Introduction

- Work related skin disorders account for nearly 40% of occupational illness.
- These dermatoses are often underreported because their association with the workplace is not recognized.
- Occupational skin diseases affect workers of all ages, occupations, and work settings.
- Industries with highest risk are manufacture, food production, construction, machine tooling, printing, metal plating, leather work, engine service and forestry.
### Occupational injuries and Illnesses: Industry Data

<table>
<thead>
<tr>
<th>Original Data Value – Bureau of Labor Statistics (BLS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series Id: IIU0000000004U100</td>
</tr>
<tr>
<td>Area: Private industry, All U.S.</td>
</tr>
<tr>
<td>Supersector: All</td>
</tr>
<tr>
<td>Industry: All workers</td>
</tr>
<tr>
<td>Industry Code: 000000</td>
</tr>
<tr>
<td>Case Type: Total recordable cases of skin disease</td>
</tr>
<tr>
<td>Data Type: Number of illness cases (thousands)</td>
</tr>
<tr>
<td>Years: 2003 to 2013</td>
</tr>
</tbody>
</table>

#### Yearly Data

<table>
<thead>
<tr>
<th>Year</th>
<th>Annual</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>43.4</td>
</tr>
<tr>
<td>2004</td>
<td>38.9</td>
</tr>
<tr>
<td>2005</td>
<td>40.1</td>
</tr>
<tr>
<td>2006</td>
<td>41.4</td>
</tr>
<tr>
<td>2007</td>
<td>35.3</td>
</tr>
<tr>
<td>2008</td>
<td>35.8</td>
</tr>
<tr>
<td>2009</td>
<td>25.9</td>
</tr>
<tr>
<td>2010</td>
<td>24.9</td>
</tr>
<tr>
<td>2011</td>
<td>24.5</td>
</tr>
<tr>
<td>2012</td>
<td>23.5</td>
</tr>
<tr>
<td>2013</td>
<td>26.0</td>
</tr>
</tbody>
</table>

![Occupational Skin Diseases Graph](chart.png)

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Skin - The skin is the outer covering of the body, also known as the epidermis. Skin performs multiple functions:

- **Protection**: an anatomical barrier from pathogens and damage between the internal and external environment in bodily defense.

- **Sensation**: contains a variety of nerve endings that react to heat, cold, touch, pressure, vibration, and tissue injury.

- **Heat regulation**: the skin contains a blood supply far greater than its requirements which allows precise control of energy loss by radiation, convection and conduction. Dilated blood vessels increase perfusion and heat loss while constricted vessels greatly reduce cutaneous blood flow and conserve heat.
Signs and Symptoms

Redness
• Itching
• Swelling
• Flaking
• Blistering
• Cracking
• Pain

Irritant Contact
90% of all dermatitis is caused by direct contact with a substance. It may occur randomly.

Allergic Contact
Once sensitised, the problem is life long and any exposure to the substance will result in an attack.
Skin Diseases

- Allergic contact dermatitis (ACD)
- Irritant contact dermatitis (ICD)
- Protein contact dermatitis
- Contact urticaria
- Skin infections
- Acne
- Cancer
- Pigment changes
- Exposure to temperature extremes
How Exposure Can Occur

- Direct handling
- Immersion
- Splashing
- Contaminated surfaces
- Deposition
ROUTES OF ENTRY

- Interact Directly With Cells
- Penetrate Interstices of The Cells
- Through The Pilosebaceous And Sweat Gland Orifices
Skin – Morphology

MORPHOLOGIC PATTERNS

Contact Dermatitis - Acute, Chronic
Acne, Folliculitis
Pigmentary Changes
Granuloma
Eccrine
Neoplasm
Ulceration
Contact Dermatitis

- Contact dermatitis (CD) is reported in 30% of all occupational disease in industrialized nations.

- CD is most common occupational skin disorder - about 90-95% of all cases of occupational skin diseases.

- Incidence rate of 0.5-1.9 cases per 1000 full-time workers per year.
  
  - 1 year prevalence estimate of 10%.
  - Lifetime prevalence rate of 20%.
  - Underestimated due to underreporting mild cases specifically.
Hands are usually 80-90% of cases

Great impact on quality of life

True epidemiologic data are lacking

No standardized method of data collection

Work aggravated skin disease like acne and psoriasis can become occupational related

US Bureau of Labor Statistics (2000) reported 41,800 cases of occupational CD. Estimates are 400,000 to 2 million cases per year where 19.9% reported prolonged sick leave and 23% experienced job loss.
Occupational dermatitis is an inflammation of the skin causing itching, pain, redness, swelling and small blisters.

Contact dermatitis is an eczematous eruption caused by external agents, which can be broadly divided into:

1. **Irritant substances** have a direct toxic effect on the skin (irritant contact dermatitis, ICD)

2. **Allergic chemicals** where immune delayed hypersensitivity reactions occur (allergic contact dermatitis, ACD)
Contact Dermatitis Overview

- A skin disease that is caused by physical, biological or chemical factor(s) in work
- Irritant contact dermatitis accounts for 60-80% of all CD
- Allergic contact dermatitis accounts for remaining 20-40%
- ACD is a specific cell mediate immunologic reaction, requiring prior sensitization
- 90% of the exposed work population can be sensitized to certain antigens such as dinitrochlorobenzene

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Caused by low-molecular weight haptens

Hapten is “incomplete allergen”

Binds to carrier protein for immunogenicity

Low molecule weight enables penetration of hapten

Hapten penetrates through *stratum corneum* of a sensitized individual

A classical Type IV reaction
Acute Allergic Contact Dermatitis

- Rash appears in areas exposed to the sensitizing agent, usually asymmetric or unilaterally.

- Sensitizing agent on the hands or clothes is often transferred to other body parts.

- Rash is characterized by erythema, vesicles and severe edema.

- Pruritus is the overriding symptom.
Non-immunologic response to skin irritant

Injury develops slowly over days to months

Xerosis dominates (abnormally dry skin)

Under excessively moist work conditions, skin irritants can cause excessive cell hydration and result in maceration, most often in the feet and groin

An irritant is a substance that will induce dermatitis in anyone if applied to the skin: (1) in high concentration, (2) over sufficient time, and (3) sufficient frequency
Irritant Contact Dermatitis

- Irritancy is dependent on the ability to remove the surface lipid layer or produce cellular damage
- Not all workers in the same area will be affected
- Depending upon individual predisposition atopic persons are more susceptible and driven by other factors: personal hygiene, other circumstances
- Diagnosis is based on the exposed area and clinical improvement after removing the agent
Irritant Contact Dermatitis

- Common irritants include: acids, alkalis, solvents, degreasers, soaps, abrasives, reducing agents, oil, and low molecular weight plastics
- Comprises about 80% of all occupational skin diseases
- Includes chemical burns and most cases of contact urticaria
- Chronic cumulative irritation is diagnosed by exclusion of an allergic cause for the dermatitis, but it may co-exist with allergic contact dermatitis
Causes of Chronic Irritant Contact Dermatitis

- Water/wet work
- Detergents
- Antiseptics
- Disinfectants
- Soap/cleansing agents
- Weak Acids & alkali
- Wet cement
- Solvents
- Low humidity
- Friction
- Fiberglass fibers
- Cutting oil
- Food
- Pesticides
- Plants & vegetation
- Rubber products
- Acrylic resins
- Soldering flux
- Dusts
- Degreasing agents

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WARNING

This gallery contains graphic images that some viewers may find disturbing.
Irritant or Allergic Contact Dermatitis?

Irritant

Allergic

Dermaamin.com

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Workplace Skin Disorders

- Chemicals
  - Acids
  - Alkalis
  - Solvents
  - Oils
  - Detergents
  - Resins
  - Plastics
  - Metals
  - Petroleum product
  - Plants and woods

- Biologic
  - Viruses (orf-wart-herpes)
  - Bacteria (anthrax-erisopeloid)
  - Fungi (candida-dermatophyte)
  - Parasites (scabies-schistosomiasis)

- Physicals
  - Pressure
  - Friction
  - Vibration

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The sites affected by occupational skin disease depend on exposure.

About 80% of patients with occupational skin disease present with hand dermatitis.

Younger workers have a slightly higher risk than older workers, but who is affected will depend on:

1. Individual predisposition – particularly atopic dermatitis/eczema or sensitive skin
2. Personal hygiene
3. Circumstances of exposure
# Irritant verses Allergic Contact Dermatitis

<table>
<thead>
<tr>
<th>Feature</th>
<th>ACD</th>
<th>ICD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fissuring</td>
<td>++</td>
<td>++++</td>
</tr>
<tr>
<td>Sharp demarcation</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Necrotic keratinocytes</td>
<td>+</td>
<td>+++</td>
</tr>
<tr>
<td>Dermal Edema</td>
<td>++++</td>
<td>++++</td>
</tr>
<tr>
<td>Lymphocytic infiltrate</td>
<td>++++</td>
<td>++++</td>
</tr>
<tr>
<td>Neutrophilic infiltrate</td>
<td>+</td>
<td>+++</td>
</tr>
</tbody>
</table>
# Common Skin Allergens

<table>
<thead>
<tr>
<th>Metals</th>
<th>Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nickel</td>
<td>Urushiol</td>
</tr>
<tr>
<td>Chrome</td>
<td>(Toxicodendron)</td>
</tr>
<tr>
<td>Cobalt</td>
<td>Sesquiterpene lactones</td>
</tr>
<tr>
<td>Mercury</td>
<td>(Compositae)</td>
</tr>
<tr>
<td><strong>Rubber additives</strong></td>
<td></td>
</tr>
<tr>
<td>Mercaptobenzothiazole</td>
<td></td>
</tr>
<tr>
<td>Thiurams</td>
<td>Primin (Primula obconica)</td>
</tr>
<tr>
<td>Carbamates</td>
<td>Tulipalin A (Tulipa, Alstroemeria)</td>
</tr>
<tr>
<td>Thioureas</td>
<td></td>
</tr>
<tr>
<td><strong>Dyes</strong></td>
<td><strong>Plastics</strong></td>
</tr>
<tr>
<td>Paraphenyline</td>
<td>Epoxy monomer</td>
</tr>
<tr>
<td>diamine</td>
<td>Acrylic monomer</td>
</tr>
<tr>
<td>Photographic color developers</td>
<td>Phenolic resins</td>
</tr>
<tr>
<td>Disperse textile dyes</td>
<td>Amine catalysts</td>
</tr>
<tr>
<td>Thimerosal</td>
<td>Biocides</td>
</tr>
<tr>
<td></td>
<td>Formaldehyde</td>
</tr>
<tr>
<td></td>
<td>Kathon CG</td>
</tr>
</tbody>
</table>
Contact dermatitis, acute
Contact dermatitis, subacute
Contact Dermatitis, Chronic
Occupational acne.
Acute, oil folliculitis
Oil Folliculitis
Chronic, Chloracne
### Phototoxic

- Coal-tar derivative
- Dyes (Eosin)
- Drug
  - phenothiazines
  - sulfonamides
- Plants and derivative
  - psoralen
  - lemon
  - lime

### Photoallergic

- Antifungal agents
- Fragrances
- Halogenated salicylanilide
- Phenothiazines
- Sunscreens
- Whiteners
- Agricultural
Phototoxic reaction to lime juice
Phytophotodermatitis
Allergic plant dermatitis
Absolute Irritant, Buttocks
Solvent, poor work practice
Ethylene oxide dermatitis
Solvent, nummular eczema
Chrome hole, nasal
Chromate dermatitis
Nickel from keys held in trouser pockets
Cutting fluids
Cutting fluids, eczematous
Skin – Allergens

ALLERGY MECHANISMS

Hapten + Tissue Protein = Complete Antigen → Sensitized T-lymphocytes
Skin – Allergens

MAJOR ALLERGENS

- Epoxy Resins
- Rhus Genus of Plants
- Chromates
- Nickel
- Rubber Chemicals
Polyester
Chemical accelerators in rubber
Poison Ivy
Plant dermatitis is common among landcapers, nurserymen and forestry workers.
Airborne allergen
Chrysanthemum
Elastic dermatitis (allergy to bleached rubber)
Contact allergy to computer keyboard wrist rests
Ultraviolet cured processes
Photosensitivity
Contact urticaria - raw fish
Tar and sunlight hyperpigmentation
Stained hands of a foundry worker
# Causes of Occupational Dermatoses

## MECHANICAL

<table>
<thead>
<tr>
<th>FRICTION</th>
<th>PRESSURE</th>
<th>OTHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calluses</td>
<td>Bullae</td>
<td>Wounds</td>
</tr>
<tr>
<td>Blisters</td>
<td>Atrophy</td>
<td>Koebner</td>
</tr>
<tr>
<td>Abrasions</td>
<td>Necrosis</td>
<td>Phenomenon</td>
</tr>
<tr>
<td>Lichenification</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Painful white fingers
Causes of Occupational Dermatoses

<table>
<thead>
<tr>
<th>PHYSICAL AGENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HEAT</strong></td>
</tr>
<tr>
<td>Burns</td>
</tr>
<tr>
<td>Hyperhidrosis</td>
</tr>
<tr>
<td>Erythema</td>
</tr>
<tr>
<td>Telangiectasia</td>
</tr>
<tr>
<td><strong>COLD</strong></td>
</tr>
<tr>
<td>Raynaud's Disease</td>
</tr>
<tr>
<td>Trench Foot</td>
</tr>
<tr>
<td>Frostbite</td>
</tr>
<tr>
<td><strong>RADIATION</strong></td>
</tr>
<tr>
<td>Keratoses</td>
</tr>
<tr>
<td>Sunburn</td>
</tr>
<tr>
<td>Radiodermatitis</td>
</tr>
<tr>
<td>Photosensitivities</td>
</tr>
<tr>
<td>Cancers</td>
</tr>
</tbody>
</table>
Hot water burn
Sunburn
Malignant lesions:

1. Basal cell carcinoma
2. Squamous cell carcinoma
3. Malignant melanoma

(2) and (3) related to work exposure – roof tilers and bricklayers

(1) related to site of welding burns

Pre-malignant lesions:

- Actinic (solar) keratoses
- Tar keratoses (‘warts’)
- Arsenical keratoses
- Keratoacanthoma
- Intra-epidermal carcinoma (Bowen’s disease)
- Lentigo maligna
Squamous cell epithelioma
# Causes of Occupational Dermatoses

## Biological Agents

<table>
<thead>
<tr>
<th>Plants</th>
<th>Insects</th>
<th>Animals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viruses</td>
<td>Bacteria</td>
<td>Fungi</td>
</tr>
<tr>
<td>Rickettsia</td>
<td>Protozoa</td>
<td></td>
</tr>
</tbody>
</table>

**Microbiological**
Some infections may be transmitted from animals to man in workplaces.

Contact with infected/infested humans may result in infections such as impetigo and tinea corporis /ringworm and infestations such as scabies and head lice.

Dermatophyte infections from horses, pigs, cattle (e.g., anthrax), cats and dogs.

Bacterial infections such as erysipeloid come from fish and contaminated waterways.
Sporotrichosis
Herpetic fingers
Milker's nodule
Orf, a viral dermatosis
Tick bite

Tick bite reaction
Nail disorder, traumatic
Wet work, nails
PREDISPOSING FACTORS

Race
Sex
Age
Skin Type

Other Skin Problems
Allergies
Cleanliness
Season
Acne prone
Poor hygiene
Copper smelter
Axillary intertrigo
Epoxy resin mixing, poor work practice
NBC Warfare Agent (Lewisite?)
Rhus dermatitis
## Predisposing Factors for Occupational Dermatitis

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Younger workers are often inexperienced or careless and are more likely to develop occupational dermatitis than older workers.</td>
</tr>
<tr>
<td>Skin type</td>
<td>Orientals and Blacks are generally more resistant to irritation than Whites.</td>
</tr>
<tr>
<td>Pre-existing disease</td>
<td>Atopy predisposes to irritant contact dermatitis. Psoriasis or lichen planus may worsen due of the Koebner phenomenon.</td>
</tr>
<tr>
<td>Temperature and humidity</td>
<td>High humidity reduces the effectiveness of the epidermal barrier. Low humidity and cold cause chapping/desiccation of the epidermis.</td>
</tr>
<tr>
<td>Working conditions</td>
<td>A dirty worksite is more often contaminated with toxic or allergenic chemicals. Obsolete equipment and lack of protective measures increase the risk of occupational dermatitis. Repetitive movements and friction may cause irritation and calluses.</td>
</tr>
</tbody>
</table>
Complete Work History
Skin – Patch Test

- Microscopic scrapings of skin to detect yeasts, fungi, parasites and fibrous glass
- Cultures
- Patch tests to detect contact allergy
- Skin biopsy
A drop of allergen placed on top of skin

Skin broken with lancet

Positive control histamine

Negative control vehicle

Positive reaction: at least 3 mm and histamine size

Overall negative: antihistamine

Overall positive: dermografismus
- **Strong positive reaction**
  
  (+++)

  - Erythema
  - Infiltration
  - Papules
  - Discrete vesicles

- **Extreme positive reaction**
  
  (++++)

  - Coalescing vesicles/bullous reaction
- Doubtful reaction (?)
  
  Faint macular or homogeneous Erythema, no infiltration

- Weak positive reaction (+)
  
  Erythema
  Infiltration
  Discrete papules
Walk-through survey
ENGINEERING CONTROLS

PERSONAL PROTECTIVE MEASURES

GOOD WORK PRACTICES

ADMINISTRATIVE CONTROLS

Materials Selection
Closed Systems
Ventilation

Protective Gear
Cleanliness
Barrier Agents

Materials Handling
Good Housekeeping

Pre-placement Exam
Monitoring
Job Rotation
Hand Washing
Personal protective equipment (PPE), gloves, apron, boots, splash goggles
## Occupations at High-Risk for Dermatitis

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Irritants</th>
<th>Sensitizers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction workers</td>
<td>Turpentine, thinner, fibreglass, glues</td>
<td>Chromates, epoxy and phenolic resins, colophony, turpentine, woods</td>
</tr>
<tr>
<td>Dental technicians</td>
<td>Detergents, disinfectants</td>
<td>Rubber, epoxy and acrylic monomer, amine catalysts, local anaesthetics, mercury, gold, nickel, eugenol, formaldehyde, glutaraldehyde</td>
</tr>
<tr>
<td>Farmers, florists, gardeners</td>
<td>Fertilizers, disinfectants, soaps and detergents</td>
<td>Plants, woods, fungicides, insecticides</td>
</tr>
<tr>
<td>Food handlers, cooks, bakers</td>
<td>Soaps, detergents, vinegar, fruits, vegetables</td>
<td>Vegetables, spices, garlic, rubber, benzoyl peroxide</td>
</tr>
<tr>
<td>Hairdressers, Beauticians</td>
<td>Shampoos, bleach, peroxide, permanent wave, acetone</td>
<td>Paraphenylenediamine in hair dye, glycercylmonothioglycolate in permanents, ammonium persulphate in bleach, surfactants in shampoos, nickel, perfume, essential oils, preservatives in cosmetics</td>
</tr>
</tbody>
</table>
## Occupations at High-Risk for Dermatitis

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Irritants</th>
<th>Sensitizers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical personnel</td>
<td>Disinfectants, alcohol, soaps and detergents</td>
<td>Rubber, colophony, formaldehyde, glutaraldehyde, disinfectants, antibiotics, local anaesthetics, pheno-thiazines, benzodiazepines</td>
</tr>
<tr>
<td>Metal workers, machinists and mechanics</td>
<td>Soaps and detergents, cutting oils, petroleum distillates, abrasives</td>
<td>Nickel, cobalt, chrome, biocides in cutting oils, hydrazine and colophony in welding flux, epoxy resins, amine catalysts, rubber</td>
</tr>
<tr>
<td>Printers and photographers</td>
<td>Solvents, acetic acid, ink, acrylic monomer</td>
<td>Nickel, cobalt, chrome, rubber, colophony, formaldehyde, paraphenylenediamine/azo dyes, hydroquinone, epoxy/acrylic monomer, amine catalysts, B&amp;W and color developers</td>
</tr>
<tr>
<td>Textile workers</td>
<td>Solvents, bleaches, natural/synthetic fibers</td>
<td>Formaldehyde resins, azo- and anthraquinone dyes, rubber, biocides</td>
</tr>
<tr>
<td>Medical Personnel</td>
<td>Disinfectants, alcohol, soaps and detergents</td>
<td>Rubber, colophony, formaldehyde, glutaraldehyde, disinfectants, antibiotics, local anaesthetics, pheno-thiazines, benzodiazepines</td>
</tr>
</tbody>
</table>

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Sources of Information

• **Occupational Dermatitis** – EczemaNet, American Academy of Dermatology

• **Occupational Skin Disease** – National Skin Centre, Singapore

• **Skin at work** – Health and Safety Executive, UK

• **Dermatitis, Allergic Contact** – Canadian Centre for Occupational Health and Safety

• **Occupational Dermatitis – Frequently Asked Questions** – Health and Safety Authority, Ireland

• **Skin Exposures and Effects** – CDC, USA

• **Occupational Dermatology Research and Education Centre** – Skin and Cancer Foundation, Victoria, Australia

• **Occupational contact Dermatitis in Australia** PDF file

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Conclusion