



Occupational contact dermatitis: Known knowns and known unknowns

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Abstract It is only by recognizing what we know that we know, and being cognizant of the things that we know that we don't know that clinicians and the health profession are able to deliver quality care to patients. Traditional learning methods can sometimes perpetuate unappraised and unfounded beliefs and practices. Evidence-based practice requires robustly conducted systematic reviews and evidence-based guidelines. There have only been three systematic reviews of occupational contact dermatitis. These inform us of what we know we know and what we know that we don't know. We know which agents cause allergic and irritant occupational contact dermatitis, and we know the occupations that present the greatest risk. We know that conditioning creams are helpful in the prevention and management of the disease, and we know that we don't know the optimal frequency of application. We know that prework creams are not universally effective. We know that avoidance of exposure can help to improve symptoms in those who have developed dermatitis, but we know that we don't know if earlier identification and earlier avoidance of exposure produces better outcomes. Most importantly, we know that there is a need for better research conducted in occupational rather than experimental settings and with contact dermatitis rather than subclinical findings as an outcome measure.

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Introduction

There are known knowns. These are things we know that we know. There are known unknowns. That is to say, there are things that we know we don't know. But there are also unknown unknowns. There are things we don't know we don't know.

Donald Rumsfeld

How individual clinicians and the health profession as a whole perform relies very much on what we know that we

know, but equally as clinicians we should be cognizant of the things that we know that we don't know. It is only by recognizing both that clinicians and the profession are able to deliver quality care. Clinicians have sometimes considered their work as much an art as a science, drawing on clinical intuition honed by years of experience¹; however, experience and, for that matter, even narrative reviews written by experts only really inform us of what we think that we know, and not necessarily what we know that we know. Among the data that we collect over the years will be unappraised beliefs and practices.

Evidence-based guideline development is one of the major recent developments in efforts to improve patient care, providing clinicians and patients with information on how to manage health problems appropriately in daily practice.² As a consequence, clinicians have increasingly applied evi-

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dence-based practice,¹ which is the conscientious, explicit, and judicious use of the current best evidence in making decisions about the care of individual patients. Clinicians still need to exercise their judgement, knowledge, and expertise, when deciding whether it is appropriate to apply evidence-based guidelines, taking into account individual circumstances and patients' wishes. Evidence-based practice is about integrating that individual clinical expertise with the best external evidence.³

The lynchpin of evidence-based practice is the systematic review. Unlike a narrative review that merely summarizes the findings from several unappraised studies, a systematic review aims to identify and appraise all of the literature on a particular topic, ranking the credibility accorded to evidence, depending on the likelihood of bias influencing data collection and interpretation. Because systematic reviews start by determining the important questions that need to be addressed, they can define the known knowns of explicit aspects of specific diseases. They can also help to identify the known unknowns; that is, areas where insufficient qualitative and quantitative evidence exists. In fact, systematic reviews are sometimes criticized for concluding that little evidence exists to answer the question⁴ and for missing the opportunity to identify outstanding gaps in the evidence.⁵ More important, identifying the known unknowns can help to stimulate more and better research to help resolve areas of uncertainty.

Systematic reviews of occupational contact dermatitis

Although there are many narrative reviews about several occupational diseases, there have been few systematic reviews of occupational disorders. This is especially the case for occupational contact dermatitis, which had not been systematically reviewed until 2005.

- The first systematic review covered aspects of treatment and prevention.⁶ The literature search found 413 contributions. After exclusion and inclusion criteria were applied, 49 studies were appraised and 28 met the quality criteria for inclusion.
- The second systematic review was published in 2009 and addressed the occupational health aspects of the management of dermatitis. Its scope was limited: the main focus was health care workers and the risk of bacterial colonization and transmission of infection to patients.⁷ The literature search identified 1677 articles. After two rounds of sifting, 48 contributions were included for critical appraisal, and 11 met quality criteria for inclusion.
- In 2010, the British Occupational Health Research Foundation published a systematic review of risk factors, prevention, identification, and management of

occupational contact dermatitis.⁸ Of the 3155 contributions that were found, 786 were critically appraised, and 117 met quality criteria for inclusion.

What do these three systematic reviews tell us about the known knowns and known unknowns pertaining to occupational contact dermatitis?

The scale of the problem

We know that occupational contact dermatitis accounts for 70% to 90% of reported cases of occupational skin disease in developed countries.⁸ The true frequency of the disease is a known unknown, however, particularly with regard to prevalence. Even the most reliable studies of incidence provide a range of estimates of 11 to 86 cases/100,000 workers per year.⁸ Such variation is due partly to inconsistent definitions, differences in diagnostic criteria and work settings, and by limited surveillance data. Incidence data from surveillance schemes are likely to suffer from underreporting. Population-based studies and mandatory reporting schemes estimate the incidence of occupational skin disease most accurately, but few such studies have been published.

The attribution of allergic vs irritant occupational contact dermatitis varies widely; the proportion of cases depends on the types of industry that prevail, the jobs that people have, the hazards to which they are exposed, the centers that report cases, and differences in defining the disease and confirming the diagnoses. Some dermatologists might believe from their clinical experience that occupational contact dermatitis is more likely to have an allergic rather than irritant attribution. This is understandable, because the proportion of patients with allergic contact dermatitis is often greater among those referred to dermatology departments. Patients with irritant occupational contact dermatitis, particularly mild or transient disease, are more likely to be managed within occupational health or primary care. There is strong evidence in the general workforce, including patients not referred to specialist centers, that irritant occupational contact dermatitis is more common than allergic occupational contact dermatitis.⁸

Risk factors

Exposure to skin irritants and allergens in the workplace is the most significant independent risk factor for developing occupational contact dermatitis. The predominant causative agents reflect variations of economic activity between and within countries, methods of data collection, and occupational classifications of workers (Table 1).

Job tenure and age are sometimes discussed as potential risk factors. Some studies have noted an increased risk for

Table 1 Risk factors

Known knowns	The most frequently reported occupational skin irritants include alcohols, cutting oils and coolants, degreasers, disinfectants, petroleum products, soaps and cleaners, solvents, and wet work.⁸ The most frequently reported occupational skin allergens include cobalt, chromates, cosmetics and fragrances, epoxies, nickel, plants, preservatives, resins, and acrylics.⁸ Those at highest risk include agricultural workers, beauticians, chemical workers, cleaners, construction workers, cooks and caterers, electronics workers, hairdressers, health care workers, machine operators, mechanics, metalworkers, and vehicle assemblers.⁸ Occupational contact dermatitis can develop at any stage of a person's career, including during the apprenticeship period.⁸ A history of atopic dermatitis, particularly in adulthood, appears to be an independent risk factor for developing occupational contact dermatitis.⁸
Known unknowns	The true relative risks presented by different occupational and personal risk factors. The extent to which physical irritants (eg, friction and low humidity) cause or contribute to occupational contact dermatitis.

the development of occupational contact dermatitis within the first 3 to 12 months of employment in the younger and least experienced workers, but this is not a universal finding and is not without confounders. Among hairdressers, those reported to be at increased risk of developing hand dermatitis are trainees and those with less than 2 years of experience, such as those who perform more frequent wet work, which is significantly associated with prevalence.

Authors commonly discuss personal or endogenous risk factors and refer to narrative reviews and book chapters rather than systematic reviews; yet, there is little original high-quality scientific research that explores such risk factors directly. The evidence that does exist derives from small studies of different design and variable quality. As a consequence, the findings are often inconsistent.

Atopy can be defined

- clinically—as a tendency to develop atopic dermatitis, hayfever, or asthma, or
- immunologically—as the ready propensity to produce specific immunoglobulin E on ordinary exposure to common aeroallergens.

These and further definitions, along with inconsistencies in methods of defining cases of dermatitis, impede the comparison of studies. Most studies report that atopy does not appear to increase the risk for type IV hypersensitivity reactions to occupational exposure that leads to allergic contact dermatitis. Respiratory atopy, in the absence of atopic dermatitis, similarly does not appear to affect susceptibility for developing occupational contact dermatitis. Some studies have suggested that a personal or family history of atopy is commoner among those with irritant contact dermatitis than in those with allergic contact dermatitis, but without comparing with rates of atopy among control groups of unaffected workers. What we do know, however, is that a history of atopic dermatitis, particularly in adulthood, appears to be an independent risk factor for the development of occupational contact dermatitis.⁸

Prevention

Primary prevention aims to avert the onset of disease in individuals and to reduce the incidence of new cases of disease at a population level. Secondary prevention aims to detect disease at an early or presymptomatic stage (eg, by health surveillance) so that remedial interventions can be arranged. Tertiary prevention aims to mitigate the effects of established disease.

Occupational contact dermatitis can be prevented by applying the normal hierarchy of control measures (Table 2). The most effective measure is primary prevention of exposure by substituting a less harmful material for the agent or by engineering and hygiene measures. This has reduced the incidence of occupational contact dermatitis in the case of substituting chromate in cement with ferrous sulfate. Substitution of powdered natural rubber latex gloves with low-protein nonpowdered gloves is similarly effective in the primary prevention of latex allergy.⁹

With studies of preventive measures, it is often difficult to distinguish the relative effect of one measure against another, because they are usually implemented in parallel as a multifaceted program. Personal protective equipment only offers protection when selected correctly, worn properly, removed safely, and replaced or maintained regularly. Some personal protective equipment, notably latex gloves,

Table 2 Hierarchy of control measures

1. Elimination	Remove the hazard from the workplace
2. Substitution	Replace the hazard with a safer alternative
3. Engineering controls	Enclosure or automation of the process, ventilation
4. Administrative controls	Safe work practices, health surveillance
5. Personal protective equipment	Gloves, safety goggles, respirators

Table 3 Prevention

Known knowns	Hazard substitution prevents occupational contact dermatitis.⁸ Limited wearing of gloves helps prevent irritant occupational contact dermatitis when coupled with other preventive measures.⁸ Cotton glove liners can prevent impairment of skin barrier function that can be caused by prolonged wearing of occlusive gloves.⁶ Some prework creams may help prevent occupational irritant contact dermatitis,⁶ but they are not generally effective as a protective measure.^{7,8} Alcohol-based hand rubs are less damaging to the skin than traditional hand washing agents or soap.⁷ Regular application of high-lipid-content conditioning or afterwork creams helps prevent irritant occupational contact dermatitis.⁶⁻⁸
Known unknowns	Appropriately targeted and sustained educational interventions induce important behavioral changes.⁹ What is the medium- and long-term effectiveness of multifaceted skin care programs?⁷ What is the optimum timing and frequency for the application of conditioning or afterwork creams?⁸ What are the best hand care programs?⁷ Which educational interventions are most effective? What is the effectiveness of health surveillance based on periodic questionnaire or a questionnaire plus examination against self-reporting of skin problems?⁷

can cause occupational allergies, including contact dermatitis. Studies on using gloves to prevent the development of occupational contact dermatitis are limited. The observed benefits were not exclusively attributable to wearing gloves, because they were only one part of a comprehensive prevention strategy. These included reduction of exposure, education, glove use, and skin care and protection programs (Table 3).

Pework creams are commonly referred to as barrier creams, inappropriately so, because they do not form a protective physical barrier. Two good-quality and two fair-quality studies found prework creams were effective in preventing irritant contact dermatitis, and one good-quality study did not.⁶ Some studies included healthy volunteers, and outcome measures included erythema, transepidermal water loss, and chromometry rather than contact dermatitis; generalizability (external validity) is therefore limited.⁶ No good-quality studies investigated the use of prework creams for preventing allergic contact dermatitis, whereas four fair-quality studies were limited to specific active ingredients for specific allergens; so again, the findings cannot be generalized.⁶

The highest-quality study was a randomized controlled trial of workers in the building and timber trades published in 2009. It found no clinical evidence that prework creams alone prevent dermatitis, although when used with cleansing and after-work creams, they were effective in improving skin condition, measured by transepidermal water loss.¹⁰ A systematic review of latex allergy concluded that prior use of prework creams is not recommended for people who wear latex gloves, with one small, nonrandomized study indicating that prework creams may favor the uptake of allergens from gloves.⁹

Periodic health surveillance for occupational contact dermatitis aims to identify cases at early and reversible stages of disease. There is no direct evidence base, derived

from studies in working populations, to address the question of the effectiveness of health surveillance in the early detection of occupational contact dermatitis or the comparative effectiveness of different screening methods.⁷

A recent systematic review of latex allergies based on four studies reported that appropriately targeted and sustained educational interventions induce important behavioral changes in latex glove use.⁹

Identification and investigation

Occupational contact dermatitis most commonly affects the hands, followed by the wrists, arms, and face.⁸ The distribution of the eruption depends upon the nature of the job, whether adequate personal protective equipment is selected and used correctly, behavior (eg, hand to face contact), and whether the offending agent is airborne. A temporal relationship between clinical manifestations and work indicates that a person's job has either contributed to or caused his or her occupational contact dermatitis⁸; however, neither the location of the eruption nor a temporal relationship with work confirms an occupational cause. Contact with agents away from work can cause dermatitis that affects the same areas, whereas temporality may simply indicate that work has aggravated a preexisting dermatitis.

The diagnosis of occupational contact dermatitis is made by fastidious history taking, clinical examination, and patch testing.⁸ The identification of any offending allergen is a major objective, because exclusion of an offending allergen from the environment can contribute to clinical recovery in the individual worker and avoidance of new cases of disease. Negative patch testing results may indicate irritant contact dermatitis if the signs show a temporal relationship with work.

Management

The pharmacologic management of dermatitis, is the same for occupational and nonoccupational forms of the disease; however, care must be taken to distinguish between occupational and nonoccupational disease and between irritant and allergic occupational contact dermatitis because the occupational management of the patient will differ. Continued exposure to the causative agent will lead to continued dermatitis, and so affected individuals should avoid further exposure to the agents that caused their dermatitis, particularly in the case of allergic disease. Redeployment to a low exposure area or the introduction of exposure controls may improve or resolve disease in some workers; however, persistent dermatitis may occur despite adequate and prolonged allergen/irritant avoidance, especially for allergic contact dermatitis to chromate and other metal salts.⁸ Substitution of powdered natural rubber latex gloves with low-protein nonpowdered gloves reduces symptoms, severity, and markers of sensitization in those who have developed latex allergy, including type I and type IV skin disease.⁹

The enhanced use of gloves or protective clothing may improve or prevent signs in some, but not all, workers who continue to be exposed to the causative agent, enabling them to continue in the same occupation. Glove use can worsen irritant hand dermatitis, although the use of cotton-lined gloves may mitigate this.⁶ A very small body of evidence shows that conditioning creams improve the condition of the skin in workers with damaged skin.⁷ There is also a very small body of evidence that prework (barrier) creams do not improve clinical indicators of skin condition.⁷

Several educational programs, consisting of verbal or written advice or formal nurse-led training, have been reported. The outcome of these interventions varies, with some having no demonstrable effect. Individuals who are knowledgeable of their diagnosis and its causes have less dermatitis and are more likely to show improvement than those who are not informed. Significantly better outcomes have been reported with nurse-led education programs for irritant occupational contact dermatitis (Table 4).⁸

We know that skin that is affected by dermatitis is more likely than normal skin to be colonized with microorganisms⁷ and that there is a moderate likelihood of colonization in health care workers with existing hand dermatitis.⁷ The level of risk to patients is a known unknown; however, it is recommended that health care workers with severe or acute dermatitis be temporarily restricted from clinical work with patients at high risk from nosocomial infection, such as high-dependency, neonates, immunocompromised patients, and surgical patients.⁷ Health care workers with mild or recurrent hand dermatitis can continue with clinical work provided that they can follow normal infection-control procedures, including hand hygiene and glove wearing, that they have not been implicated in a case of nosocomial infection, and that the dermatitis is not aggravated by work.⁷

Prognosis

We know that the prognosis for occupational contact dermatitis varies widely and that many workers continue to have active signs and impaired function years after diagnosis, despite treatment and change of job.⁸ Although occupational contact dermatitis commonly leads to loss or change of employment, most affected workers manage to continue working in some capacity, albeit sometimes in different work.⁸ In some occupational settings, reasonable control of signs and job retention is possible.⁸ A small proportion of patients continue to have persistent or postoccupational contact dermatitis in the very long-term, even after removal from exposure.⁸

Conclusions

We know much about the prevention and management of occupational contact dermatitis, but there is still room for improvement. Much of what we know, particularly in the aspect of prevention, is derived from studies that were undertaken in experimental settings and where outcomes

Table 4 Occupational management

Known knowns	Allergen and irritant avoidance can improve or resolve occupational contact dermatitis in some workers who continue to be exposed to the causative agent, but is not always effective. ⁸ Appropriate health education can enable a worker to continue using the agent that caused their dermatitis and improve outcome. ⁸ Topical steroids improve clinical and nonclinical outcomes in allergic occupational contact dermatitis. ⁶ Conditioning creams improve skin condition in workers with damaged skin. ⁷ Pework creams do not improve skin condition in workers with damaged skin. ⁷
Known unknowns	Does early identification and early removal from exposure produce better outcome? What is the risk that health care workers with occupational contact dermatitis will transmit organisms from colonized hand dermatitis to patients in a health care setting? To what extent are workers with occupational contact dermatitis a risk to product and consumers in catering and sterile manufacturing facilities?

were measured after only short intervention periods. The foundations for some of what we know that we know need to be underpinned by more substance. Properly conducted longitudinal prospective cohort studies are needed in real workers in workplace settings with suitable controls and where contact dermatitis and return to work are the outcome measures. Occupational contact dermatitis presents much opportunity for further research that will be of practical value to workers.

References

1. Parker LE, Ritchie MJ, Kirchner JE, Owen RR. Balancing health care evidence and art to meet clinical needs: policymakers' perspectives. *J Eval Clin Pract* 2009;15:970-5.
2. Grol R, van Weel C. Getting a grip on guidelines: how to make them more relevant for practice. *Br J Gen Pract* 2009;59:e143-4.
3. Sackett DL, Rosenberg MC, Gray JA, Haynes RB, Richardson WS. Evidence based medicine: what it is and what it isn't. *BMJ* 1996;312:71-2.
4. Petticrew M. Why certain systematic reviews reach uncertain conclusions. *BMJ* 2003;326:756-8.
5. Brown P, Brunnhiber K, Chalkidou K, et al. How to formulate research recommendations. *BMJ* 2006;333:804-6.
6. Saary J, Qureshi R, Palda V, et al. A systematic review of contact dermatitis treatment and prevention. *J Am Acad Dermatol* 2005;53: 845-55.
7. Smedley J, Pedersen K, Glassington L, et al. Dermatitis: occupational health aspects of management: a national guideline. London: Royal College of Physicians; 2009.
8. Nicholson PJ, Llewellyn D, editors. Occupational contact dermatitis & urticaria. London: British Occupational Health Research Foundation; 2010.
9. Ahmed SM, Adisesh A, Aw TC, et al. Latex allergy: occupational health aspects of management: a national guideline. London: Royal College of Physicians; 2008.
10. Winker R, Salameh B, Stolkovich S, et al. Effectiveness of skin protection creams in the prevention of occupational dermatitis: results of a randomized, controlled trial. *Int Arch Occup Environ Health* 2009; 82:653-62.