Occupational Skin Disease: Beyond Skin Deep

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Pilar Gomez, HBScOT, Reg(Ont), OHS Dip.

St Michael’s Hospital
Occupational Disease Specialty Program
Outline

• Introduction
• Causative Agents
• Prevalence
• Diagnosis
• Dermal Exposure Assessment
• Prevention
• Case studies
Significance of Skin Exposure

“Occupational skin exposures will remain significant occurrences for some time because of the present general lack of understanding among occupational health specialists about the risks”.

Boeniger, Mark. Invited Editorial-The Significance of Skin Exposure.
Significance of Skin Exposure

Extent of the Problem:

• Contact dermatitis long reported as 1º occupational disease associated with chemical exposures
• Incidence of OCD estimated 50x > than typically reported
• Long-term prognosis typically poor
• Direct association between > medical & comp costs and delayed referral to physicians
Occupational Skin Disease

- 90%- 95% is contact dermatitis
- Other types:
  - Folliculitis, acne
  - Infections
  - Actinic changes
  - Cancer
  - Pigmentary changes - vitiligo
Definition of Contact Dermatitis

“reactive eczematous inflammation of the skin provoked by direct contact with an environmental chemical or substance”
Definition of Contact Dermatitis

or, in other words:

• a skin condition caused by things that people touch at work
• hands are most commonly affected but the face and other exposed skin can also be affected if the substance is airborne
Contact Dermatitis:

• Irritant
• Allergic
  – Type 1 allergic response
    • Contact urticaria – hives
  – Type IV allergic response
    • Eczematous
### Examples of skin irritants and sensitizers, together with occupations where they occur

<table>
<thead>
<tr>
<th>Example occupations</th>
<th>Examples of Irritants</th>
<th>Examples of Sensitisers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural workers</td>
<td>Artificial fertilisers; cleaning products; diesel; disinfectants; dust including soil and food products; gasoline; oils; pesticides; plants; solvents; wet-work.</td>
<td>Animal feeds; barley; cement; fungicides; germicidal products; oats; plants; pesticides; veterinary medications; wood dust; preservatives; wool.</td>
</tr>
<tr>
<td>Bakers</td>
<td>Acids; detergents; wet-work.</td>
<td>Ammonium persulphate; benzoyl peroxide; dyes; essential oils; enzymes; flavours; flour; some fruits.</td>
</tr>
<tr>
<td>Bartenders</td>
<td>Detergents; disinfectants; scale-removers; wet-work.</td>
<td>Formaldehyde; some fruits.</td>
</tr>
<tr>
<td>Beauticians (Nails)</td>
<td>Dusts; acetone; disinfectants.</td>
<td>Ethylmethacrylate; methylmethacrylate.</td>
</tr>
<tr>
<td>Butchers and abattoir workers</td>
<td>Acids and alkalies; detergents; waste products; wet-work.</td>
<td>Animal proteins; formaldehyde; latex rubber protein; nickel; sawdust.</td>
</tr>
<tr>
<td>Cabinet makers and carpenters</td>
<td>Detergents; glues; solvents; thinners; wood dust; wood preservatives.</td>
<td>Colophony; dyes; fungicides; glues; turpentine; varnishes; wood dust.</td>
</tr>
<tr>
<td>Carpet layers</td>
<td>Adhesives; dusts.</td>
<td>Adhesives; mites; fungus; animal waste.</td>
</tr>
<tr>
<td>Cleaners</td>
<td>Detergents; other cleaning products; solvents; wet-work.</td>
<td>Formaldehyde; germicidal agents.</td>
</tr>
<tr>
<td>Construction workers</td>
<td>Cement; dusts; solvents; sand; wet-work; building materials.</td>
<td>Cement; chromium; chromium compounds, cobalt; epoxy resins; nickel; resins; thuram in gloves; wood dust.</td>
</tr>
<tr>
<td>Cooks and caterers</td>
<td>Acids and alkalies; bleaching agents; detergents; vegetable juices; wet-work.</td>
<td>Flavours (some types); formaldehyde; garlic; sodium metabisulphite; spices (some).</td>
</tr>
<tr>
<td>Dentists and dental technicians</td>
<td>Detergents; wet-work.</td>
<td>Dental Impression material; disinfectants; eugenol; local anaesthetics (some); mercury; methacrylates; latex rubber free protein.</td>
</tr>
<tr>
<td>Doctors, nurses and others</td>
<td>Disinfectants; detergents; wet-work.</td>
<td>Latex gloves; Some anaesthetics, antibiotics and antiseptics; phenothiazines; formaldehyde; glutaraldehyde; liquid chloroxylenol.</td>
</tr>
<tr>
<td>Electricians</td>
<td>Fibre glass; soldering fluxes.</td>
<td>Epoxy resins; rubber; isocyanates; soldering fluxes; dusts.</td>
</tr>
</tbody>
</table>
# Examples of skin irritants and sensitizers, together with occupations where they occur

<table>
<thead>
<tr>
<th>Example occupations</th>
<th>Examples of irritants</th>
<th>Examples of sensitisers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor-layers</td>
<td>Solvents.</td>
<td>Cement; epoxy resins; house mites; wood; wood dust.</td>
</tr>
<tr>
<td>Florists and gardeners</td>
<td>Compost; fertilisers; pesticides; wet-work; soil; preservatives.</td>
<td>Plants; pesticides; insecticides.</td>
</tr>
<tr>
<td>Foundry workers</td>
<td>Dust; sand.</td>
<td>Chromium; cobalt; nickel; phenol/urea-formaldehyde resins.</td>
</tr>
<tr>
<td>Hairdressers</td>
<td>Bleaching agents; dyes; permanent wave solutions; shampoos; wet-work.</td>
<td>Dyes; nickel; persulphates; perfumes; latex rubber protein; amine based chemicals,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>including paraphenylenediamine (ppd).</td>
</tr>
<tr>
<td>Hospital and care home</td>
<td>Detergents; disinfectants; wet-work.</td>
<td>Latex rubber protein; medicines.</td>
</tr>
<tr>
<td>Home workers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal workers</td>
<td>Cutting oils /fluids; solvents; metal shavings/dusts.</td>
<td>Additives/preservatives in cutting fluids; chromium; nickel.</td>
</tr>
<tr>
<td>Mechanics</td>
<td>Cleaners; diesel; gasoline; greases; oils; solvents.</td>
<td>Chromium; epoxy resin; nickel.</td>
</tr>
<tr>
<td>Motor vehicle repairers</td>
<td>Aggressive hand cleaning products; fuels; oils; paints; solvents.</td>
<td>Chromium; cobalt; epoxy resins; nickel.</td>
</tr>
<tr>
<td>Painters</td>
<td>Aggressive hand cleaners; solvents; thinners; wallpaper adhesives including antibacterial/mould agents.</td>
<td>Turpentine; thinners; chromium; formaldehyde; epoxy products; polyester resins.</td>
</tr>
<tr>
<td>Photographic industry</td>
<td>Solvents; wet-work.</td>
<td>Chromium; colour developers; para-aminophenol; formaldehyde; hydroquinone; sodium</td>
</tr>
<tr>
<td>workers</td>
<td></td>
<td>metabisulphite.</td>
</tr>
<tr>
<td>Printers</td>
<td>Solvents.</td>
<td>Colophony; formaldehyde; metals in resins/inks; resins and hardeners; turpentine.</td>
</tr>
<tr>
<td>Rubber products</td>
<td>Solvents; talc; uncured rubber; zinc stearate.</td>
<td>Colophony; dyes; rubber conditioning chemicals; different amines and epoxy resins.</td>
</tr>
<tr>
<td>workers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Veterinarians</td>
<td>Disinfectants; wet-work.</td>
<td>Some anaesthetics, antibiotics and antiseptics; chloroxylenol; formaldehyde; glutaraldehyde; latex rubber protein; phenothiazines.</td>
</tr>
</tbody>
</table>
### Examples of causes of contact urticaria and occupations where they occur

<table>
<thead>
<tr>
<th>Agents</th>
<th>Type of workers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foods, spices, herbs</td>
<td>Cooks, food preparation workers, other kitchen workers</td>
</tr>
<tr>
<td>Food additives, eg: Cinamic acid, benzaldehyde, benzoic acid, albumin</td>
<td>Cooks, food preparation workers, other kitchen workers, bakers and millers</td>
</tr>
<tr>
<td>Animal hair</td>
<td>Animal husbandry worker, veterinarians and nurses, laboratory workers</td>
</tr>
<tr>
<td>Latex proteins</td>
<td>Health care workers, animal husbandry workers, veterinarians, laboratory workers</td>
</tr>
<tr>
<td>Topical drugs</td>
<td>Health care workers, pharmaceutical workers</td>
</tr>
<tr>
<td>Disinfectants</td>
<td>Hair dressers, cleaners, kitchen staff</td>
</tr>
<tr>
<td>Resins</td>
<td>Construction workers, resin manufacturing, printers, nail technicians</td>
</tr>
<tr>
<td>Chemicals used in rubber production</td>
<td>Rubber processing workers</td>
</tr>
</tbody>
</table>

**Source:**
UK HSE Website
Irritant Contact Dermatitis (ICD)

• Types
  – Acute: e.g. chemical burn
  – Chronic: weeks to years of exposure to mild to moderate irritant
Wet Work

- Recognition that ‘wet work’ is a common cause of skin disease for a number of occupations
- Working definition of ‘wet work’ initiated by Germany in technical standard TRGS531
Irritants & Wet Work
The German Experience

Definition:
• Water-exposed
• Liquid detergents
• Other liquids (eg., metalworking fluids)
• Prolonged occlusion (ie., glove use)
Irritants & Wet Work
The German Experience

• Regulation applies to working with wet hands for > 2hrs/day

• Employer must:
  – Check working conditions to ↓ wet work
  – Substitute hazardous materials where this applies
  – Institute job rotation
  – Set up a ppe scheme
  – Provide appropriate skin care products
  – Education program for workers
Allergic Contact Dermatitis

Urticaria
• Type 1 allergic response
• Immediate, IgE-mediated

Eczema
• Type IV allergic response,
• Delayed, cell-mediated
Occupational Dermatitis Prevalence

Dermatitis Claims by Industry Sector
Registration Date 1993 to 2005

Number of Claims

<table>
<thead>
<tr>
<th>Sector</th>
<th>All Claims</th>
<th>Allowed Claims</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automotive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td></td>
<td></td>
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<tr>
<td>Education</td>
<td></td>
<td></td>
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<tr>
<td>Electrical</td>
<td></td>
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<tr>
<td>Food</td>
<td></td>
<td></td>
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<tr>
<td>Forestry</td>
<td></td>
<td></td>
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<tr>
<td>Health Care</td>
<td></td>
<td></td>
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<tr>
<td>Manufacturing</td>
<td></td>
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<tr>
<td>Mining</td>
<td></td>
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<tr>
<td>Municipal</td>
<td></td>
<td></td>
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<tr>
<td>Primary Metal</td>
<td></td>
<td></td>
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<tr>
<td>Pulp &amp; Paper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schedule II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service</td>
<td></td>
<td></td>
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<tr>
<td>Transportation</td>
<td></td>
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</tr>
</tbody>
</table>

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WSIB DERMATITIS CLAIMS

All Dermatitis Claims
Registered from 1993 to 2005

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Claims</th>
<th>Rate per 100 workers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993</td>
<td>602</td>
<td>0.013</td>
</tr>
<tr>
<td>1994</td>
<td>650</td>
<td>0.014</td>
</tr>
<tr>
<td>1995</td>
<td>804</td>
<td>0.017</td>
</tr>
<tr>
<td>1996</td>
<td>847</td>
<td>0.018</td>
</tr>
<tr>
<td>1997</td>
<td>788</td>
<td>0.016</td>
</tr>
<tr>
<td>1998</td>
<td>826</td>
<td>0.016</td>
</tr>
<tr>
<td>1999</td>
<td>743</td>
<td>0.014</td>
</tr>
<tr>
<td>2000</td>
<td>952</td>
<td>0.018</td>
</tr>
<tr>
<td>2001</td>
<td>1414</td>
<td>0.026</td>
</tr>
<tr>
<td>2002</td>
<td>1326</td>
<td>0.023</td>
</tr>
<tr>
<td>2003</td>
<td>1200</td>
<td>0.021</td>
</tr>
<tr>
<td>2004</td>
<td>1065</td>
<td>0.018</td>
</tr>
<tr>
<td>2005</td>
<td>1068</td>
<td>0.018</td>
</tr>
</tbody>
</table>

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OCCUPATIONAL DERMATITIS PREVALENCE

Allowed Dermatitis Claims
Registered from 1993 to 2005

Total Allowed: 397 368 420 418 401 376 363 487 782 700 661 602 555
Rate per 100 workers: 0.009 0.008 0.009 0.008 0.007 0.009 0.014 0.012 0.011 0.010 0.009

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Irritants & Wet Work
The German Experience

OCD

• 6,000 cases in 1960
• 20,000 cases in 1990
• 1984-1992: 12,000 to 24,000/year
• 140 million €/year

Strict reporting system
Financial incentive
OCD is underestimated
(Diepgen, OEESC 2011)

• The incidence of OCD in the USA and Germany is being grossly underestimated\textsuperscript{1,2}

• The milder cases of skin disease are not being registered at all.

• The extent of under-reporting is likely to differ between countries because each country has its own system of notification and its own criteria for compensation.

\textsuperscript{1}Taylor 1988,
\textsuperscript{2}Diepgen & Schmidt 2002
Economic Burden of Dermatitis in US Workers¹

- Economic burden in people aged 16 to 65 yrs and working in seven industry sectors
  - Agriculture forestry, and fishing
  - Mining
  - Construction
  - Manufacturing
  - Wholesale and retail trade
  - Transportation, warehousing, and utilities
  - All services

¹Blanciforti (2010) JOEM 52: 1045-54
Economic Burden of Dermatitis in US Workers\textsuperscript{1}

- Total economic burden\textsuperscript{2} $11.5 billion
  - Direct costs $8.4 billion
  - Lost productivity $3.2 billion
- Economic burden of 7 industry sectors was ~ $1.2 billion (10.5\% of cost of all skin diseases & disorders)

\textsuperscript{2} all skin diseases and disorders

\textsuperscript{1} Blanciforti (2010) JOEM 52: 1045-54
DIAGNOSIS
Irritant Contact Dermatitis

• Clinical features
  – Non-specific, eczematous
  – Predominantly or exclusively at site of contact

• Diagnosis
  – Based on appropriate history and consistent findings
  – No definitive test
Allergic Contact Dermatitis

• Clinical features
  – eczematous
  – vesicles on skin surfaces other than palms and fingers, unusual pattern
  – involvement of skin without obvious contact more likely

• Diagnosis
  – Based on appropriate history & consistent findings
  – Positive patch test to allergen documented in workplace

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Patch Testing

- Diagnostic test characteristics
  - Reliability
  - Validity
- Standardized methodology
  - Test appliances
  - Allergens
  - Timing
  - Scoring methods
PATCH TESTING
PATCH TESTING
PATCH TESTING

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PPD+ at 48 hrs.
Growing interest in dermal exposure…
(Cherrie, OEESC 2011)
Dermal Exposure Assessment

A simple approach to dermal exposure risk assessment

Identify and assess exposure

Measuring dermal exposure is rarely a practicable proposition

What are you going to measure?

What lands on the skin?

What remains on the skin?

What is absorbed into the skin?

What penetrates through the skin?

A combination of several or all of these?
Dermal Exposure Assessment

- Sampling methods available fall into 3 broad categories:
  - In-situ (visualization techniques eg., fluorescent tracers)
    - Mass of a surrogate compound retained on the skin
  - Removal techniques
    - Mass of contaminant left on the skin
  - Interception methods (or surrogate skin)
    - Mass of chemical that lands on skin over the sampling time
- Little standardization in the approaches used by different researchers using these techniques
A novel sampling method . . .  
(Llewellyn, OEESC 2011)

• The role of ‘wet work’ was highlighted in the study “The causative factors of dermatitis among workers exposed to metalworking fluids” (Semple 2007)

• During this project, work on a novel method to monitor ‘wet work’ exposure was initiated
Wet Work Monitor

A tool to measure duration and number of occasions hands are wet

A New Sampler to Assess Dermal Exposure During Wet Working

JOHN W. CHERRIE1*, ANDREW APSLEY1 and SEAN SEMPLE2

1 Institute of Occupational Medicine, Research Avenue North, Riccarton, Edinburgh EH14 4AP, UK;
2 University of Aberdeen, Department of Environmental and Occupational Medicine, Foresterhill Road, Aberdeen AB25 2ZP, UK

Received 4 May 2006; in final form 30 June 2006; published online 19 September 2006

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Dermal Exposure Assessment

- Concentration of the substance in the skin contamination layer is not measured
- Need a biologically-relevant sampler
Biologically-relevant samplers...
(Cherrie, OEESC 2011)

• An interception sampler that mimics the skin
  – with a diffusion membrane, ideally chosen with similar uptake characteristics to the skin
  – adsorbent material
  – impervious backing

• Prototype IOM dermal sampler

• NIOSH POD sampler


Pitfalls…
(Cherrie, OEESC 2011)

• Little progress towards measuring biologically relevant exposure
• Little connection between measurement and modeling
• Poor understanding of the effectiveness of PPE
• Insufficient collaboration within and between constituent groups
• Haven’t really convinced our colleagues of the importance of dermal exposure measurements
Dermal Exposure Assessment

• “The Final Frontier”
• “The Achilles Heel of Risk Evaluation”

(Bickis: www.ohscanada.com/virtual-issue/articles/skin.html)

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Prevention

Occupational skin disease can be prevented by applying the normal hierarchy of control measures

• Elimination
• Substitution
• Engineering controls
• Administrative controls
• Personal protective equipment
Prevention

• In EU, substitution of chromate in cement with ferrous sulphate has reduced the incidence of occupational contact dermatitis (Avnstorp 1989, Roto 1996)

• Substitution of powdered natural rubber latex gloves with low-protein non-powdered gloves is similarly effective in preventing latex allergy (NHS Plus 2008)

• German wet work regulation (adopted as guidelines by the UK HSE, Australia)
Prevention

• Administrative controls involve changing the way the work is carried out e.g.
  – Applying a safe working distance
  – Job rotation
  – Restricting access
Prevention – Having the Right Tools

A floor coating being applied by a worker who is kneeling down and using a short-handled spreader.

Source: Sithamparanadarajah, R. Controlling Skin Exposure to Chemicals & Wet-Work (2008)

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Prevention - Having the Right Tools

Source: Sithamparanadarajah, R. Controlling Skin Exposure to Chemicals & Wet-Work (2008)

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Prevention - Skin Education Program

Skin checks for dermatitis

Regularly check your skin for early signs of dermatitis

Look for...

Dryness

Itching

Redness

...which can develop into flaking, scaling, cracks, swelling and blisters

If you think you may have dermatitis, report it to your employer

Contact name

Your employer may need to refer you to an Occupational Health Doctor or Nurse

www.hse.gov.uk

Small steps stop dermatitis becoming a big problem.

1. Dry your hands thoroughly with a soft cotton or paper towel.

2. Change gloves between clients.

3. Moisturise after washing your hands, as well as at the start and end of each day.

4. Wear disposable non-latex gloves when mixing, shampooing, colouring, bleaching, etc.

5. Check skin regularly for early signs of dermatitis.

For more information, call 0845 345 0055 or visit www.badhandday.hse.gov.uk

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Prevention - Education

Correct removal of gloves
Single use gloves (splash resistant)

Follow the steps shown

Remove gloves carefully to protect your skin from contamination

Dispose of gloves in a suitable container

www.hse.gov.uk

Correct removal of gloves
Reusable gloves (chemically resistant)

Follow the steps shown

Wipe or rinse gloves and remove carefully to protect your skin from contamination

Dispose of gloves in a suitable container

Always select the correct size gloves
Use gloves for no longer than one day

Store gloves on a clean surface for re-use

www.hse.gov.uk

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The Lung-Skin Connection

Must consider the dermal route of exposure in the development of other occupational diseases such occupational asthma.
Occupational Asthma

- OA has been shown to develop from dermal exposure to isocyanates
- Mechanism not fully understood
- More research needed
The Lung-Skin Connection

CONCLUSIONS

• Workers reported symptoms in both systems and this may be under-recognized both in the workplace and the clinical setting
• Association between history of eczema & concurrent skin & respiratory symptoms suggests a role for impaired barrier function but needs further investigation

Of note: concurrent symptoms were more common among derm stream subjects (46%) compared with AA stream subjects (16%)
St. Michael’s Hospital
Occupational Disease Specialty Program

• WSIB specialty clinic
• Provincial referral centre

Disease Streams
• Occupational dermatitis
• Occupational allergy/asthma
• Hand-arm vibration syndrome (HAVs)
• General occupational disease (toxicology)
St. Michael’s Hospital
Occupational Disease Specialty Program (ODSP)

Purpose:
- Link expert resources in occ health in Ontario
- Expedite access to expertise consultation
- Enable research in occupational diseases
  (to further prevention, diagnosis, recovery and return to work)
ODSP – MULTIDISCIPLINARY MODEL

Clinical Activities Coordinator
The administrative team lead for a patient’s flow through the clinic process – books appointments, communicates with WSIB re bookings and reports.

Nurse
The team lead for facilitating, coordinating and integrating the overall clinical needs of the patient.

Clinical Occupational Hygienist
The team lead on the workplace relevance including exposure assessment and link with diagnosis and considerations for workplace exposure “treatment”

Return-To-Work Coordinator
Team lead if patient requires return to work assistance. Communicates with patient, WSIB and workplace to facilitate return to work.

Clinical Support Technician
Performs specialized clinical testing such as patch testing, skin prick and HAVS testing.

Physician Specialist
The clinical team lead for diagnosis and management and follow up assessment. Specialties include occupational medicine, dermatology, respirology, and allergy and immunology.

Patient/Worker

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Work-Related Dermatitis

Key Points:

- MSDS: “May be Spurious Data Sheets”
- Additional allergens are often required
- Custom allergens may be needed
- Repeat patch testing may be required
- Opportunities for reassessment
- Expert counselling re: avoidance of allergens
- RTW coordination can be indispensable
ODSP Referral Criteria: All Streams

• Clarification of diagnosis and/or prognosis
• Clinical hygiene assessment needed
• Requires specialized testing or referral
• Treatment plan unclear / not working
• Difficulty with RTW prescription/ work plan
• Formal monitored RTW program needed

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ODSP Referral Criteria: Derm Stream

Confirm diagnosis - allergy vs irritant

• Has not seen a dermatologist
• Seen by derm but never patch tested
• Patch testing incomplete i.e. did not include all relevant allergens
• Custom allergen (s) needed
Clinical Occupational Hygienist

• Provides detailed occupational exposure history including exposure identification, exposure controls in place (as per hierarchy of controls)
• Follows up with employer as required
• Contacts manufacturers and chemical product suppliers
• Provides recommendations for patch testing strategy from OH perspective
• Work site visits as appropriate
• Develops “workplace prescription” including RTW and exposure prevention
Return to Work Coordinator (RTWc)

• Outlines the workplace recommendations as per the multidisciplinary assessment findings
• Provides worker with skin management plan (including “workplace prescription”)
• Coordinates plan with WSIB, worker, employer
• Coordinates skin monitoring in order for the team to review data and adjust plan as needed
• Follows up with RTW progress
Thank You!

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