sensitisers) in the workplace through substitution, engineering controls, or the correct use of appropriate PPE; providing improved worker education and training, or identifying atopic individuals who may be at greater risk to ensure they are adequately trained and protected from exposures to skin allergens at work.

1 Introduction

Occupational skin diseases (OSDs) are one of the most common and preventable occupational diseases around the world. The largest contributor is occupational contact dermatitis and many workers are still developing this condition despite the advent of work health and safety legislation, the availability of preventative measures and guidance on the implementation of the hierarchy of controls.[1] In Australia, based on the Occupational Dermatology Clinic (ODC) data for 1993–2010, workers most commonly affected are those in the hair and beauty, healthcare, food, construction and mechanical industries.[2] In this project the researchers interviewed both workers and employers delving into the reasons why workers are still developing skin conditions related to work. This is a unique project—similar research that may have been conducted elsewhere has not been identified. The information obtained will help inform future work health and safety initiatives for preventing OSDs in Australia.

The project aimed to identify:

- the reasons why workers are still developing:
    - allergic contact dermatitis (ACD)
    - irritant contact dermatitis (ICD)
    - occupational contact urticaria (OCU)
- gaps in prevention, workplace training and work health and safety practice
- ways that the hierarchy of controls can be better implemented in regards to occupational contact dermatitis prevention, and
- targets for the development of evidence based strategies that will prevent occupational contact dermatitis and OCU.

1.1 Overview of the project

This study was conducted by the Occupational Dermatology Research and Education Centre (ODREC), based at the Skin and Cancer Foundation Inc. in Carlton, Victoria. The Skin and Cancer Foundation Inc. is a not-for-profit organisation which aims to further clinical treatments, research and education involving skin diseases. Members of ODREC also run the ODC based at the Skin and Cancer Foundation Inc. where workers with suspected occupational contact dermatitis are referred for assessment and patch testing. The study concept was developed through discussions with staff from Safe Work Australia.

Patients were assessed at ODC by either Associate Professor Rosemary Nixon or Dr Jennifer Cahill. ODREC has been collecting de-identified information about common causes of dermatitis for more than 20 years using an electronic notes system and database, PatchCams® (originally CAMS) which ODREC developed. PatchCams® was used as the primary method of data collection for this project. The study incorporated two questionnaires: Part 1 involved the worker (workers questionnaire at Appendix 1) and Part 2 the employer (employer questionnaire at Appendix 2). Further details are provided in the methods section of this report.

1.2 Background information

1.2.1 Types of occupational skin diseases (OSDs) covered in this report

The OSDs in this report included occupational contact dermatitis and OCU. Occupational contact dermatitis was further defined as ACD or ICD depending on the underlying cause. Occupational contact dermatitis is an inflammatory skin condition caused by work related exposure(s) which may be irritant (ICD) or allergic (ACD) in nature. ICD is caused predominantly by a direct toxic effect on the skin and may occur acutely from exposure to strong irritants such as acids or alkalis or chronically as a result of the cumulative effect of one or more irritants like soaps, detergents and wet work. ACD is caused by a delayed hypersensitivity immunological reaction to an allergen. OCU comprises an immediate hypersensitivity reaction to a work related allergen. Occupational contact dermatitis is by far the most common OSD affecting workers across a range of industries accounting for 70-90% of OSD.[3] People working in healthcare, hair and beauty, food, construction and mechanical industries are at the highest risk of developing dermatitis because of frequent contact with irritants such as water, repetitive wet work, soaps and detergents and many chemicals.[2] With appropriate education and good workplace practices this condition is largely preventable.

1.2.2 Incidence of OSDs

The most reliable international estimates of incidence of occupational contact dermatitis vary between 11-86 cases per 100 000 full time workers per year.[3-6] ODREC published an estimate of period prevalence of 34.5 cases per 100 000 full-time workers in Melbourne (incidence 20.5) based on cases presenting to general practitioners from September 2002 to September 2003.[7] However, incidence data is likely to considerably under represent the true extent of occupational contact dermatitis for a number of reasons including:

- the occupational association of a skin condition is often poorly recognised and documented
- not all workers with an occupational related skin disease will present to a medical practitioner
- there is not one universal practitioner that a worker with occupational contact dermatitis will present to—an emergency department, a dermatologist, general practitioner, occupational physician or occupational nurse may manage a worker's occupational contact dermatitis
- data collection on incident cases of occupational contact dermatitis from medical practitioners may be difficult, and
- workers may be reticent to acknowledge an occupational cause fearing it may affect their employment.

Workers' compensation data does not appear to reflect the magnitude of skin conditions. It was reported as 6.5 cases per 100 000 full-time workers in Victoria during the same time period mentioned above. Information on whether this rate represented incidence rate or prevalence rate was not available but this rate was lower than either the prevalence or incidence rate from the previous ODREC study.[7] There is also evidence from the Occupational Dermatology Clinic that only approximately 40% of workers diagnosed with occupational contact dermatitis actually submit a workers' compensation claim. The majority prefer to manage their dermatitis themselves and try to continue working, change their work duties, or, if necessary, their occupation.

OCU is considerably less common than occupational contact dermatitis and the incidence ranges from an estimated 0.3 to 6.2 cases per 100 000 workers per year.[3] The workers most commonly reported to be at risk of developing OCU include bakers, farmers, health and social care workers and those in the food preparation industry.[2-3] It is most commonly caused by latex and food proteins.[3]

1.2.3 Consequences of OSDs

Occupational contact dermatitis often has a poor prognosis.[8] Research including studies at the ODREC indicates at least 15% of workers with occupational dermatitis develop 'persistent post occupational dermatitis' (PPOD), a condition where dermatitis persists despite avoidance of known causative factors.[9] While the majority of workers do improve with time results from a follow up study of ODREC's patient population revealed that over 70% of workers still experienced occasional flare-ups of dermatitis.[10] In a North American study workers with occupational contact dermatitis responded to a questionnaire at least two years after diagnosis. While 76% noted improvement only

40% were free of dermatitis at the time the study was conducted. Approximately one third noted their skin disease interfered with household, work and/or recreational activities.[11]

A Western Australian study reported that of patients diagnosed with OSD who were reviewed at least six months later after original diagnosis (60% were reviewed two years later) 55% were still suffering from the original OSD itself or the consequences of the OSD. Over 10% of cases had evolved into PPOD with no obvious cause. Forty per cent of males and 44% of females stated their OSD caused them to change jobs and 61% had lost time from work due to their skin disease. Approximately one in four stated they had lost income from disability caused by their OSD. Six in ten (60%) of males and 73% of females stated their OSD had interfered with their leisure activities, sexual experiences and their social life in general.[12] A Swedish study of workers who were surveyed 12 years after notification of OSD to the Social Insurance Office found 85% of workers reported skin symptoms at any stage after one year following diagnosis. Only 28% considered themselves recovered. 66% had re-consulted a doctor for the same skin condition. The majority (82%) had performed occupational changes (such as changing jobs or tasks, shortening work hours). These changes included 44% who had changed jobs and 15% who were excluded from the labour market through unemployment or disability pension. Almost half (48%) had been on sick leave for at least one period of seven consecutive days due to the OSD. About a third (32%) described their private economic situation as worse as a result of the OSD.[13] A history of atopic dermatitis is not only an independent risk factor for development of occupational contact dermatitis[3] but is the strongest unfavourable indicator for prognosis.[13-14]

In addition to potential job change, modification or loss OSDs also have a financial impact on the individual and workplace. Direct costs include medical appointments, costs associated with disability, workers' compensation, treatments and rehabilitation. Indirect costs include cover for time away from work and loss of productivity.[15] There are also emotional costs and impacts on quality of life associated with the appearance of the skin.[16]

Given the prevalence of OSDs, the significant impact they can have across a wide variety of life domains[17-18] and poor prognosis prevention is of the utmost importance. To date, many reports have collected information about the common causes of OSD and provided recommendations about how to prevent it.[19-28] Despite these recommendations workers are still developing skin problems. The literature suggests that there are several reasons to explain why OSDs are still occurring. For example, a recent study reported that there may be gaps in training programs and that workplaces that are small or non-unionised generally experience more OSD.[22]

1.2.4 Initiatives to prevent OSDs are known, available and are effective

Many OSDs are preventable and preventative action can be taken at a number of different levels:

- It can target the source by eliminating harmful exposures via removal and substitution of skin irritants and allergens (sensitisers).
- It can involve the implementation of engineering controls reducing exposures; and finally involve the use of personal protective equipment.
- Other actions which might supplement those above include implementing training and educational programs and health surveillance for dermatitis.[15,19]

In general, preventative strategies have been shown to be effective. A multi-faceted implementation strategy for preventing hand eczema in the hospital environment is currently being trialled in the Netherlands.[23] Primary educational prevention strategies for healthy workers in at-risk professions helped reduce rates of occupational contact dermatitis for hairdressers[24] and health care workers[25] in Germany. A randomised controlled intervention study which included providing education and evidence based guidelines to workers was shown to be effective in reducing dermatitis in Danish slaughterhouse workers. Twelve months after baseline 27% of workers who previously had dermatitis and received the intervention did not report any dermatitis for the previous three months.[26] A randomised intervention study of aged care nurses showed the frequency of skin disease decreased from 26% at baseline to 17% at follow up, one year after receiving education on good skin care.[27] A preliminary intervention study of print workers showed positive signs after skin care policies, and information, skin checks and appropriate gloves and moisturising creams were

implemented in reducing occupational contact dermatitis. However the numbers were too small for definitive conclusions to be reached.[28]

Box 1: Highlights from this report

The study

- *The study included face to face interviews and skin patch testing of 44 workers with occupational skin disease who presented to the Occupational Dermatology Research Clinic from January to August 2013. Among the 36 employers of these patients, 29 agreed to participate in a telephone interview.*

Main findings

- *Workers can be diagnosed with more than one type of occupational skin disease:*
    - *Allergic contact dermatitis (ACD) was the most common diagnosis among workers in this study (70%).*
    - *Just over half (52%) and 16% of the workers were diagnosed with irritant contact dermatitis (ICD) and contact urticaria (CU) respectively.*
    - *Eleven workers had both ACD and ICD, four had ACD and CU and three had ACD, ICD and CU.*
- *Avoidable allergens for ACD included acrylates, epoxy resin and potassium dichromate. ACD could also be associated with ubiquitous or hard-to-avoid allergens (not commonly recognised allergens or inadvertent exposure). These hard-to-avoid allergens included isothiazolinones (preservative), rubber accelerators and constituents of hand washes.*
- *The common irritants causing ICD among these workers were wet work, sweating, heat, dust/fibres, friction and prolonged glove use. Most ICD was cumulative caused by exposure to multiple irritants over time.*
- *There were seven workers with contact urticaria and all had latex allergy. Six of these workers were not in healthcare. This was surprising as the use of latex gloves is primarily unnecessary for most workers outside healthcare.*
- *The four main factors contributing to skin diseases were:*
    - *lack of education on skin hazards*
    - *inadequate or inappropriate PPE (including inappropriate use of latex gloves)*
    - *exposure to hard-to-avoid allergens, and*
    - *atopy.*

Conclusions

- *The findings suggest there is a greater need for training and plain language guidance on chemical hazards for employers and workers. Specific suggestions for future initiatives include supplementing hospital hand hygiene programs with education on prevention of ICD and appropriate skincare, providing information on appropriate PPE in plain language and consulting with the cement manufacturing industry for voluntary or mandatory addition of ferrous sulphate to cement to reduce chromium VI levels in cement.*

2 Methodology

Workers attending the ODC with a primary diagnosis of significantly work related contact dermatitis or contact urticaria from January to August 2013 inclusive were enrolled in this study. All workers consented to participate in the study. One worker did not consent to their employer being contacted. The diagnosis was made by Associate Professor Rosemary Nixon or Dr Jennifer Cahill following extensive patch testing together with immunoglobulin E (IgE) specific radio-allergosorbent testing (RAST) if relevant.

Patch testing was performed to International Contact Dermatitis Research Group recommendations.[29] Patients were patch tested to the Australian Baseline Series which comprised 60 of the most important and relevant allergens in the patient population; focussed allergen series depending on their exposure history and their own products, diluted appropriately. Testing was performed using AllergEAZE chambers (Smart Practice, Phoenix, Az, USA). The patches were applied to the upper back for 48 hours and readings were performed on days 2 and 4. The allergens were purchased from both Chemotechnique Diagnostics AB (Vellinge, Sweden) and AlmirallHermal GmbH (Reinbek, Germany). A positive patch test reaction was defined by a reading of 1+ or greater on day 4. A relevant positive patch test reaction was defined as the allergen being deemed to be contributing to the workers' presenting dermatitis, based on a history of exposure together with a time course of dermatitis consistent with the exposure.

RAST is a blood test which measures specific immune complexes (IgE) that are responsible for immediate hypersensitivity. It provides evidence for the diagnosis of contact urticaria. Specific RASTs were only ordered if the clinician suspected contact urticaria on the basis of a history of exposure to a known urticant.

Patients were reviewed on days 0, 2 and 4. At the initial, day 0, consultation a thorough medical history and examination were performed, patch tests applied as described above and RASTs ordered if relevant. Patch tests were removed and reactions documented on day 2. Patch test final readings were performed on day 4 and RAST results obtained. The clinician then listed the patient's diagnoses. The primary diagnosis was defined as the diagnosis which the clinician determined to be the main contributor to their current clinical presentation. It is possible for a patient to have multiple diagnoses and these are also documented. In addition to information obtained on medical history during the consultation if a patient was given a primary diagnosis of occupational contact dermatitis or OCU they were asked questions from a standardised questionnaire to assess factors contributing to their OSD (Appendix 1). The questionnaire was completed by the clinician and some questions required the clinician's assessment rather than the patient's response.

For this study, allergens were considered avoidable if they were known common causes of ACD or CU and exposure should have been avoided through engineering controls or the appropriate use of PPE. Hard-to-avoid allergens were those which uncommonly cause ACD and exposure occurred inescapably for example through the use of a hand wash or from PPE itself like gloves.

The second part of data collection involved interviewing the employer of the worker attending the clinic to gain an insight into what they believed were the contributing factors to their worker's skin condition. Work practices, education regarding skin hazards and skin care were investigated. This process involved a standardised telephone questionnaire (Appendix 2) administered by the clinician.

Answers to the employee and employer questionnaire and information were entered into our electronic notes and database system, PatchCams. Data was then collated using Microsoft Excel® and analysed.

3 Results

3.1 Study cohort

Forty-four consecutive workers with occupational contact dermatitis or OCU were recruited for this study. Consistent with ODREC's previous experience[2] tradespersons and labourers (n=14), healthcare workers (n=13) and hair and beauty workers (n=6) were the most common occupational groups represented in this study (Table 3.1).

Table 3.1: Occupations of workers enrolled in study

Occupational group	Occupation	No. of workers
Tradespersons and labourers	Concreter	3
	Spray painter	2
	Electrical worker	2
	Floor sealer	1
	Labourer- (makes fibre glass moulds for basins)	1
	Mechanic	1
	Painter	1
	Plumber	1
	Renderer	1
	Welder/metalworker	1
Healthcare worker	Nurse	6
	Dental nurse	3
	Dentist	2
	Patient Services Assistant	1
	Radiographer	1
Hair and beauty workers	Hairdresser	4
	Nail technician	2
Other	Abattoir worker	1
	Bakery manager	1
	Bike mechanic	1
	Chemical engineer	1
	Childcare worker	1
	Greengrocer	1
	Horse stud worker	1
	Horticulture (vine yard)	1
	Ink manufacture	1
	Pharmaceutical manufacturing	1
	Scientist/lab worker	1
Total		**44**

Among 44 participants, eight workers were self-employed. Thirty six workers worked for an employer. Twenty nine out of 36 employers were able to be contacted and consented to being interviewed.

Workers had an average duration of 11.7 years in their current occupation prior to presentation at the clinic. This highlights that allergies can develop after any time in the job which is always very surprising to patients. This may also reflect that in some cases there is a cumulative effect of irritants over time. Another reason may be delays in presentation and referral for occupational contact dermatitis.

Workers were from workplaces of a variety of different sizes (Table 3.2). More than half worked in large workplaces (more than 100 employees). Fourteen workers reported that their workplace was small with 20 or less employees.

Table 3.2: Size of workplace as reported by worker

Size of workplace	Total
Small ≤ 20	14
Medium 21-100	7
Large > 100	23

3.2 Diagnoses

When considering just the diagnoses of ACD, ICD and CU nine patients had only ICD, 17 had only ACD, 11 had both ICD and ACD, four had ACD and CU and three ACD, ICD and CU. ACD was the most common diagnosis in the study cohort (31/44,70%) followed by ICD (23/44, 52%) and CU (7/44, 16%). Some workers reacted to both avoidable and hard-to-avoid allergens. Latex was the only cause of CU identified in this study (Table 3.3).

Table 3.3: Diagnoses of workers who participated in this study

Work related diagnoses	Total
ACD to a hard-to-avoid allergen	20
ACD to an avoidable / inappropriate allergen	16
ICD	23
CU to latex	7
Non-work related, concomitant diagnoses	
Endogenous eczema	8
Psoriasis	2
Dermographism	2
Rosacea	1
Peri-oral dermatitis	1
Photosensitivity	1

Note: The number of diagnoses adds up to more than 44 as a worker can have more than one condition. A worker can also have ACD associated both avoidable and hard-to-avoid allergens.

ACD was also the most common primary diagnosis in this study population (Table 3.4). Generally, ICD is regarded as the most common cause of occupational contact dermatitis.[30-31] However, at tertiary referral centres such as ODREC, a larger proportion of cases of ACD are often observed which may be explained by a referral bias towards the more severe, treatment resistant cases of occupational contact dermatitis.

Table 3.4: Worker's primary diagnosis

Primary diagnosis	**Total**
ACD	26
ICD	16
CU to latex	2

Atopy refers to a predisposition toward the development of immediate hypersensitivity reactions to common environmental allergens, most commonly manifesting as allergic rhinitis (hay fever), asthma or atopic dermatitis (eczema). Atopic dermatitis has been identified as a risk factor for the development of ICD[32] and CU.[33] It is not a known risk factor for ACD.

Patients were diagnosed as atopic if they stated that they had a personal history of asthma, eczema or hay fever. Atopy was not thought to play a role in the patient's condition if they were diagnosed only with ACD. Sixteen out of 23 (70%) patients diagnosed with ICD were atopic while 63% of the cohort was atopic. This is significantly more than the usual rate of atopy in the normal population of 20-30%. This would appear consistent with a link between development of ICD and a personal history of atopy. Two out of seven (29%) patients with contact urticaria were atopic which is consistent with the rate in the normal population (Table 3.5).

Table 3.5: Role of atopy in the worker's skin condition

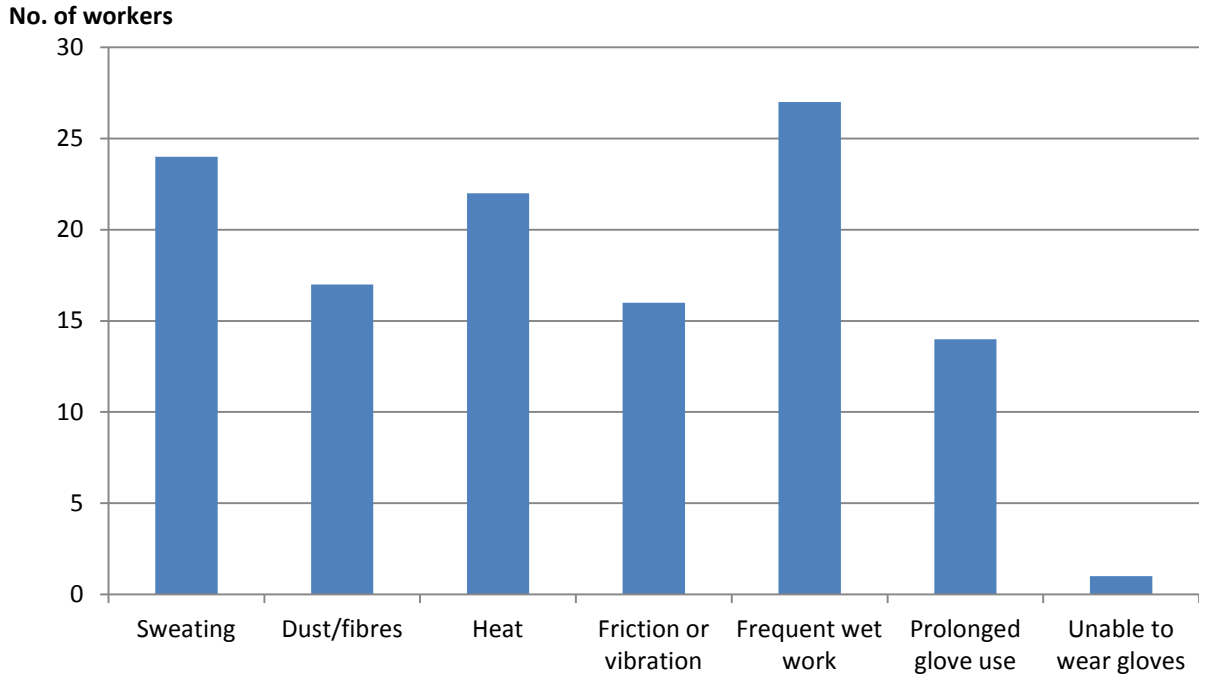
Role of atopy	**Total**
Atopic and ICD	16
Atopic and CU	2
Atopic, but no role in worker's skin condition	9
Not atopic	17

3.3 Occupational exposures

3.3.1 Irritants

ICD was diagnosed in 23/44 (52%) workers included in this study (Table 3.3). The identified irritants in **all** workers from most common to least common were wet work (27), sweating (24), heat (22), dust/fibres (17), friction (16) and prolonged glove use (14) (Figure 3.1). Only one worker was unable to wear gloves in their workplace. Most ICD was the cumulative type caused by exposure to multiple irritants over time. However, there was one incident of severe, acute ICD which occurred with exposure to a corrosive solvent when gloves were not worn. This was a new product; material safety data sheets (SDS) were not checked prior to the use of the solvent and appropriate PPE was not worn. This highlights that employers need to be aware of the hazardous properties and potential adverse health effects of chemicals in new products, make SDS accessible to workers and train workers to consult SDS prior to using chemicals. This will help workers to be aware of the products they are using and that they need to read labels and consult the SDS prior to use of chemicals.

Figure 3.1: Irritants at work



3.3.2 Avoidable allergens

Avoidable allergens included notorious known allergens such as epoxy resin and potassium dichromate where skin contact should be avoided by the use of engineering controls and the correct use of PPE. The known allergens included acrylates (5 cases), epoxy resins (4 cases), potassium dichromate from cement (3 cases) and p-phenylenediamine (PPD) (permanent hair dye) (2 cases). Seven cases of OCU were caused by latex exposures (Table 3.6). These are all known allergens and ACD and CU to these allergens should be preventable with appropriate awareness, education, engineering controls and appropriate PPE. For example, CU to latex is more likely to occur when powdered, disposable latex gloves are worn.

Table 3.6: ACD/CU to avoidable allergens

Avoidable allergens	Total
Latex (contact urticaria)	7
Acrylates	5
Epoxy resin	4
Potassium dichromate	3
Isocyanates	2
Paraphenylenediamine (PPD)	2
Ammonium persulfate	1
Cobalt	1
Phenol formaldehyde resin	1
Thebaine, oroparvine (morphine derivatives)	1

Note: Workers may be exposed and sensitised to more than one allergen.

Interestingly, of the seven cases of latex allergy six of these were NOT healthcare workers. This is an important point as the use of disposable latex gloves outside of the healthcare industry is rarely appropriate. The use of latex gloves in healthcare gained popularity in the 1980s with the awareness

of blood-borne viruses and need for standard precautions. Disposable latex gloves provide an effective barrier for bodily fluids and also allow fine and dexterous movements.

Following a peak in the 1990s latex allergy in healthcare workers has now been documented to be reducing across the world. This is due to the use of powder-free latex gloves, improved manufacturing of latex gloves resulting in lower quantities of latex protein in the finished product and the more widespread use and availability of disposable nitrile gloves.[34-40] Compared to the latex gloves used in healthcare other disposable latex gloves may be powdered and manufactured to lower standards resulting in higher amounts of latex protein and therefore increased risk of allergy. It is thought now that the glove powder plays an important role in facilitating latex allergy.

The non-healthcare related cases of latex allergy in this study occurred in a worker working in ink manufacturing, a hairdresser, laboratory worker, bike mechanic and two concreters. Apart from the laboratory worker who had contact with animals the workers were unnecessarily using disposable latex gloves.

The second most common avoidable allergen in this study was acrylates. Acrylates form a hard plastic compound when cured (forming a polymer from starting as a monomer). The acrylic monomer is a highly sensitising allergen but the cured polymer is not.[41] The two most common sources of exposure to acrylates are from dentistry and from artificial nails. There were two cases each of these exposures. The fifth case was in an automotive spray painter.

The two dental workers in this study were aware of the potential for allergy but unfortunately acrylic monomers are small and can penetrate gloves. Wearing two pairs of disposable gloves—2 pairs of nitrile disposable gloves or at least one pair of nitrile disposable gloves over another disposable glove—is often recommended. However this can be difficult when fine dexterous movements are required. Instruments can be used to prevent skin contact; however one worker had adopted a work practice of 'smoothing' out the acrylate with her index finger.

The nail technicians in this study were simply not aware of the possibility of developing ACD to acrylates and were not wearing appropriate PPE at all. One nail technician was self-employed. The employer of the other nail technician was unaware of risks posed by acrylates. The nail technicians were exposed to acrylic monomers via ‘gel’ nails. The nail technicians appeared to have received minimal education either during training or at the workplace about this skin hazard. One of the nail technicians stated that she knew of numerous fellow nail technicians who had developed skin problems with the use of these 'gel' nails. This led her to develop a social media page for them despite not understanding the cause of the skin rash until she attended the ODC for testing. Unfortunately, many nail technicians are also exposed to the nail polish remover acetone, also a skin irritant, which can damage the gloves that nail technicians use to protect their hands. Many nail technicians work in small or self-run businesses. In addition to this study we spoke with two suppliers who were completely unaware of the risk of ACD to acrylates.

Epoxy resins, like acrylates, form a durable plastic compound following curing from monomer to a linked polymer state with the addition of a hardening agent. Epoxy resins are very versatile chemicals with multiple uses and are particularly used in flooring and in marine paints to create water resistant surfaces. They are also used as adhesives, in electrical equipment, vehicle parts and sporting goods.[34] The workers in this study found to be allergic to epoxy resins comprised tradesmen including an electrical worker, a labourer and a concreter and floor sealer.

ACD to PPD in hair dye was observed in two hairdressers and ACD to ammonium persulphate (hairdressing bleach) in another. Hairdressers are one of the most common occupational groups presenting to the ODC as they are exposed to a number of irritants and allergens. In this setting, exposure to skin irritants often initially causes ICD which damages the skin barrier and facilitates the development of allergy. PPD is a common cause of occupationally relevant ACD seen in workers presenting to the ODC.[2] Exposure sometimes occurred following a spill of hair dye and/or from skin contact with hair dye on areas of skin not protected by gloves. One case involved a young hairdresser who was completely ignorant of the potential of hair dye to cause allergy while the other hairdresser was aware and had already changed her practice to avoid skin contact with hair dye after a previous reaction. The hairdresser who was allergic to ammonium persulphate was using products marketed as ‘organic’ and ‘natural’ and misconstrued this to mean that the products were safe and

'chemical free'. Marketing information which might easily be mistaken for chemical safety information may be contributing to exposure to skin allergens.

ACD to potassium dichromate was seen in two concreters and a renderer. Potassium dichromate in cement remains a common cause of occupational contact dermatitis in Australia.[2] In Europe the addition of ferrous sulphate to cement to transform allergenic soluble hexavalent chromate to insoluble trivalent chromate with much less penetration of the skin barrier has reduced the incidence of this condition.[42] Ferrous sulphate is not added to cement in Australia.

3.3.3 Hard-to-avoid or ubiquitous allergens

Allergies may also develop from agents that are not commonly recognised as allergens or to which workers are exposed inadvertently. Hard-to-avoid allergens predominantly included allergens in skincare products or gloves which were designed and anticipated to contact the skin. In this study there were more cases of ACD to an inadvertent or hard-to-avoid allergen than to the known common causes of occupational ACD. 'Hard-to-avoid' allergens identified in this study included rubber accelerators: thiurams, dithiocarbamates, diphenylguanidine and thioureas; constituents of hand washes: coconut diethanolamide, lanolin, fragrance, cocamidopropylbetaine and the antiseptic chlorhexidine; and preservatives: methylchloroisothiazolinone (MCIT[1]), methylisothiazolinone (MIT), chloroacetamide, formalin and iodopropynyl butylcarbamate. There was also one case of ACD to cinnamates (UV absorbers) in paint.

Preventing the development of an ACD to these chemicals is difficult because of ubiquitous use of these chemicals in a wide range of products. However, it is important for practitioners to be aware of the potential allergenic nature of these chemicals and workers to be investigated and appropriately diagnosed. Once a diagnosis has been made workers then know to avoid these chemicals. Ideally these exposures should be engineered out and such chemicals substituted with less allergenic ones. Unfortunately most preservatives cause ACD, some more than others. Addition of preservatives to many products is necessary to prolong shelf life and avoid contamination with microorganisms. If removal of such preservatives is not feasible it is essential that both employers and workers are educated about the importance of maintaining an effective skin barrier and have an understanding of skin irritants that may disrupt the skin barrier.

In this study the isothiazolinone preservatives methylisothiazolinone (MIT) and/or methylchloroisothiazolinone (MCIT) were the most common cause of ACD (Table 3.7). Workers who were allergic to MIT in this study were from a wide range of occupations including a dental nurse, a nurse, a concreter, a mechanic and a painter. These preservatives are used in water based products and are known allergens. Exposure occurred through hand washes, shampoo and conditioners, moisturising creams and lotions, moist wipes and paints. ACD to MCIT and MIT is not limited to the occupational setting and these allergens are found in many consumer products. Similar to the situation reported overseas the ODC is currently experiencing a large increase in numbers of people with contact allergy to these preservatives.[43-46] Until 2005 MCIT/MIT was approved for use in consumer products in a 3:1 ratio of 11.25 ppm MCIT and 3.75 ppm MIT.[47] MIT alone is now approved for use as a preservative in consumer products at a concentration of up to 100ppm. The increase in concentration and use in consumer products has apparently led to this outbreak of contact allergy.

For rubber accelerators there has been a gradual diminution in the use of thiurams which are more allergenic than carbamates. Thiurams have long been one of the top occupational allergens.[2] At ODREC there were three recent cases (one included in this study) of ACD to diphenylguanidine used as an accelerator in a new type of surgical glove made from polyisoprene. This highlights that different allergies may arise when there is a change of materials used in product manufacture.

Allergens such as coconut diethanolamide, cocamidopropyl betaine and lanolin are generally thought of as weak allergens. However, they still have the potential to cause ACD. This was particularly seen in healthcare workers where irritants cause skin barrier damage and allow these weak allergens to penetrate the skin and facilitate the development of ACD.

[1] Methylchloroisothiazolinone is sometimes abbreviated as MCI instead of MCIT and methylisothiazolinone is sometimes abbreviated as MI instead of MIT.

Table 3.7: ACD to hard-to-avoid allergens

Hard-to-avoid allergens	Common use	N
Isothiazolinones	preservative	8
Coconut diethanolamide	emulsifying agent	4
Thiurams	rubber accelerator	3
Chlorhexidine	antiseptic	2
Thioureas	rubber accelerator	2
Iodopropynyl butylcarbamate	preservative	2
Diphenylguanidine	rubber accelerator	1
Cocamidopropyl betaine	foaming agent	1
Fragrances	fragrances	1
Chloroacetamide	preservative	1
Lanolin	medicine, cosmetics	1
Dithiocarbamates	rubber accelerator	1
Cinnamates	sunscreens	1

Note: Workers may be allergic to multiple allergens

3.4 Control measures provided

Only four workers had an inappropriate exposure to wet work or irritants (Table 3.8). The majority of irritants were unavoidable, for example hand washing in healthcare workers and hand sweating with manual labour.

There are control measures which can reduce the irritant load for healthcare workers. Control measures can include substituting moisturising hand cleansers for social hand washing (when antiseptic action is not required), encouraging the use of moisturising lotions when appropriate and using administrative controls like rostering so that fewer consecutive days are worked, shorter shift duration and combining clinical and administrative duties to reduce clinical exposures

Nine non-healthcare workers stated that they had accidentally come in contact with a skin hazard which in retrospect may well have led to sensitisation and the subsequent development of ACD. These contacts occurred through handling products without wearing PPE (e.g. gloves, chemsuits, face masks or boots) or chemical spills onto areas of skin not protected by PPE. This highlights the importance of appropriate PPE covering all areas of skin potentially exposed to allergens. It emphasises the importance of educating both employers and workers that chemical spills are particularly dangerous: exposure to concentrated chemicals can be associated with the development of allergy.

Table 3.8: Occupational exposures contributing to a worker's skin condition

Occupational exposures	Yes	No	N/A
Inappropriate exposure to wet work/irritants	4	40	0
Accidental exposure/chemical spill	9	35	0
Engineering controls adequate	8	5	31

Engineering controls like the use of instruments or machines can eliminate direct skin contact with hazardous chemicals. As shown in Table 3.8 engineering controls were considered not applicable in many of the workplaces of the workers of this study (31/44). For instance, it might not have been possible to provide a considerable number of healthcare workers with engineering controls. Where engineering controls could be provided in 8/13 (62%) cases the engineering controls were thought to be appropriate by the clinician (Dr Nixon or Dr Cahill) on the basis of talking to workers and their employers; workplaces were not visited as part of the study.

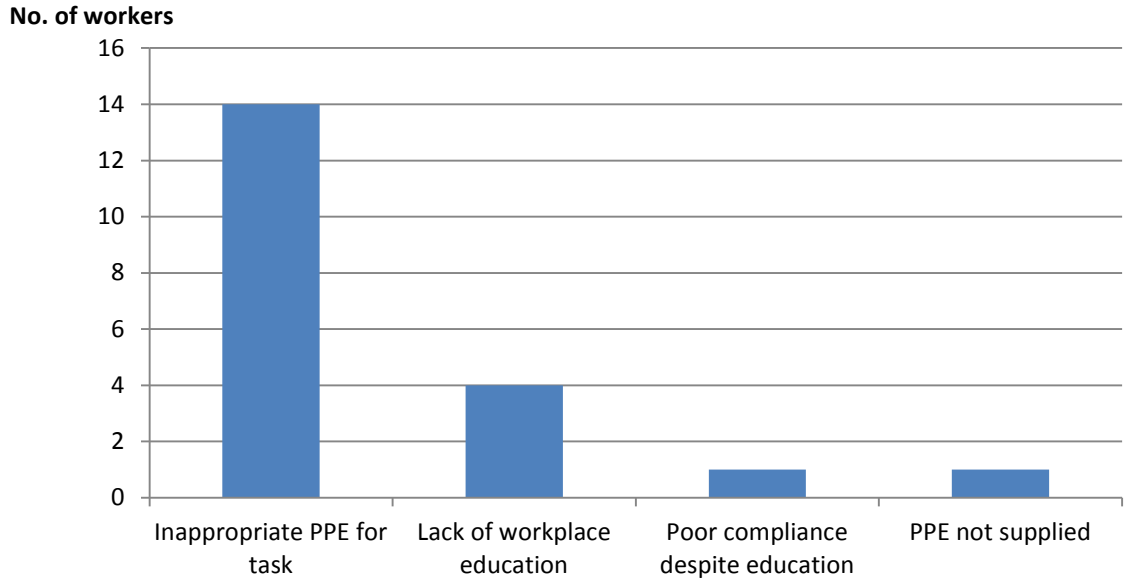
The 29 employers in this study were also asked about both engineering controls for skin hazards in their workplace and about general engineering controls. Sixteen employers thought that engineering controls were not applicable to their workplace either generally or in relation to skin hazards (Table 3.9). In line with the dermatologist's view the majority of the remaining employers (9/13, 69%) thought that their general engineering controls were adequate. Only 5/29 (17%) employers reported having engineering controls in place for skin hazards.

Table 3.9: Engineering controls according to the employer

According to the employer	Yes	No	N/A
Do you have engineering controls for skin hazards in your workplace?	5	8	16
Do you think there are adequate engineering controls, in general, in your workplace?	9	4	16

PPE used by 17/44 (39%) workers was seen as inadequate by the clinician (see Figure 3.2). Among the 36 workers with an employer, PPE was provided by the employer in all but one case. Reasons for inadequate PPE as assessed by the clinician included inappropriate PPE for the task, lack of workplace education and poor compliance with PPE despite education.

Figure 3.2: Why PPE was inadequate, as assessed by the clinician



Employers' assessment of adequacy of PPE differed from the clinician's assessment. In one workplace PPE was not required (N/A response to 'is PPE supplied?') but PPE was required in workplaces of 28 employers. When first asked if PPE they provided was adequate 25/28 (89%) employers reported that the PPE they provided was adequate (Table 3.10). Upon further discussion 11 employers acknowledged that the PPE they supplied was inadequate and this was due to lack of knowledge. The remaining 17 employers still felt that the PPE they provided was adequate (coded as 'N/A' to the question 'why was appropriate PPE not supplied?').

Table 3.10: Provision of PPE according to the employer

According to employer		Yes	No	N/A
Is PPE supplied?		26	2	1
Is PPE adequate?		25	3	1
Why was appropriate PPE not supplied?†	Not required	0	11	17
	Too costly	0	11	17
	Didn't know what was needed	11	0	17
Do your workers always wear PPE?		12	12	5
Do you express concern if safe work practices are not adhered to?		14	9	6

Note: † The 28 responses are from 28 workplaces where PPE was required.

The inappropriate use of latex gloves outside healthcare has already been commented on. These gloves are also more likely to be powdered and have higher amounts of latex protein thereby facilitating allergy[2]. Only one worker with latex allergy worked in an occupation where latex gloves might be appropriate (a laboratory worker handling animals).

Information about appropriate gloves for certain tasks and chemical exposures can readily be obtained from glove manufacturers like Ansell (http://ppe.ansell.com.au/) or regulators like the National Institute for Occupational Safety and Health (www.cdc.gov/niosh/). It is important for both employers and workers to be aware of the appropriate PPE required for an occupational task.

Disposable vinyl gloves are appropriate for food handlers to wear but are not appropriate for exposure to many industrial chemicals. Disposable nitrile gloves often provide equivalent if not better protection in healthcare and other areas of chemical exposure than disposable latex gloves and with less risk of allergy. However, disposable gloves are often used inappropriately instead of thicker, longer, reusable gloves for some types of wet work like washing hair. Short disposable gloves allow water to get inside the gloves and do not prevent exposure of the forearms to water and potentially other chemicals. For protection against acrylates two pairs of nitrile disposable gloves or one pair of nitrile disposable glove over another disposable glove are recommended. Those using epoxy resins should use thick reusable nitrile gloves.

Another example of inappropriate glove use was the use of nylon gloves with a rubberised palm for concreting. These gloves fail to provide adequate protection from both water and cement. The hands of the worker became irritated from being constantly wet and were exposed to potassium dichromate in cement in an occluded environment facilitating the development of ACD to potassium dichromate. Concrete workers should use thicker, reusable gloves.

Control measures were often inadequate in preventing OSDs because of ignorance about skin hazards and hence, the need to prevent exposures that might result from chemical spills, a lack of knowledge and lack of general awareness about contact dermatitis by the employer, and reliance on PPE which was often inappropriate or not worn all the time.

3.5 Provision of training on skin hazards

The provision of training on skin hazards was highly variable across workplaces. Most workers did not receive training on skin hazards. Only 6/36 (17%) workers received adequate training—adequate training was assessed as training which covered skin hazards and raised awareness of particular allergens that were present and needed to be avoided (Table 3.11). The training in healthcare institutions was about hand hygiene rather than actual skin hazards like the risk of ICD from repetitive hand washing and associated control measures. Examples of education provided in other occupational settings included courses on the safe handling of chemicals and reviewing SDSs. Only

[2] In extremely rare cases, the glove powder itself (e.g. corn starch) can cause contact urticaria. One such case has been reported in Liu, W., & Nixon, R. L. (2007). Corn contact urticaria in a nurse. *Australasian Journal of Dermatology, 48*(2), 130-131.

four workers received education on the risk of skin irritants and measures to help prevent ICD which is important in ensuring that they use the appropriate control measures.

Table 3.11: Education and training on skin hazards according to the worker

Education/training on skin hazards to the worker	Total
Yes	16
No	20
N/A‡	8
Training deemed adequate by clinician	6
What did training involve?	**Total†**
Hand hygiene, infection control, sharps	7
Use of appropriate PPE, gloves	5
SDS, product information, hazard information, safe handling of chemicals	4
Skin irritants, use of moisturiser/barrier creams, use of alcohol based hand rubs	4

Note: ‡ N/A responses are from the eight self-employed workers; † multiple responses possible per worker

There was a lack of training in dermatitis prevention with only five employers providing this for their workers (Table 3.12). The two reasons provided by employers for not offering education in dermatitis prevention included a small workplace size (13/24, 54%) and lack of knowledge (11/24, 46%).

Table 3.12: Education and training on skin hazards according to the employer

According to employer		Yes	No	N/A
Was any education or training provided on skin hazards to the worker?		15	14	0
Did it include advice on PPE?		14	1	14
Does your workplace conduct an induction program?		17	12	0
Is dermatitis prevention mentioned?		5	12	12
Why is training in dermatitis prevention not offered?	Lack of knowledge	11	13	5
	It's expensive	0	24	5
	Small workplace size	13	11	5

The majority of larger healthcare institutions have dedicated Infection Control nurses to promote education and reinforcement of hand hygiene and standard precautions. Repetitive hand washing is considered an occupational necessity for nurses and other healthcare workers leading to disruption of the skin barrier and ultimately ICD. Healthcare workers in this study said they received minimal to no education on the risk of ICD with repetitive hand washing and wet work nor how best to prevent and manage ICD by using alcohol rubs instead of washing hands with water and soap when appropriate. A greater awareness of the skin risks in healthcare workers is needed. Combining education on skin hazards and appropriate skin care with the already effective education on hand hygiene would help to reduce OSD in healthcare workers.

Studies also indicate that skin which has had its integrity disrupted is likely to have higher bacterial counts[48-49] and be colonised with potentially pathogenic organisms like staphylococcus aureus, gram negative bacteria, enterococci and candida.[50] ICD is also one of the main reasons healthcare workers fail to comply with hand hygiene.[51]

3.6 Worker perceptions about why skin hazards are not being addressed adequately

Fourteen workers believed that their employer knew that there were skin hazards at work but these were not being addressed (Table 3.13). Examples for why workers thought that skin hazards at work were not being addressed included the following: only a small number of workers were affected, they were often regarded as being only mildly affected and a skin condition was something often not seen as serious.

Table 3.13: Employer factors contributing to a worker's OSD as reported by the worker

Employer factors contributing to worker's OSD	Total
Should have known the risks but didn't	3
Did know risks but didn't address	14
Did not know due to lack of technical knowledge	11
Financial limitations	0
N/A	16

As shown in Table 3.14, the majority of workers believed that their employers were supportive of both their work (27/36, 75%) and skin condition (22/36, 61%). All employers believed their workplace was supportive of their workers (data not shown).

Table 3.14: Employer support

Worker feels that employer is supportive of their work in general	Total
Yes	27
Partially/sometimes	7
No	2
N/A	8†
Worker feels that employer is supportive of their skin condition	**Total**
Yes	22
Partially/sometimes	9
No	5
N/A	8†

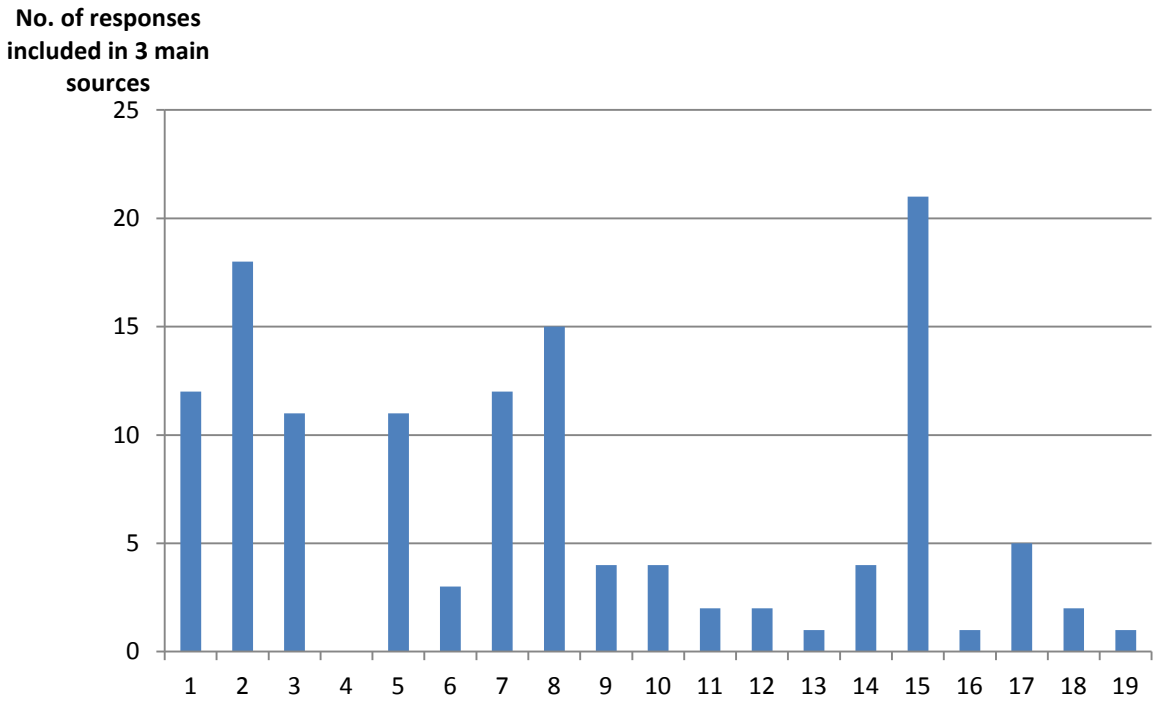
Note: † these eight workers were self-employed so this question was not applicable to these workers.

3.7 Sources of work health and safety information

Information on known work health and safety issues should be effectively communicated to both employers and workers. Employers and workers in this study were asked about how they obtained work health and safety information to help inform future dissemination of guidance and information.

Workers were asked to rank the top three ways they learnt something useful about work health and safety (Figure 3.3).The most common useful sources of work health and safety information reported by workers were doing the job itself (21/44, 48%), structured training courses (18/44, 41%) and workmates (15/44, 34%). Supervisors and managers were nominated among the top useful source of work health and safety information by 12 workers.

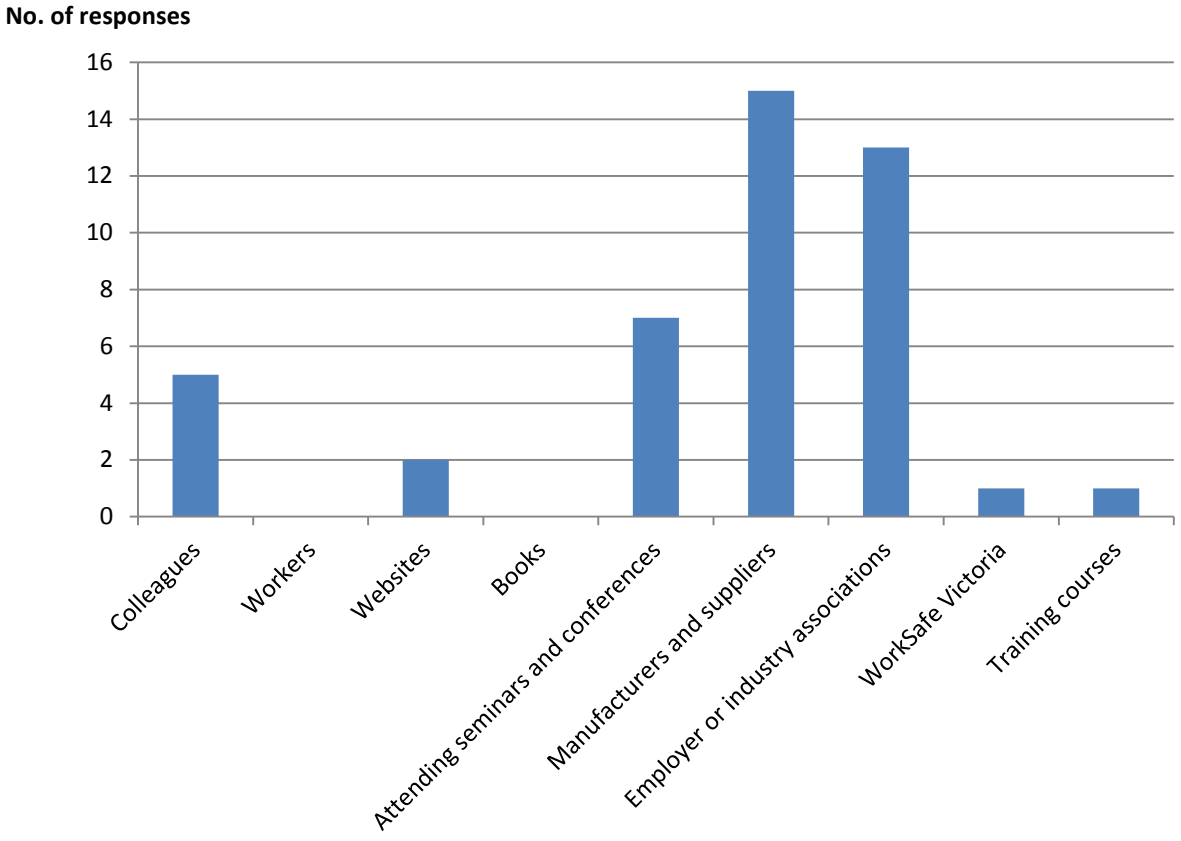
Figure 3.3: Sources of work health and safety information from which the worker has learnt something useful



Note: workers were allowed to nominate 3 sources; 1=supervisors/managers; 2=training courses (e.g. at work, TAFE, apprenticeship, university); 3=meeting at work; 4=industry pamphlets / newsletters; 5=posters/signs/notices at work; 6=email at work; 7=health and safety representatives; 8=workmates; 9=family; 10=media (e.g. magazines, newspapers, television, radio); 11=unions; 12=employer/industry associations; 13=government health and safety inspectorates (e.g. WorkSafe Victoria website, office, inspector); 14=internet; 15=experience/doing the job itself; 16=government Acts/regulations, publications; 17=supplier; 18=none/nothing; 19=don't know.

The most common sources of work health and safety information reported by employers were manufacturers and suppliers (15/29, 52%) and employer or industry associations (13/29, 45%) (Figure 3.4). These two sources appear to be the best potential targets for addressing employers' lack of awareness and provision of training on skin hazards. Half of the employers (13/26) reported that they conducted work health and safety updates for workers on a regular basis. This means information provided to employers in an appropriate format about skin hazards through suppliers or industry associations may help them improve their own knowledge and awareness of skin hazards and associated health effects and help them inform their workers.

Figure 3.4: Employers' sources of work health and safety information (multiple responses accepted)



4 Discussion

Occupational contact dermatitis remains one of the most common occupational diseases despite work health and safety legislation, preventative measures and the general implementation of the hierarchy of controls. Consistent with previous research, tradespersons and labourers, healthcare workers and hair and beauty workers were the most common occupational groups represented in this study.[2]

Workers are still developing ICD with wet work, sweating and exposure to heat being the most commonly identified skin irritants in this study. Many of the irritants are difficult to avoid in the performance of certain occupational tasks. The prevalence of occupational ICD could be reduced by greater awareness of these risks, education and administrative controls such as shorter work shifts and less consecutive days worked. Using skincare measures, changing gloves regularly, using cotton gloves under protective gloves and longer gloves for better arm protection, ensuring that appropriate PPE is worn and using administrative controls will help reduce the irritant load for a worker.[3,25-27]

Chemical spills emerged as another important cause of exposure to both skin irritants and allergens. It would clearly be beneficial to educate employers and workers about the possibility of sensitisation occurring after just one chemical exposure and to highlight how important it is to ensure that skin is protected against the possible contact with chemicals if spills occur.

Atopic individuals are an at-risk group for the development of ICD. In this study, 70% of workers diagnosed with ICD had a personal history of atopy. Guidelines exist as to the management of atopics in the workplace. Atopic workers should be educated right from the start about skin hazards and the importance of maintaining a healthy skin barrier rather than be excluded from certain careers and occupations and employers should ensure that they are protected from skin hazards.[52]

OCU occurring to latex was somewhat surprisingly the second most common cause of allergic reactions. Interestingly, these reactions occurred predominantly in non-healthcare workers presumably because of the ready availability of disposable powdered latex gloves. Countries such as Germany have reduced rates of latex allergy by requiring powder free, low allergen latex gloves to be provided at workplaces and banning the use of powdered latex gloves in workplaces. In Australia it appears that there is little awareness of the possibility of latex allergy outside the healthcare sector.

ACD to known common and avoidable allergens remains an issue in the occupational setting. PPE was supplied for all except one worker in this study. In the majority of cases of ACD the PPE — gloves, protective clothing, face shields/visors/goggles — was considered inappropriate by the clinicians for the task which likely led to sensitisation. This was particularly the case for those working with acrylates, epoxy resins and cement. It is important for the employer to be aware of the allergens (sensitisers) in their workplace and the appropriate PPE required to prevent skin exposure and subsequent sensitisation. Hairdressers in particular continue to be ignorant of the many chemicals in their work environment which are hazardous to the skin.

ACD to hard-to-avoid allergens in skincare products and gloves perhaps remains a more difficult issue to address which will ultimately be solved by the substitution of less allergenic chemicals. The ODC data does show a declining rate of allergy to the rubber accelerators thiurams (unpublished data). Latex free (nitrile) gloves are now readily accessible by healthcare workers to prevent ACD associated with some of these allergens, and sulfur-based chemical accelerator free disposable gloves are also available, although not routinely supplied. However, this study highlighted an increase in preservative allergy to MIT found in substances used on the skin such as hand cleansers. Most preservatives can cause allergy and there have been mini-epidemics of ACD to preservatives over the years but ACD to MIT seems to be a major problem in a number of countries including Australia. [44-48]

Some of these hard-to-avoid allergens in skincare products are weak allergens. They sensitise only because there is pre-existing skin barrier damage from the effect of skin irritants particularly in healthcare workers who perform wet work which leads to the development of ICD. If the ICD is recognised early and treated these workers may not go on to develop ACD.

Three-quarters (75%) of the workers in this study were from three broad occupational categories: tradespersons and labourers (14), healthcare workers (13) and hair and beauty workers (6). These occupations and associated industries should be targeted in future campaigns to raise awareness of occupational contact dermatitis among both employers and workers.

Through discussions with workers and their employers this study has given an insight into some of the causes and factors contributing to the development of occupational contact dermatitis and OCU in Victoria. Being a small study (44 workers and 29 employers) the findings in this report may not be generalisable. However, such small studies are often the only feasible way of getting both clinical information and survey data to explore issues further in depth. Despite this limitation it is important to note that this is the first study of its kind exploring factors contributing to contact dermatitis among workers and employers and the study provides valuable insights for future initiatives.

Future initiatives could target removing hazardous substances from the workplace through substitution or preventing exposures through the use of engineering controls, administrative controls or the appropriate use of PPE. Other initiatives could focus on education and training to increase awareness of skin hazards and appropriate controls among employers and workers especially for atopic or at risk workers. A number of specific recommendations are proposed in the next section based on the findings of this project.

5 Suggestions for future initiatives arising from this study

The results of this study have identified possible target areas for the implementation of work health initiatives which could be used to reduce the burden of occupational contact dermatitis and OCU. Suggestions for these initiatives are as follows:

1. Existing hospital hand hygiene educational programs should be supplemented with an educational program on the prevention of ICD and appropriate skin care for healthcare workers. This could also be delivered through on-line modules and the achievement of competencies for healthcare workers, developed in collaboration with the Australian Commission on Safety and Quality in Health Care and Hand Hygiene Australia.

2. The use of cheaper, powdered latex gloves outside the healthcare industry remains an ongoing concern. Regulations preventing the use of powdered latex gloves in workplaces and replacing them with low allergen powder free gloves could be effective in reducing OCU to latex as it has been in Germany.

3. PPE was provided by nearly all workplaces. However, a number of cases of occupational contact dermatitis occurred where the PPE was not appropriate for the work being performed. It is important for employers to consult and supply data sheets and to ensure that appropriate PPE is used especially where chemicals like epoxy resins and acrylates are used. This highlights the lack of awareness of the possibility that skin problems can occur. In addition sometimes correct information regarding appropriate PPE is not provided or is not readily accessible in an understandable format.

4. Many workers experienced ICD from multiple, often difficult-to-avoid, skin irritants encountered in their work environment. Education and awareness of dermatitis prevention and good skin care was lacking. With support from Safe Work Australia, ODREC is in the process of translating our Resources About Skin Health (RASH) train-the-trainer style education package into an online e-learning tool which can be used to educate workers about dermatitis prevention. It could be used as part of induction programs or as part of work health and safety updates. In particular atopic individuals need to be educated that they are at increased risk of occupational contact dermatitis and need to particularly look after their skin.

5. The most common cause of ACD was the inadvertent exposure to the preservative MCIT and/or MIT. Australia, like many other countries, is experiencing an outbreak of ACD to MIT coinciding with the increase in permissible concentration in consumer products. The ongoing safe use of MIT as a preservative needs further consideration.

6. There should be improved training for nail technicians with regard to the hazards posed by acrylic nail chemicals. A nail products supplier spoken to in the course of this study asked researchers at ODREC to contribute to several nail and beauty industry magazines with information regarding ACD to acrylic monomers and advice on appropriate PPE. Many technicians working in this industry have told us that they are completely unaware of any skin hazards from these chemicals.

7. Although some years ago ODREC developed training information for hairdressing students and hairdressers which has possibly had some impact on the number of hairdressers assessed in our clinic hairdressers remain an important group at risk of occupational contact dermatitis.[54] Of recent concern is the number of hair dyes being advertised as PPD-free and yet they contain similar chemicals such as toluene-2,5-diamine sulphate. Toluene-2,5-diamine sulphate is itself an allergen and it often cross-reacts with PPD because of its similar chemical structure.[55] In this context the term ‘PPD-free’ is quite misleading. Many of these products are advertised as ‘natural’ or ‘organic’ and some of the hairdressers that the researchers spoke to considered them to be ‘chemical-free’ and not harmful. It is important for hairdressers to be aware of potential allergens, to ideally be able to read the ingredients on the labels of these products and not to mistake marketing information for safety information.

8. As raised in the previous report[2] there should be further investigation of the extent of ACD to potassium dichromate in concreters in Australia. Regulators could consult with the industry on addition of ferrous sulphate to cement to reduce chromium VI levels as currently occurs in Europe. This measure reduces the allergenicity of the potassium dichromate in cement. European chromium

regulations requiring the addition of a reducing agent to cement to reduce chromium VI levels have been effective in reducing ACD due to chromate. For example, in Denmark, one of the first countries to restrict the concentration of chromate in cement to 2 ppm, the prevalence of ACD due to chromium reduced from 10.5% to 1.6% among cement workers. [56] This requirement to reduce chromate levels to 2 ppm was later adopted in *Directive 2003/53/EC of the European Parliament and of the Council of 18 June 2003 amending for the 26th time Council Directive 76/769/EEC relating to restrictions on the marketing and use of certain dangerous substances and preparations (nonylphenol, nonylphenol ethoxylate and cement)* (EU Cement Directive).[57] Data from the UK following the adoption of the EU Cement Directive shows that the incidence of ACD attributed to cement among cement workers significantly decreased after the introduction of its chromium legislation. [58]

9. Finally, 75% of the workers in this study were from three broad occupation categories: tradespersons and labourers, healthcare workers and hair and beauty workers. occupational contact dermatitis prevention initiatives targeting these three areas would likely have the greatest health benefit. Provision of appropriate information to employers in these areas is essential. This is so that employers can incorporate this information into health and safety updates at the workplace to address lack of knowledge and awareness among workers regarding skin hazards.

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Abbreviations

Acronym	Description
ACD	Allergic contact dermatitis
CU	Contact urticaria
ICD	Irritant contact dermatitis
ICDRG	International Contact Dermatitis Research Group
MCIT	Methylchloroisothiazolinone
MIT	Methylisothiazolinone
SDS	Material safety data sheet
OCU	Occupational contact urticaria
ODC	Occupational Dermatology Clinic
ODREC	Occupational Dermatology Research and Education Centre
OSD	Occupational skin disease
PPE	Personal protective equipment
ppm	Parts per million
PPOD	Persistent post occupational dermatitis
RASH	Resources about skin health
RAST	Radio-allergosorbent test

Glossary

Allergic contact dermatitis (ACD)	This is an itchy skin rash caused by a particular type of immunological reaction to skin contact with chemicals known as delayed hypersensitivity. This rash does not occur upon initial skin contact with the chemical but after the process of sensitisation. This process takes 10-30 days but only affects a certain proportion of people exposed to the chemical. Once a person is sensitised the rash will develop on re-exposure to the chemical. The rash is usually delayed from the time of re-exposure, taking at least 4 hours and up to 2 days to develop. While there are often clinical clues it can be difficult to diagnose and sometimes hard to differentiate from forms of eczema, another common itchy skin rash. Testing for this condition involves a process known as 'patch testing' where appropriately diluted substances are applied to the patient's back for 48 hours and the results read 48 and 96 hours after the initial application.
Atopy	This refers to an innate propensity to develop atopic eczema, asthma and/or hay fever. People with atopy, and especially with atopic eczema, might have impaired skin barrier function which causes their skin to be more easily irritated than others.
Avoidable allergen	For this study allergens were considered avoidable if they were known common causes of ACD or CU and exposure should have been avoided through the appropriate use of engineering controls or PPE.
Contact urticaria (CU)	A less common red, itchy skin rash which occurs almost immediately after substances contact the skin. CU is tested for by prick testing (not patch testing) or by a blood test known as radio-allergosorbent testing (RAST). Latex and certain foods are common causes.
Hard-to-avoid allergen	For this study allergens were considered hard to avoid if exposures occurred inadvertently, for example exposures to rubber accelerators in protective gloves or to preservatives in a recommended workplace hand wash, or exposures were to agents not commonly recognised as skin allergens.
Irritant contact dermatitis (ICD)	This itchy rash occurs because of skin contact with irritants. It may be acute, for example cement burns caused by kneeling in very alkaline cement, or chronic caused by cumulative exposures to a number of irritants over time. Skin irritants include wet work (i.e. repetitive wetting and drying of the skin), soaps, detergents, shampoos, oils, solvents, dusts and physical factors such as heat and sweating.
Occupational contact dermatitis	This includes allergic and irritant contact dermatitis and contact urticaria where the causative skin exposures are significantly related to the workplace.
Occupational contact urticaria (OCU)	This refers to contact urticaria caused by a skin exposure significantly related to the workplace.
Occupational skin disease (OSD)	Any skin disease attributable to the workplace, including but not limited to, occupational contact dermatitis or occupational contact urticaria.
Persistent post occupational dermatitis (PPOD)	This refers to occupational contact dermatitis that fails to resolve despite avoidance of the causative factors. It is usually diagnosed upon follow up so it is an uncommon diagnosis in the clinic setting where people present for initial assessment of their skin condition.

Appendix 1: Worker Questionnaire

QUESTIONS FOR DERMATOLOGIST REGARDING FACTORS CONTRIBUTING TO THE DEVELOPMENT OF OCCUPATIONAL CONTACT DERMATITIS

Atopy	
1. Has atopy played a role in this patient's condition?	Yes
	No
	N/A (not atopic)
2. If yes, how?	Immediate i.e. contact urticaria
	ICD in an atopic
	Other:
Occupational exposures	
A. Hard-to-Avoid	
1. Known (unavoidable) allergen exposure	Yes
	No (skip to Question 5)
2. List unavoidable allergens	
3. Which environmental factors are relevant? (circle all that apply)	Sweating
	Dust/fibres
	Heat
	Friction or vibration
	Not applicable
4. Unavoidable irritant exposure (circle all that apply)	Frequent wet work
	Prolonged glove use
	Unable to wear gloves e.g. fine work, machinery etc
	Other:
B. Avoidable/inappropriate	
5. Known (avoidable) allergen exposure	Yes
	No (skip to Question 9)
6. List avoidable allergens	
7. Is there avoidable (inappropriate) exposure to wet work/other irritants?	Yes
	No
8. Was there an accidental exposure e.g. chemical spill?	Yes
	No
Engineering controls	
9. Are engineering controls adequate (as assessed by Dr)? Specify details	Yes
	No
	Not applicable
Personal Protective Equipment (PPE)	
10. Is the PPE adequate? Specify	Yes (skip to Question 14)

details	No
11. Why is the PPE inadequate? (circle all that apply)	Lack of workplace education
	Poor compliance despite education
	Why poor compliance? Specify
	PPE not supplied
	Inappropriate PPE
	Other:
Skin care	
12. Is any skincare provided? Eg moisturising cream, barrier cream	Yes
	No
	N/A or not required
Education	
13. Was any education or training provided on skin hazards to the worker?	Yes
	No (Skip to Question 18)
	N/A or not required
14. What did this training and education cover?	
15. Was the training adequate?	

16. What were the three sources of information from which you have learnt something useful about work health and safety in the last year or so?	Supervisors / managers Training courses (e.g. at work, TAFE, apprenticeship, university) Meetings at work Industry pamphlets / newsletters Posters/ signs/ notices at work Email at work Health and Safety Representatives Workmates Family Media (e.g. magazines, newspapers, television, radio) Unions Employer/ industry associations Government Health and Safety inspectorates (e.g. WorkSafe Victoria website, office, inspector) Internet Experience/ doing the job itself Government Acts/ Regulations/ Publications Suppliers None/ Nothing Don't know

Employer factors

17. Tick any factors relevant for this patient	
Employer ignorance – should have known the risks but didn't	
Employer ignorance – did know risks but didn't address (why not according to worker?)	
Employer ignorance – did not know due to lack of technical knowledge (unavoidable)	
Financial limitations (engineering controls or PPE too expensive)	
18. Does the worker feel their employer is supportive with regard their work generally?	Yes No Partially/sometimes
19. Does the worker feel their employer is supportive with regard to their skin problem?	Yes No Partially/sometimes

Appendix 2: Employer Questionnaire

Education	
1. Was any education or training provided on skin hazards to the worker?	Yes
	No
	N/A or not required
2. Did it include advice on PPE?	Yes
	No
	N/A or not required
3. Does your workplace conduct an induction program for new workers?	Yes
	No (skip to question 4)
	N/A
4. Is dermatitis prevention mentioned in this program?	Yes
	No
5. Does your workplace conduct OHS updates for workers on a regular basis?	Yes
	No
	N/A
6. Is dermatitis prevention mentioned in this program?	Yes
	No
7. If training in dermatitis prevention is not offered, is this because of?	Lack of knowledge
	It's expensive
	Workplace size. I.e. Too small?
8. Where do you get your OHS information from?	Colleagues
	Workers
	Websites
	Books
	Attending seminars and conferences
	Manufacturers and suppliers
	Employer or industry associations
	WorkSafe Victoria

	Training courses (at work, TAFE, University, apprenticeship training)
Engineering controls	
9. Do you have engineering controls in your workplace for skin hazards/ a particular allergen?	Yes
	No (Skip to question 11)
	N/A
10. What are the engineering controls for this hazard in your workplace? (list engineering controls)	
11. Do you think there are adequate engineering controls in your workplace? Why?	Yes
	No
Personal Protective Equipment (PPE)	
12. Is PPE supplied?	Yes
	No
	N/A (skip to Question 17)
13. Do you think PPE is adequate? Why?	Yes
	No
14. Is the PPE adequate? (Dr to answer)	Yes
	No
15. Why is the PPE inadequate? (circle all that apply) (Dr to answer)	Lack of workplace education
	Poor compliance despite education
	PPE not supplied
	Inappropriate PPE
	Other
16. What is the reason why appropriate PPE is not supplied?	Not required
	Too costly
	Didn't know what was needed

	Other		
17. Do your workers always wear PPE when it is needed? If not, why?	Yes		
	No		
	N/A		
18. Do you express concern if safe work practices are not adhered to (e.g. workers not wearing PPE when needed)?	Yes		
	No		
	N/A		
Skin care			
19. Is there any skin care provided?	Yes		
	No (Skip to Question 22)		
20. Do you provide?			
Skin care item	**Supplied (tick)**	**Not applicable (not needed/not appropriate)**	
a. Moisturiser	Yes	No	Not applicable
b. Barrier cream	Yes	No	Not applicable
c. Skin cleanser	Yes	No	Not applicable
d. Alcohol based hand rubs	Yes	No	Not applicable
<u>Employer factors</u> Tick any factors relevant for this employer (Dr to answer)			
21. What are the employer factors? Tick any factors relevant for this employer (Dr to answer)	Employer ignorance – should have known the risks but didn't		
	Employer ignorance – did know risks but didn't address (and why?)		
	Employer ignorance – did not know due to lack of technical knowledge (unavoidable)		

	Financial limitations (engineering controls or PPE too expensive)
22. Does the employer believe their workplace is supportive of workers?	Yes
	No
	Partially/sometimes
Workplace size	
23. How many people work in your workplace?	Self employed
	Small (2-19)
	Medium (20 to 199 employees)
	Large (200-1999 employees)
	Very large (>2000)