June 5 - 8
Toronto, Canada
OEESC 2011
5th International Conference on
Occupational and Environmental Exposure of Skin to Chemicals
www.oeeesc.org

Sponsored by:

UNIVERSITY OF TORONTO
DALLA LANA SCHOOL OF PUBLIC HEALTH

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Nearly a decade has passed since the inaugural OEESC took place in 2002 in Washington, DC. Significant progress has been made with regards to knowledge and awareness of dermal exposure and diseases. The OEESC’s with their multidisciplinary approach and plenary sessions have contributed substantially to knowledge exchange between researchers and practitioners around the world. Although many of these themes will look familiar, for each of the plenary sessions, the goal is to have keynote speakers summarize advancements achieved during the decade of progress and provide their vision for the decade of promise where the ultimate goal is delivering the science (i.e., knowledge exchange) in a form the practitioner can readily implement.
Acknowledgements

WE GRATEFULLY ACKNOWLEDGE OUR SUPPORTERS

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CIHR IRSC
Canadian Institutes of Health Research
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AIHA
Protecting Worker Health

Creod
Centre for Research Expertise in Occupational Disease

CDC
Workplace Safety and Health

NIOSH

UNIVERSITY OF TORONTO
DALLA LANA SCHOOL OF PUBLIC HEALTH

UNIVERSITY OF TORONTO
FACULTY OF MEDICINE
Accreditation

This course is sponsored by the Office of Continuing Education and Professional Development, Faculty of Medicine, University of Toronto.

The Royal College of Physicians and Surgeons of Canada
This event is an Accredited Group Learning Activity (Section 1) as defined by the Maintenance of Certification program of the Royal College of Physicians and Surgeons of Canada, approved by the University of Toronto for up to 19 Section 1 credits.

American Medical Association
The Office of Continuing Education and Professional Development, Faculty of Medicine, University of Toronto designates this educational activity for a maximum of 19 Category 1 credits toward the AMA Physician’s Recognition Award. Each physician should claim only those credits the he/she actually spent in the activity.

European Accreditation Council for Continuing Medical Education (EACCME)
As a result of a reciprocal agreement between the EACCME and the AMA, European registrants may claim AMA Category 1 credits as equivalent.

The Canadian Registration Board of Occupational Hygienists (CRBOH) has awarded 1.0 maintenance point for each full day attendance, 0.5 maintenance points for each half-day attendance. Maximum of 3.5 maintenance points (RM approval number: 2011-73). Upon proof of attendance.

The American Board of Industrial Hygiene (ABIH) has awarded 1.0 maintenance point for each full day attendance, 0.5 maintenance points for each half-day attendance. Maximum of 3.5 maintenance points (CM approval number: 11-843). Upon proof of attendance.

Letters of Accreditation or Attendance

Letters of accreditation/attendance will be available online following the course. Participants will be emailed information within two weeks specifying how to obtain their letter of accreditation/attendance online.

Disclosure

Speakers will be requested to disclose to the audience any real or apparent conflict(s) of interest that may have a direct bearing on the subject matter of this program.

For Information

Office of Continuing Education and Professional Development
Faculty of Medicine, University of Toronto
500 University Avenue, Suite 650, Toronto, Ontario M5G 1V7
Tel: 416.978.2719 / Toll Free: 1.888.512.8173
E-mail: info.cepd@utoronto.ca
Website: www.cepd.utoronto.ca
<table>
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<tr>
<th>Time</th>
<th>Sunday, June 5, 2011</th>
<th>Monday, June 6, 2011</th>
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<tr>
<td>08:00</td>
<td>Registration</td>
<td>Plenary Session 2: From the Outside In: Penetration, Uptake and Metabolism of Skin Exposures and Their Modifying Factors</td>
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<td>08:30</td>
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<td>08:30 Keynote 3&lt;br&gt;Ian Kimber</td>
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<td>08:30</td>
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<td>09:00 Keynote 4&lt;br&gt;Simon Wilkinson</td>
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<td>09:00</td>
<td>Clinical Workshop</td>
<td>09:30 Keynote 5&lt;br&gt;Sanja Kezic</td>
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<td>09:30</td>
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<td>Morning Break and Poster Viewing&lt;br&gt;&lt;em&gt;Alumni Hall and Foyer, Victoria College&lt;/em&gt;</td>
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<td>10:30</td>
<td>Break</td>
<td>Abstract Driven Parallel Sessions</td>
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<tr>
<td>11:00</td>
<td>Clinical Workshop, continued</td>
<td>Parallel Session #1: Exposure Models</td>
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<tr>
<td>11:30</td>
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<td>Parallel Session #2: Exposure Uptake</td>
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<td>12:00</td>
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<tr>
<td>13:00</td>
<td>Welcome</td>
<td>Plenary Session 3: Exposure Assessment: Models, Measurements and Monitoring</td>
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<td>13:30</td>
<td>Plenary Session 1: Defining the Problem, Health Effects,</td>
<td>13:00 Keynote 6&lt;br&gt;John Cherrie</td>
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<td>Burden of Disease, Causation &amp; Outcomes</td>
<td>13:30 Keynote 7&lt;br&gt;Dhimiter Bello</td>
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<td>14:00</td>
<td>Keynote 1&lt;br&gt;Thomas Diepgen</td>
<td>14:00 Keynote 8&lt;br&gt;Adam Wisnewski</td>
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<td>14:15</td>
<td>Keynote 2&lt;br&gt;Tove Agner</td>
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<td>Afternoon Break and Poster Viewing&lt;br&gt;&lt;em&gt;Alumni Hall&lt;/em&gt; and Foyer, &lt;em&gt;Victoria College&lt;/em&gt;</td>
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<td>17:30</td>
<td>Welcome Reception - to 19:00&lt;br&gt;&lt;em&gt;Koerner Hall, The Royal Conservatory of Music&lt;/em&gt;&lt;br&gt;273 Bloor Street West, Toronto</td>
<td>Conference Dinner - to 21:30&lt;br&gt;Great Hall, Hart House&lt;br&gt;University of Toronto Campus</td>
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### Program at a Glance

#### Tuesday, June 7, 2011

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<td>Plenary Session 4: Prevention of Occupational Skin</td>
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<td>Diseases - Workplace Focus</td>
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<td>08:45</td>
<td>Keynote 9</td>
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<td>Diane Llewellyn</td>
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<td>Keynote 10</td>
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<td>Linn Holness</td>
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<td>Facilitated Interactive Discussion</td>
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<td>Parallel Session #1: Prevention in the Person</td>
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<td>Parallel Session #2: Prevention in the Population</td>
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<td>12:00</td>
<td>Lunch - Victoria College Quadrangle</td>
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<td>Plenary Session 5: Prevention of Occupational &amp;</td>
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<td>Environmental Skin Disease: Regulatory &amp; Societal Focus</td>
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<td>The North American Perspective</td>
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<td>16:15 OEESC 2013 Planning Meeting</td>
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<td>Cancer</td>
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<td>Chairs: Rosemary Nixon, Paul Demers</td>
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<td>Lung/Skin Interactions</td>
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<td>Chairs: Victoria Arrandale, John Cherrie</td>
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<td>Risk Assessment/Management</td>
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<td>Chair: Chris Packham</td>
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**SUNDAY, JUNE 5th 2011**

08:00  **Registration**  Foyer, Victoria College, University of Toronto

09:00 to 10:30  **Clinical Workshop**  Northrop Frye Hall, Room 003
   Rosemary Nixon, Melanie Pratt, Swen John
   To include: diagnosis, patch testing, management, interesting cases
   Diagnosis of Occupational Contact Dermatitis  Rosemary Nixon (Australia)
   Interesting Cases from the Ottawa Hospital Patch Test Clinic  Melanie Pratt (Canada)
   Prevention of Occupational Skin Disease in a Clinical and International Context  Swen John (Germany)

10:30 to 11:00  **Break**  Alumni Hall, Old Victoria College

11:00 to 12:00  **Clinical Workshop, continued**  Northrop Frye Hall, Room 003
   **Oral Abstract Presentations:**
   (10 min presentations with 2-5 minutes for questions)
   3812 Variation in Allergen Content Over Time of Acrylates/Methacrylates in Patch Test Preparations
   3837 Combined – New Abstract the Impact of a Multidisciplinary Team and a Dedicated Return to Work Co-Ordinator for Workers with Work-Related Skin Disease
   3851 An Integrated Inpatient/Outpatient Rehabilitation Program - The German Approach
   3859 Patient Safety Tools Including Check Lists in Occupational Medicine and Dermatology

12:00 to 13:00  **Lunch**  (not provided)

13:00 to 13:30  **Welcome**  Northrop Frye Hall, Room 003
   Conference Co-Chairs: Linn Holness and Irena Kudla
   **Oral Abstract Presentation:**
   3843 Knowledge Translation of Research in Occupational Skin Disease - The Creod Experience

**Plenary Session 1:**  **Defining the Problem, Health Effects.**  Northrop Frye Hall, Room 003
   **Burden of Disease, Causation & Outcomes**
   The goal of the keynote(s) for this session will be to summarize the current state-of-the art with respect to burden of disease, causation and outcomes. Future expectations/challenges will be presented.
   **Chair:** Melanie Pratt (Canada)

13:30 to 14:15  **Keynote 1**  Thomas Diepgen (Germany)
   **Defining the Problem: Causation, Burden of Disease**
   (35 minutes presentation, 10 minutes interactive discussion)

14:15 to 14:45  **Keynote 2**  Tove Agner (Denmark)
   **Defining the Problem: Causation, Burden of Disease**
   (20 minutes presentation, 10 minutes interactive discussion)
Program

SUNDAY, JUNE 5th 2011

14:45 to 15:15pm  Break for Coffee/Poster Viewing (Clinical Theme)  Alumni Hall & Foyer, Victoria College

Poster Abstract Presentations:
3805  To Investigate Some Manifestation of Allergic Reaction in People Exposed to Chemical
3712  Skin Morbidity Among Construction Site Workers
3831  Study on Working Conditions and Epidemiology of Urticaria in Workers Producing and Preliminarily Treating Rubber Latex
3854  Housekeeping Worker - Case Study

15:15 to 16:45  Abstract Driven Session (Platform Presentations)  Northrop Frye Hall, Room 003

Chair – James Taylor (USA)

Oral Abstract Presentations:
(10 min presentations with 2-5 minutes for questions)
3696  Skin and Mucous Membrane Complaints Related to Indoor Climate Problems
3822  Exposure to Wet-Work in Australian Workplaces
3826  Recognizing Risk Factors for Persistent Post-Occupational Dermatitis
3858  Estimating Occupational Exposure to Skin Carcinogens in Canada
3863  Inventory of the Chemicals and the Exposure of the Workers Skin to These at Two Leather Factories In Indonesia
3897  Hand Eczema in Danish Hairdressers

17:30 to 19:00  Welcome Reception
Royal Conservatory of Music
273 Bloor Street West, Toronto, ON

MONDAY, JUNE 6th 2011

Plenary Session 2:  From the Outside In: Penetration, Uptake and Metabolism of Skin Exposures and Their Modifying Factors  Northrop Frye Hall, Room 003

The goal of the keynote(s) for this session will be to summarize the state of knowledge (“best practice”) on how chemicals penetrate the dermal barrier, how chemicals are metabolized, how these mechanisms result in disease and the factors that modify these processes. Future expectations/challenges will be presented.

Chair: Fred Frasch (USA)

08:30 to 09:00  Keynote 3  Ian Kimber (United Kingdom)
Mechanisms of Chemical Effect in the Skin
20 minutes presentation, 10 minutes interactive discussion

09:00 to 09:30  Keynote 4  Simon Wilkinson (United Kingdom)
Permeation of Chemicals Through the Skin
20 minutes presentation, 10 minutes interactive discussion

09:30 to 10:00  Keynote 5  Sanja Kezic (The Netherlands)
Factors Modifying the Uptake of Chemicals Through the Skin
20 minutes presentation, 10 minutes interactive discussion
MONDAY, JUNE 6th 2011
10:00 to 10:45  Morning Break/Poster Viewing  Alumni Hall & Foyer, Victoria College

Poster Abstract Presentations:

3329  Evolution of Concentrated (50%) Sodium Hydroxide Burns on Human Skin Explants Ex Vivo
3802  A Novel Skin Washing ‘By Difference’ Method for Predicting Dermal Absorption
3813  Dermal Exposure and Skin Condition of Workers Co-Exposed to Cobalt and Nickel at a South African Base Metal Refinery
3845  Integration of Bio-Monitoring and Dermal Exposure Assessment
3852  Dermal Absorption of Benzene in Occupational Settings: Estimating Flux and Applications for Risk Assessment
3289  Hazard Identification and Risk Assessment in a Manufacturing Industry in the Philippines: A Continuing Study
3722  In Vitro Percutaneous Penetration of Polycyclic Aromatic Hydrocarbons from Sunscreen Creams
3742  Episkin Reconstructed Human Skin Model: A Pertinent Screening Tool to Measure Permeability Coefficient
3744  In-Vitro Dermal Absorption of 1-Bromopropane
3764  Skin Barrier Function Alteration Induced by Noise Stress and Organic Solvent Among Aircraft Maintenance Workers
3806  Determining Dermal Absorption of Nanoparticles Using a Novel In Vitro Flexing Skin Model (Cutaflextm)
3815  The Skin Penetration of Organophosphorous Compounds is Highly Dependent on Agent Concentration and Hydrophilic Properties
3817  A Biomarker for Skin Exposure to Isocyanate
3820  Surface to Skin Transferof Isocyanates in Automotive Refinishing.
3823  Investigation of Chemical Uptake at Low Loads on Skin
3825  Assessment of Indoor Dermal Exposure to Svocs
3840  The Role of Donor Surface Distribution in Finite Dose Skin Absorption Experiments
3846  Characterizing Dermal Exposures to Chemicals Within Emergency and Workplace Settings
3856  Exposure-Response Relationships for Skin Symptoms Among Bakery and Isocyanate-Exposed Workers
3902  Exposure Assessment Tool for Early Diagnosis of Occupational Eczema
3910  Tape Stripping For Aliphatic Polyisocyanates: A Laboratory Investigation Examines Recovery
MONDAY, JUNE 6th 2011

10:45 to 12:00  Abstract Driven Parallel Sessions

**Parallel Session #1**  
**Exposure Models**  
Chair: Frank Jungbauer (The Netherlands)  
Victoria College, Room 115  
(10 min presentations with 2-5 minutes for questions)

3704 Upercit: A Web-Based Tool to Aid the Identification of Chemicals Potentially Posing a Health Risk Through Percutaneous Exposure
3713 A New Database of Dermal Contact Transfer Factors
3739 How To Use DPK Parameters to Improve Cutaneous Absorption Knowledge for Cosmetic Ingredients?
3768 IH-Skinperm An Advanced Skin Absorption Model
3818 Mathematical Modeling of Transdermal Penetration After Finite Dosing

**Parallel Session #2**  
**Exposure Uptake**  
Chair: Francesca Larese Filon (Italy)  
Victoria College, Room 215  
(10 min presentations with 2-5 minutes for questions)

3725 Metal Nanoparticles Skin Absorption
3745 Skin Permeability from Different Vehicles: Maximum Steady-State Flux
3810 Factors Affecting Particle Adherence to Bare Skin and Sampling Substrates
3834 Penetration Patterns of Monomeric and Polymeric 16-Hexamethylene Diisocyanate in Human Skin
3857 Single Nucleotide Polymorphisms Associated with Skin Naphthyl-Keratin Adduct Levels Among Jet Fuel Exposed Workers

12:00 to 13:00  Lunch  
Victoria College, Alumni Hall

**Plenary Session 3**  
**Exposure Assessment: Models, Measurements and Monitoring**  
Northrop Frye Hall, Room 003

The goal of the keynote(s) for this session will be to summarize the state of knowledge on methods for assessing dermal exposure (questionnaires, measurement, biomonitoring, prediction models). Including, the validation of new approaches and the development of scenario-based modeling techniques.

Chair: Aleks Stefaniak (USA)

13:00 to 13:30  
Keynote 6  
**Dermal Exposure Assessment: Progress & Pitfalls**  
20 minutes presentation, 10 minutes interactive discussion  
John Cherrie (United Kingdom)

13:30 to 14:00  
Keynote 7  
**Models for Predicting Dermal Exposure: Development, Validation and Application**  
20 minutes presentation, 10 minutes interactive discussion  
Dhimiter Bello (United States)

14:00 to 14:30  
Keynote 8  
**Biomonitoring: Promising Targets for Measurement in Populations and Individuals**  
20 minutes presentation, 10 minutes interactive discussion  
Adam Wisnewski (United States)

14:30 to 15:45  
**Afternoon Break/Poster Viewing**  
Alumni Hall & Foyer, Victoria College
MONDAY, JUNE 6th 2011

15:45 to 16:30  Abstract Driven Parallel Sessions

Parallel Session #1  Chair: Greg Day (USA)  Victoria College, Room 115
Exposure Sampling  (8 min presentations with 2 minutes for questions)

3816 Dermal and Respiratory Exposure to Cobalt Salts in a Packaging Area at a Base Metal Refinery
3821 Evaluation of a Newly Developed Wet-Work Sampler for Quantification of Wet-Work Exposure in Nurses: Final Results
3833 Measurement of Dermal Exposure to Diisocyanates and Exposure Control Measures in Different Work Environments Within the Swedish Motor Trade
3909 Dermal Absorption of Products of Combustion Encountered During Firefighter Training Exercises

Parallel Session #2  Chair: Victoria Arrandale (Canada)  Victoria College, Room 215
Methods for Exposure Assessment  (8 min presentations with 2 minutes for questions)

3811 Use Of Artificial Sweat as an Extraction Solvent for Quantification of Biologically Meaningful Exposure to Chromium
3824 Simulation of Removal of Chemicals from Skin by Washing
3830 A Review and Evaluation of Dermal Exposure Data in the Context of Dermal Exposure Modeling

18:00 to 21:00  Conference Dinner
Great Hall, Hart House
University of Toronto Campus
Nethercott Lecture: Dr. Howard Maibach

TUESDAY, JUNE 7th 2011

Plenary Session 4  Prevention of Occupational Skin Disease: Workplace Focus  Northrop Frye Hall, Room 003
The goal of this session will be to summarize the current state of knowledge (best practice) for the prevention of work-related skin disease at the workplace, governmental and societal levels. Future expectations/challenges will be addressed.
Chair: Dhimiter Bello (USA)

08:30 to 08:45  Plenary Welcome

08:45 to 09:30  Keynote 9  Diane Llewellyn (United Kingdom)
Prevention – Workplace Focus
(40 minute presentation, 5 minutes interactive discussion)

09:30 to 10:00  Keynote 10  Linn Holness (Canada)
Evaluating Proposed Interventions
(25 minute presentation, 5 minutes interactive discussion)

10:00 to 10:30  Facilitated Interactive Discussion
TUESDAY, JUNE 7th 2011

10:30 to 11:00

Morning Break & Poster Viewing

Alumni Hall & Foyer, Victoria College

Poster Abstract Presentations:

3838 Workplace Characteristics and Prevention Activities of Workers Being Assessed for Possible Work-Related Skin Disease

3848 A Decade of Progress for Research But What About the Shop Floor Experience - An Ontario Snapshot

3724 Prevention of Skin Exposure to Metal Working Fluid in Tool Manufacturing Plant: An Intervention Approach

3726 Standard Limits for Surface Contamination an Important Tool to Reduce Workers Exposure: The Example of Beryllium

3801 Two Recurrent Cases of Occupational Contact Dermatitis in a Cook and a Vegetable Handler after Changing Their Jobs in Japan -How to Improve Pre-Employment Counseling?

3814 Permeation of a Hair Dye Compound Through Nitrile Rubber Gloves Used by Hairdressers and the Influence of Hydrogen Peroxide

3839 Screening for Hand Dermatitis in Health Care Workers

3853 Assessing Effectiveness of Dermal Exposure Control Work Practices in the Castable Polyurethane Industry

11:00 to 12:00

Abstract Driven Parallel Sessions

Parallel Session #1
Prevention in the Person

Chair – Irena Kudla (Canada)
Victoria College, Room 115
(8 min presentations with 2 minutes for questions)

3353 Diphoterine(R) for Sodium Hydroxide (Naoh) Skin Splash Decontamination: In Vitro and Experimental Animal Studies

3804 Predictors of Dermal Exposures to Polycyclic Aromatic Compounds Among Asphalt Paving Workers

3850 The Distance Between Theory and Practice - Glove Use and Education in the Workplace

3855 Skin and Respiratory Exposure Prevention in a Clinical Population with Suspected Work-Related Disease

Parallel Session #2
Prevention in the Population

Chair: Swen John (Germany)
Victoria College, Room 215
(8 min presentations with 2 minutes for questions)

3827 Strategies for Assessing and Managing Dermal Exposures Under the EU Reach Regulation

3828 Teledermatology in Occupational Skin Health Surveillance - Diagnostic Accuracy and Reliability

3841 Evaluation of the Awareness of Latex Allergy And the Appropriate Use of Gloves Among Healthcare Workers

3844 Raising Awareness for Dermatitis in the Service Sector: Slow Steps to Prevention

3849 Reduction of Occupational Skin Exposure to Hazards: First Voluntary Agreement by European Social Partners in a High Risk Profession (Hairdressing)
TUESDAY, JUNE 7th 2011

12:00 to 13:00  Lunch & Poster Viewing  Foyer & Quadrangle, Victoria College

Plenary Session 5  Prevention of Occupational & Environmental Skin Disease: Northrop Frye Hall, Room 003
Regulatory & Societal Focus

The goal of this session will be to summarize the current state of knowledge for the prevention of occupational and environmental skin disease at the governmental and societal levels. Various jurisdictions will present their perspectives. Future expectations/challenges will be addressed.

Chair: Irena Kudla (Canada)

13:00 to 13:15  The North American Perspective  Scott Dotson (USA)
10 minute presentation, 5 minutes interactive discussion

13:15 to 13:30  The European Union Perspective  Swen John (Germany)
10 minute presentation, 5 minutes interactive discussion

13:30 to 13:45  The Australian Perspective  Rosemary Nixon (Australia)
10 minute presentation, 5 minutes interactive discussion

13:45 to 14:15  International Perspectives
South Africa & Japan (other jurisdictions will be asked to comment)

14:15 to 14:45  Facilitated Interactive Discussion

14:45 to 15:15  Afternoon Break & Poster Viewing

Plenary Session 6  General Discussion: Fulfilling the Decade of Promise  Northrop Frye Hall - 003

15:15 to 16:15  Facilitated interactive discussion with participation of keynote speakers and the Co-Chairs of previous OEESC meetings.

WEDNESDAY, JUNE 8th 2011

08:30 to 10:30  Workshops

Cancer  Victoria College, Room 115

Discussion of the role of occupational and environmental skin exposure in the etiology of cancer. Skin as a “sink” for carcinogens in the workplace

Chairs: Rosemary Nixon, Paul Demers

Lung/Skin Interactions  Northrop Frye Hall, Room 003

Discussion of how skin exposure may play a role in the development of asthma, including the host and environmental factors that modify these processes.

Chairs: Victoria Arrandale, John Cherrie

Risk assessment/Management  Victoria College, Room 215

Interactive workshop with “situational” examples where participants will be asked to assess risk of damage to health due to actual or potential skin exposure or decide how to manage the exposure with emphasis on technical/engineering/process controls rather than PPE.

Chair: Chris Packham
WEDNESDAY, JUNE 8th 2011

10:30 to 11:00  Break for Coffee  Alumni Hall, Victoria College
11:00 to 11:15  Summary of Cancer Workshop  Northrop Frye Hall, Room 003
11:15 to 11:30  Summary of Lung/Skin Interactions Workshop  Northrop Frye Hall, Room 003
11:30 to 11:45  Summary of Risk Assessment/Management Workshop  Northrop Frye Hall, Room 003
11:45 to 12:00  Closing Remarks  Northrop Frye Hall, Room 003
12:00 to 13:00  Light Lunch
Abstracts
Hazard identification and risk assessment in a manufacturing industry in the Philippines: A continuing study

JL Lu, National Institutes of Health, University of Philippines, Manila, YC Lu, Sophia Mineral Services

Background: This study was conducted in a manufacturing industry in the Philippines that uses toxic chemicals such as trichloroethylene, sulfuric acid, ethylene chloride, acetone and alcohols. The industry employs about a thousand workers, and the recent medical record shows an increasing number of workers having eye and skin irritation.

Methods: Baseline data was done for the work processes for ventilation and chemical concentration measurements. Sampling motor pumps, charcoal tubes, detector tubes, and ventilation measurement instruments were used.

Results: Baseline measurement showed that ventilation measurements for all work areas were 0 ft/min. Chemical readings showed the following:

<table>
<thead>
<tr>
<th>Work Area</th>
<th>Sodium Hydroxide (mg/m3)</th>
<th>Trichloroethylene (mg/m3)</th>
<th>Isopropyl Alcohol (mg/m3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area A (Exhaust Area)</td>
<td>9.96</td>
<td>1.58</td>
<td>0.96</td>
</tr>
<tr>
<td>Area B (Exhaust)</td>
<td>6.39</td>
<td>Below 1</td>
<td>163.5</td>
</tr>
<tr>
<td>Area C (Supply)</td>
<td>15.89</td>
<td>0.27</td>
<td>0.27</td>
</tr>
</tbody>
</table>

Based on the results, the capture velocities were negligible and thus the ducting system was not effective. The air velocity in the measurement was far below this recommended capacity.

Some solvents exceeded the threshold limit value. Researches show that these chemicals can cause eye and skin irritation at work. Recommendations included: 1) Lowering concentration of chemicals used in the workplace or substituting them with less toxic ones; 2) installing additional round duct be extended to where the worker is performing work for better exhaust ventilation; 3) putting enclosures in these work area using toxic chemicals, and if not feasible, use non-corrosive plastic curtain to enclose the work area so that contamination will not extend to other areas; 4), the slot velocity should be a minimum of 2000 fpm as recommended by OSHA and OHSC; and 5) the exhaust discharge must terminate out-of-doors, preferably using a vertical discharge cap that extends well above the roof eddy zone.

Conclusions: Hazard identification is the fist step to risk assessment. The study showed that control measures such as ventilation system and chemical reduction strategies can be done with regard to work process and ventilation system design so as to prevent exposure to solvents that can have adverse dermatologic effects.

Evolution of concentrated (50%) sodium hydroxide burns on human skin explants ex vivo

Laurence Mathieu (Prevor Laboratory), Francois Burgher (Prevor Laboratory), Elian Lati (BIO-EC Laboratory), L Peno-Mazzarino (BIO-EC Laboratory), D Bouzard (BIO-EC Laboratory), Alan Hall (TCMTS, Inc. and Colorado School of Public Health), Howard Maibach (University of California-San Francisco)

Background and Purpose/Objectives: This study investigated evolution of concentration (50%) NaOH burns in human skin explants ex vivo using histological observations.

Methodology: With informed consent, human skin explants were obtained from an abdominoplasty patient. Untreated controls were sampled at T0, 24 and 48 hours, and 6 and 9 days. Group B explants were exposed to 50% NaOH solution on saturated filter paper disks for 20 seconds, 1, 2, 3, 4, 5, 10, and 30 minutes, and 1, 2, 3, 4, 10, 24, and 48 hours, preserved in Bouin’s solution, dehydrated, placed in paraffin slices, and observed histologically. Group C explants were exposed for 20 seconds, placed back in culture, and sampled at 24 and 48 hours and 6 and 9 days.

Results/Impact/Outcomes: The untreated explants remained essentially unchanged. In Group B, there was early swelling and more significant keratinization of the stratum corneum. By 4 minutes, cleavages appeared in its center. By 30 minutes, there was clear destruction of the stratum corneum. By 1 hour, there was stratum corneum membrane lysis and by 2 hours, no cellular viability was apparent in the epidermis or papillary dermis. In Group C, at 24 hours the stratum corneum was swollen and there were cleavages in its center. Epidermal and papillary dermal cells remained viable.

Conclusions and Discussion: The initial lesions were alterations of the stratum corneum progressing to lysis and followed by total loss of cellular viability in the underlying skin layers. This experimental model is promising for comparative studies of skin decontamination solutions.
Diphoterine(R) for sodium hydroxide (NaOH) skin splash decontamination: In vitro and experimental animal studies

Hui-fei Wang (Department of Fire Engineering, The Chinese People’s Armed Forces Police Academy), Fan Zhang (Tianjin No. 1 Special Firefighting and Rescue Detachment), Laurence Mathieu (Prevor Laboratory), Alan Hall (TCMTS, Inc; Colorado School of Public Health)

Background and Purpose/Objectives: Diphoterine® is an amphoteric, water-soluble, sterile solution for active decontamination of chemical skin splashes. In vitro and experimental animal studies were performed to compare the decontamination efficacy of Diphoterine® versus 3% boric acid solution, or water against sodium hydroxide.

Methodology: In vitro: Diphoterine® was compared with 3% boric acid solution or water in a beaker study using 40% sodium hydroxide (NaOH). pH and temperature changes were measured. Experimental animals: 40% NaOH was applied to rabbit skin for 5 seconds and then removed. Burns were washed with Diphoterine®, 3% boric acid solution, or water. Wound pH and temperature were measured and healing was observed.

Results/Impact/Outcomes: In vitro: Diphoterine® and 3% boric acid solution returned the pH to physiological (~6.7). There was no significant heat release with Diphoterine®, while both boric acid solution and water increased temperature. Water did not return the pH to physiological. Experimental animals: Diphoterine® washing produced the best healing and did not result in significant heat release. Neither boric acid solution nor water released enough heat to potentially result in thermal burns, but healing was less good than with Diphoterine®.

Conclusions and Discussion: Of the 3 tested washing solutions, Diphoterine® was safer and more efficacious. These studies support the improved efficacy of Diphoterine® over water for initial alkali chemical skin splash decontamination.

Skin and mucous membrane complaints related to indoor climate problems

Jan Gerard Bakker (Netherlands Center for Occupational Diseases Academic Medical Center Amsterdam)

Background: Skin and mucous membrane disorders are often attributed to working conditions, sometimes resulting in epidemics/pseudoepidemics referred to as Sick Building Syndrome, Toner Disease and Multiple Chemical Sensitivity. Consequently, measures are often taken without an adequate medical and toxicological diagnosis having been carried out, in turn resulting in employee unrest, inappropriate investments and persistent health complaints.

Methodology/Investigation Model: This research model combines dermatological diagnostics with occupational hygiene and toxicology assessments of the work place resulting in individual medical diagnoses, group diagnoses and process diagnoses. It also uses a five-step plan drawn up by the Netherlands Center for Occupational Diseases in order to objectify the relationship between work and skin disorders.

Outcomes: Ten studies have been reported on by an occupational dermatologist and a clinical occupational physician. Abnormalities were often encountered in the workplace with regard to indoor climate and dust, although these did not explain the medical complaints. Often, no abnormalities were found in the climate norms deemed adequate for average employees rather than those with symptoms, usually a subpopulation of ‘sensitive’ individuals with atopic diathesis, atopic and seborrheic eczema, acne rosacea and dry skin. Medical explanations were available, however, in those cases referred to as Sick Building Syndrome, Toner Disease or Multiple Chemical Sensitivity.

Conclusions and Discussion: Work-related conditions affecting the skin (and mucous membranes) remain primarily the domain of occupational health physicians and dermatologists. The research model described here provides answers to individual health complaints, the degree to which these are work-related, and the problem on a group-wide scale, thus allowing specific measures to be taken that alleviate the health problems.
UPERCUT: A web-based tool to aid the identification of chemicals potentially posing a health risk through percutaneous exposure

Jerome Lavoue (CRCHUM / University of Montreal), Antoine Milon (Institute for work and health), David Vernez (Institute for work and health)

Few tools are available to the industrial hygienist to assess the potential of chemicals to exert toxic effect after penetrating through the skin. We developed a tool (UPERCUT) aimed at integrating several sources of information to help practitioners assess skin exposure situations. A database of 1686 substances was constructed. For each substance, UPERCUT calculates a Dermal Hazard Ratio (DHR) which estimates the ratio of the dose potentially received through the skin to the dose corresponding to full shift exposure at a reference concentration in the air. The DHR value is accompanied by a quantitative uncertainty analysis based on Monte Carlo simulation. UPERCUT also provides indices of toxic effects based on animal toxicity data, an index for dermal penetration potential, and the presence of a skin notation. UPERCUT will be available from the web at the time of the OEESC 2011 conference. UPERCUT is a hazard identification tool that answers to a need from the practicing community by presenting in a synthetic way several types of information relevant to dermal risk assessment.

Skin morbidity among construction site workers

Ashish Trivedi (SBKS Medical College and Research Institute, India)

Background: Construction workers are the second largest workforce in un-organized sector of the country. They are exposed to various hazards due to the work conditions. Occupational Dermatitis is one of the commonest hazards among construction workers, most commonly due to Cement and other materials like Paints, Resins which are used at construction sites.

Objectives: To find out skin morbidity and its relation with provision and practice of usage of Personal Protective Equipments (PPEs) among construction workers.

Methodology: A Cross Sectional Study among construction workers working at various sites of SumandeepVidyapeeth. Data was collected with the help of a Pre-designed, Pre-tested questionnaire for skin morbidity.

Results: 20.3% of workers had skin morbidity like dermatitis and itching. Only 28(12.5%) of workers were provided the PPEs at work however, only eight were using them regularly during work and it was found that prevalence of skin morbidity was less in this group compared to the group which was not using them regularly at workplace.

Conclusion: In conclusion, Skin morbidity was one of the common hazards among construction workers. Morbidity was lesser among regular PPE users at workplace.
A new database of dermal contact transfer factors
Melanie Gorman Ng (Institute of Occupational Medicine/University of Aberdeen), Martie van Tongeren (Institute of Occupational Medicine), Sean Semple (University of Aberdeen/Institute of Occupational Medicine)

Background and Purpose: The efficiencies of transfer of substances from surfaces to the skin and from hands to the mouth are important determinants of dermal and inadvertent ingestion exposure respectively. Furthermore, dermal and inadvertent ingestion exposure routes are closely linked as inadvertent ingestion arises from hand-to-mouth contact. The aim of this work was to catalogue all available data on transfer efficiency into a database to assist in the development of predictive models for both dermal and inadvertent ingestion exposure.

Methodology: A literature review was carried out to identify studies that report transfer efficiency data. These data generated a database including the source of the data, substances involved in transfer, substance characteristics, the relevant transfer scenario, surfaces involved, contact duration and pressure, number of contacts, and the calculated transfer efficiency.

Outcomes: Twenty-five studies were identified for inclusion covering a range of chemical and biological substances and a range of contact surfaces. Average transfer efficiencies were 23% (SD = 31) and 16 (SD = 6) for surface-to-hand and hand-to-mouth respectively.

Conclusions and Discussion: The database can be used to study the determinants of transfer efficiency and to estimate the transfer efficiency of any substance within a particular scenario. Estimates can be made by selecting an appropriate surrogate substance from within the database and choosing parameters to describe the contact scenario. Ideally, the database will be expanded to enable more accurate estimates for a wide range of substances and contact scenarios. We plan to make the database publicly available and to encourage others to contribute their findings.

This work is funded by the UK Health and Safety Executive.

In vitro percutaneous penetration of polycyclic aromatic hydrocarbons from sunscreen creams
Pietro Sartorelli, Roberta Liberatori, Monica Pescaglini, Loretta Montomoli, (Division of Occupational Medicine and Toxicology, University of Siena, Italy)

Background: Dermal exposure to Polycyclic Aromatic Hydrocarbons (PAHs) affects many outdoor workers such as asphalt workers. Usually the use of sunscreen creams is suggested to protect them from UV radiation. However sunscreen could prevent or facilitate dermal absorption of industrial chemicals.

Objectives of study: The aim of the study was to assess percutaneous penetration of anthracene using 2 different sunscreen creams as vehicle.

Methodology: In vitro permeation experiments were conducted with static Franz diffusion cells. Excised human skin prepared to approximately 350 μm thickness was fixed on the diffusion cells. The receiving phase was a saline solution with 6% PEG 20. The 2 sunscreen creams (one lipophilic and one idrophilic) were applied uniformly (2mg/cm2) on the skin mounted on the diffusion cell. After 20 minutes a solution of anthracene and artificial sweat was added. Analysis of anthracene in the receptor samples was carried out by beta counter analyzer (Packard).

Results: Results did not show a percutaneous penetration of anthracene from sunscreen creams while in previous studies in vitro percutaneous penetration of anthracene was demonstrated using the same methodology.

Conclusions: The use of sunscreen creams among outdoor workers, would not seem to enhance percutaneous penetration of PAHs. On the contrary it would be able to reduce dermal absorption of anthracene in the workplace.
Prevention of skin exposure to metal working fluid in a tool manufacturing plant: an intervention approach

Ali Reza Dehdashti (Semnan university of Medical Sciences-Occupational Health Dept.), Ali Khavanin (TarbiatModares University-Environmental and Occupational Health Dept.)

Background and Purpose/Objectives: Metal working fluids consist of a wide variety of chemicals used in different combinations and may contain potentially hazardous chemicals ingredients. Substantial scientific evidence indicates that occupational exposure may lead to an increased risk of skin diseases. The purpose of this action research was to develop and implement an occupational safety and health intervention to reduce skin exposure of machine operators.

Methodology: A safety and health program carried out in a metal tool manufacturing industry. Program components include worksite analysis to evaluate workers' potential skin exposure and recognition of potential hazards, safety and health training, prevention and control measures and health monitoring of the exposed workers. A questionnaire was used to collect data on occupational skin exposure and workers' complaints to evaluate the program.

Results: Worksite survey showed that metal working fluid skin contact may occur when workers handle tools, machine parts and equipment covered with fluids or may also result from fluid splashing onto the worker during machining operations. Our study showed that use of machine guarding and personal protective equipment and clothes reduced remarkably workers' exposure risk. We found that following safety and health training workers were able to detect hazardous situations and recognize safe work practices and the adverse health effect associated with metal working fluid exposure.

Conclusions and Discussion: We concluded that the employers' commitment in the development and implementation of a safety and health program is crucial. A comprehensive prevention program could prevent unnecessary occupational exposure risk resulting in a safe working condition and improve workers' productivity.

Metal nanoparticles skin absorption

Francesca Larese Filon (University of Trieste), Matteo Crosera (University of Trieste), Gianpiero Adami (University of Trieste), Giovanni Maina (University of Torino)

Background and Purpose/Objectives: The potential for metal NP (nanoparticles) to penetrate the skin lies at the centre of the debate concerning the safety for their use. There is a lack of available data demonstrating whether manufactured NP can gain access to the epidermis and derma after the skin contact. The aim of this experimental study was to evaluate nickel and cobalt NP skin permeation.

Methodology: Skin absorption was evaluated by means of the Franz diffusion cell method with human skin, intact (n. 14) and damaged (n. 14). We used nickel NP (25 nm) and cobalt NP (20-40 nm) measured by transmission electron microscopy. They were dispersed in ethanol 0.14%wt%. The receptor fluid was physiological solution and his metal content was performed by electro-thermal atomic absorption spectrometry with Zeeman background correction.

Results: The concentration of nickel in the receiving phase after 24 hours was 0.0241+/-0.013 ug cm^-2 in intact skin and 5.43+/-2.13 ug cm^-2 using damaged skin. The concentration of cobalt in the receiving phase after 24 hours was 0.0085+/-0.012 ug cm^-2 in intact skin and 1.87+/-0.86 in damaged skin. A flux of 0.076+/-0.049 ug cm^-2 and a lag time of 2.7+/-2.1 hours were calculated for cobalt in damaged skin.

Conclusions and Discussion: Data from this study shows that Ni and Co NP can permeate the skin in higher amount for nickel in damaged skin. These findings are consistent with other studies on silver NP. Our data demonstrated for the first time that Ni and Co NP can permeate the skin. More research is needed to explore the absorption of metal NP through human skin.
3726
Standard limits for surface contamination, an important tool to reduce workers’ exposure: the example of Beryllium

Mounia El Yamani (ANSES :Agence nationale de sécurité sanitaire de l’alimentation, de l’environnement et du, France)
Beryllium sensitization, chronic beryllium disease and lung cancer are the main health concerns due to exposure to beryllium. As we now have a better understanding of the health risks associated with low-level exposure, monitoring of surface contamination levels is an important tool in controlling emissions – especially since the cutaneous effects of Be include dermatitis, sensitization, etc.

The ANSES OEL committee recommended that occupational exposure to airborne Beryllium dust be limited to 0.01μg/m3 at an 8h-TWA and attempted to recommend a health-based standard limit for beryllium surface contamination. However none of the toxicology studies examined could identify a health basis for surface contamination levels. The only advice concerned values recommended by the Department of Energy (DOE): it acknowledged the lack of connection between surface contamination and concentrations of airborne beryllium and explained that the proposed value is based on its capacity to meet a stated level of cleanliness. Therefore as a tool dedicated to minimizing exposure to beryllium in the workplace, OEL Committee recommended that no salvaging of equipment contaminated with beryllium be made until surfaces have been cleaned to the lowest levels possible, and until testing shows that surface contamination does not exceed 0.2μg/cm2 (DOE value).

The work should be continued for beryllium 1) by identifying information on the chemical nature of Be compounds present on the surfaces and 2) by recommending the best methods for surface sampling (wet, dry wipes, vacuum sampling, etc).

3739
How to use DPK parameters to improve cutaneous absorption knowledge for cosmetic ingredients?

Sébastien Grégoire, William Wargniez, Alexia Garrigues-Mazert, Daniel Duché, Jean Roch Meunier (L’ORÉAL Research and Development, ADMET – Cutaneous Absorption, Aulnay-sous-Bois, France)
Chemical absorption from topical application is governed by two mains dermopharmacokinetic (DPK) parameters: the coefficient of diffusion through the stratum corneum (DSC) and the partition coefficient between the vehicle and the stratum corneum (KSC/V). These parameters describe respectively the velocity and the intensity of the cutaneous absorption. DSC is mainly related to the chemical size, whereas KSC/V is related to log P, as the vehicle is water.

An in-silico model was developed for ingredients used in cosmetics. This model takes into account these DPK parameters. Such a model allows estimating the amount “total skin + receptor fluid”. Good performances were observed: 90% of the data were predicted within a factor five (n=101). For chemicals less well predicted, DPK parameters measurement could improve their prediction.

According to guidelines, cutaneous absorption study was representative for the in use condition (i.e. finite dose of finished cosmetic product). An additional study was conducted on ex-vivo human skin to measure DPK parameters (i.e. infinite dose with water as vehicle). These experimental values were used instead of those calculated to predict amount “total skin + receptor fluid”. according to in use condition.

For a new chemical entity developed by L’Oreal, experimental DPK parameters refined significantly the prediction amount “total skin + receptor fluid”. Indeed, the difference between predictive and experimental data was reduced from a factor 10 to 2.

This example supports the great benefit of well characterizing the DPK parameters. These parameters could be measured using classical infinite dose experiments.
3742
Episkin reconstructed human skin model: A pertinent screening tool to measure permeability coefficient
Alexia Garrigues-Mazert, Sébastien Grégoire, Jean RochMeunier (L’ORÉAL Research and Innovation, ADMET – Cutaneous Absorption, Aulnay-sous-Bois, France)

According to their similarities to human tissue in terms of morphology, lipid composition and biochemical markers, reconstructed human epidermis (RhE) have been identified as useful tools for the in vitro testing of phototoxicity, corrosivity and irritancy. These last years, some papers claim that RhE are appropriate alternatives to human skin for in vitro penetration study.

Among all, RhE models commercially available, Episkin® from SkinEthic are particularly adapted for testing. Indeed, its design allows to measure penetration directly in the insert without mounting the tissue in a diffusion cell. These results lead to the development of reliable protocols for the upstream ranking assessment of the skin penetration of cosmetic ingredients under their conditions of cosmetic use.

Permeability coefficient (Kp) measurement requires sampling as a function of time. It could be done using flow through diffusion cell (as PermeGear cell) or using directly insert with totally or partially replacement of a given volume of receptor fluid at given time gap. Both approaches have been tested with caffeine as reference compound.

With sink condition and infinite dose, flux as a function of time should reach a constant value corresponding to the steady state. Results show that steady state is not reached with PermeGear cell contrary to Insert. For three references, Kp values measured on Episkin were compared to human skin data;

Episkin model is particularly well designed for kinetic penetration study. Moreover, comparison with human skin data reinforce previous studies conclusion on RhE model as relevant alternative to human skin for in vitro penetration study.

3744
In-vitro dermal absorption of 1-Bromopropane
H Frederick Frasch,, G Scott Dotson, Ana M Barbero (US NIOSH)

Background and Purpose/Objectives: 1-Bromopropane (1-BP) has found increasing use as a vapor degreaser and substitute for tetrachloroethylene (“perc”) in the dry cleaning industry. The present studies measured the dermal absorption of 1-BP from neat and saturated aqueous exposures, and from a commercial dry cleaning solvent containing 1-BP.

Methodology: Heat separated human epidermal membranes were mounted on static diffusion cells. Absorption of 1-BP from both infinite and finite dose (10 µl/cm² skin surface) exposures was measured. For each exposure, 3 skin discs from 3 different donors were used.

Results/Impact/Outcomes: For infinite dose neat 1-BP exposures, steady state (SS) flux averaged 625 µg.cm⁻².h⁻¹. For infinite dose, saturated aqueous 1-BP exposures, SS flux was 545 µg.cm⁻².h⁻¹ (Permeability coefficient 0.24 cm.h⁻¹). For finite dose neat 1-BP exposures, average absorbed amount was 21.8 µg.cm⁻², or 0.16% of the applied dose. Dermal absorption of 1-BP from a commercial dry cleaning solvent was similar to neat 1-BP absorption.

Conclusions and Discussion: Based on a recent analysis of SS flux data, 1-BP would be classified as a “good” penetrant. However, owing to its volatility (vapor pressure = 110 mmHg), most of the applied unoccluded finite dose evaporates while only a small amount is absorbed. The penetration potential of 1-BP is thus highly dependent upon the type and duration of exposure. This information will be used by NIOSH to evaluate the assignment of a skin notation to 1-BP.
3745
Skin permeability from different vehicles: Maximum steady-state flux

H Frederick Frasch, Ana M Barbero,, Lun-Yi Zang (US NIOSH)

Background and Purpose/Objectives: Numerous measurements have been reported of skin permeability coefficients (kp's) of chemicals from aqueous vehicle, and various mathematical algorithms allow their prediction. However in occupational settings, neat chemical exposures or complex vehicles are the norm and these cannot be directly compared with aqueous vehicle exposures. These studies demonstrate an approach whereby skin permeation from a complex vehicle, metal working fluid, can be predicted based upon permeation from simple aqueous vehicle.

Methodology: Human epidermal membranes were mounted on static diffusion cells. Skin was exposed either to 4-chloro-3-methylphenol (CMP) in water, or to a metal working fluid (MWF) which contains CMP. Steady-state (SS) CMP fluxes were measured. In addition, static head space analysis was used to evaluate relative thermodynamic activity of CMP in the 2 donor vehicles.

Results/Impact/Outcomes: SS flux of CMP from water was ~45x greater than from MWF at similar CMP concentrations. SS fluxes from both vehicles were similar at similar thermodynamic activities. Maximum SS flux occurred at maximum thermodynamic activity, which corresponds to the solubility limit of CMP in the respective vehicle.

Conclusions and Discussion: Donor solution thermodynamics play a defining role in skin permeability. Permeability coefficients are vehicle-specific, whereas maximum steady-state flux is unique for a given chemical and provides a simple, conservative means of assessing dermal absorption potential.

3764
Skin barrier function alteration induced by noise stress and organic solvent among aircraft maintenance workers

Tzu-Chieh Chou, Yu-Hsiang Liu, Shun-Xin Qi-Wei, Ching-Tang Kuo, Trong-Neng Wu (Department of Public Health, China Medical University, Taiwan)

Background and Purpose: Skin barrier alteration and stress were both remarkable health issues among workers. Noise, a common physiological stress in an occupational environment, has been demonstrated in change of hormone level of human body. Moreover, organic solvent exposure has been demonstrated as a risk factor of skin barrier function alteration in occupational environment. Aircraft maintenance workers exposed to the extremely high noise and organic solvent including n-hexane and methyl ethyl ketone in work place. The objective of this study is to investigate the skin barrier function alteration of noise and/or organic solvent exposure.

Methodology: 44 aircraft maintenance workers in mid-Taiwan were recruited in this study. Questionnaire was collected to adjust the confounders of workers. Skin barrier function index such as transepidermal water loss (TEWL) and skin recovery within 24 hours were measured to estimate the skin barrier disruption.

Results: We found noise may change the barrier integrity and induce the alteration of 3, 6 and 24h recovery. Basal TEWL is elevated after organic solvent exposure and a change of barrier integrity and a perturbation of 6h recovery caused by noise exposure were also found. Moreover, there was an interaction between co-exposure of noise and solvent.

Conclusions: In summary, noise may change the barrier integrity and induce the alteration of barrier recovery among aircraft maintenance workers. Organic solvents may cause the damage of basal TEWL and may change the effect of skin barrier alteration induced by noise.
Abstracts

3768
IH-SKINPERM, an advanced skin absorption model
Wil ten Berg (Santoxar, Netherlands), Daniel Drolet (EASC-AIHA, Canada), Rosalie Tibaldi (ExxonMobil Biomedical Sciences, Inc., USA)

Background and Purpose: The goal of the present study was to provide a software program for a guesstimate of the dermal absorption dose due to skin exposure. In the software program, the experimental information on the skin permeation behavior of a wide spectrum of compounds has been compiled and processed.

Methodology: An advanced skin absorption model has been formulated in Visual Basic macros (MS-Excel) in order to estimate the extent of evaporation and of dermal absorption dependent on:
- deposition rate per hour
- the affected skin area
- duration of exposure
- evaporation and absorption rate of the substance
- physicochemical properties of the substance

The most relevant output of the program is the absorption of the substance in real time.

Results: IH SkinPerm simulates and shows evaporation, uptake in stratum corneum and permeation through the skin simultaneously in real time of exposure and of subsequent observation. Graphical displays give users a dynamic visual of chemical interaction with the skin and an output report provides useful data for dermal risk assessment. Maximum dermal absorption values estimated from the model are generally within the same order of magnitude as obtained in published laboratory studies.

Discussion and Conclusion: The performance of the model as a first tier approach for risk assessment of dermal absorption results in a reasonable estimate considering the limited input requirements.

3801
Two recurrent cases of occupational contact dermatitis in a cook and a vegetable handler after changing their jobs in Japan - How to improve pre-employment counselling?
Keiko Minamoto (Kumamoto University, Japan), Thomas Diepgen (University Hospital Heidelberg)

Background: Almost no attention is paid for prevention of OCD in Japan.

Objective: To suggest how to prevent OCD according to the literatures and discuss about obstacles for the implementation in two recurrent OCD cases.

Methodology: Two recurrent cases after changing their jobs and literature review of OCD prevention are presented.

Results: Two recurrent OCD cases of a 22 year-old female cook after giving up becoming a baker and a 51 year-old female worker in a vegetable processing factory after being forced to leave a job as a sales clerk of vegetable are presented. Coenraads and Diepgen suggested a practical guide for occupational preemployment counselling based on three risk categories. Both cases can be in the first risk category where occupations with wet work or other exposure to irritants is not recommended.

Discussion: In German regulation, wet work is defined as more than 2 hours per day with hands in wet conditions, frequent washing hands and wearing gloves with occlusion effects for a corresponding period. Furthermore wet work for more than 4 hours is a subject for mandatory precautionary occupational medical examinations for a future employee. Much more intense counseling and advise for job choice and precautionary education for protective measure should have been done to the two cases. Its problematic consequence of the precautionary advise can be smaller job market for such susceptible cases. And dermatologists can not offer free treatments and counseling from labor hazard insurance without their employer’s consent and direct advise to their employers.
Abstracts

3802
A novel skin washing ‘by difference’ method for predicting dermal absorption

Richard Moody (Health Canada, Exposure and Biomonitoring Division, Ottawa, ON), Anna Yip (Health Canada, Exposure and Biomonitoring Division, Ottawa, ON), Sanya Petrovic (Health Canada, Contaminated Sites Division, Ottawa, ON)

Background and Purpose/Objectives: A highly precautionary, cost-effective in vitro dermal absorption method is reported. This method predicts absorption of environmental contaminants using only skin soap wash % recovery to calculate % absorption ‘by difference’ from applied dose. For example if 10% wash recovery was obtained, total % absorption including skin depot was 100% – 10% = 90%. Published soil contaminant data from our laboratory and from a pilot study with 16 polyaromatic hydrocarbons (PAHs) were evaluated.

Methodology. In vitro Bronaugh Teflon flow-through diffusion cells held human breast skin with Hanks receiver containing 4% bovine serum albumin. For published data study, radiolabeled contaminants were applied both without soil, or spiked into gardening soil. For pilot study, unlabelled PAHs were applied without soil or with unspiked soil from a contaminated site. In both studies skin was soap washed at 24 hrs.

Results/Impact/Outcomes: In the published data study, inverse correlations with % soap wash versus % absorption with R2 values of 0.88 (n = 6), and 0.96 (n = 6) were obtained with and without soil, respectively, supporting ‘by difference’ method validity. In the PAHs study, inverse correlations with % dermal absorption predicted ‘by difference’ versus PAH lipophilicity were obtained with R2 values of 0.92 (n = 5) and 0.57 (n = 11) with and without soil, respectively, suggesting optimal absorption lipophilicity was exceeded.

Conclusions and Discussion: Overall data suggest that the ‘by difference’ method provides a precautionary, cost-effective alternative to standard in vitro tests. Further method validation is required.

3804
Predictors of dermal exposures to polycyclic aromatic compounds among asphalt paving workers

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Objectives: To identify the sources and work practices that affect dermal exposure to polycyclic aromatic compounds (PACs) among asphalt paving workers.

Methods: Twelve workers were monitored for 3 days/week for 4 weeks. Two weeks were under normal conditions with regard to dermal exposures. In the third week, biodiesel was substituted for diesel oil as a cleaning agent and in the fourth week workers were supplied dermal protection (gloves, neck cloth, clean long shirts and pants). Dermal exposure to PACs was quantified by: a passive organic dermal (POD) sampler specifically developed for this study, and a sunflower oil hand wash (HW) technique. Linear mixed effects models were used to evaluate predictors of PAC exposures.

Results: Dermal exposures were low such that most analytes were rarely detected above the LOD with the exception of phenanthrene (Phen) and pyrene (Pyr). The geometric mean (GM) concentrations of Phen were 0.69 ng/cm2 on the POD sample and 1.37 ng/cm2 in the HW sample. GM concentrations of Pyr were 0.30 ng/cm2 on the POD sample and 0.29 ng/cm2 in the HW sample. Increasing frequency of glove use was associated with significant reductions (p<0.0001) in exposure that ranged from 40 to 90% by analyte and method. Similar reductions in HW Phen (p= 0.01) and Pyr (p=0.003) concentrations were observed when biodiesel was substituted for diesel oil. Higher asphalt temperatures were found to significantly (p=0.01) increase exposure.

Conclusion: Reductions in dermal exposure to PACs among pavers can be achieved with increased dermal coverage and substituting biodiesel for diesel oil as a cleaning agent. Additional reductions may be possible by decreasing the application temperature of asphalt.

This study was sponsored by the National Asphalt Paving Association (NAPA) and the State Asphalt Paving Associations (SAPA).
To investigate some manifestations of allergic reactions in people exposed to chemicals

Nguyen Thu Ha, Ta Tuyet Binh (National Institute of Occupational and Environmental Health, Vietnam)

This study was carried out to investigate some manifestations of allergic reactions in people exposed to chemicals. 3428 subjects, who lived in the same area of industrial zone of PT province were interviewed. Among them 192 subjects had to expose to chemical when working and 3236 subjects belong to non-exposed group. The result showed that the rate of subjects having some manifestation of allergic reaction of body organs (skin, eye, nose, throat…) in exposed group was higher than that among in non-exposed group significantly (P<0.001). The study also finds out the relation between feeling of polluted environmental degree and some manifestation of allergic reaction of body organs clearly (P<0.001).

It’s necessary to apply some methods to protect people’s health.

Determining dermal absorption Of nanoparticles using a novel in vitro flexing skin model (CutaflexTM)

Vanessa Viegas (Health Protection Agency and University of Hertfordshire), James Wakefield (Health Protection Agency), Matthew Traynor (University of Hertfordshire), Marc Brown (University of Hertfordshire), Robert Chilcott (Health Protection Agency and University of Hertfordshire)

Background and Purpose: To date, there is no definitive evidence to support the theory that nanoparticles can penetrate normal skin. This may result from the lack of a suitable dermal exposure system. In limited in vitro studies where skin flexion has been employed, dermal penetration of nanoparticles has been demonstrated. Therefore, it is our hypothesis that current (OECD-compliant) skin exposure methods require modification to incorporate skin flexion to produce a more realistic model.

Methodology: For initial characterisation of the flexing system (Cutaflex), a standard in vitro dermal absorption procedure (OECD Guideline 428) will be employed using model penetrants. Nanoparticles will be suspended using aqueous media, probe sonicated and sized using DLS. The particles will then be applied to porcine skin in both the Cutaflex and standard diffusion cells. Twenty-four hours after dosing, skin will be taken for histological assessment and fluorescence microscopy, while receptor fluid will be analysed using both fluorometry and ICP-MS analysis.

Results/Impact: With the added dimension of flexion in our novel diffusion cell system, we expect to see a difference in absorption of nanoparticles through the skin as compared to that of a static standard system. We can then elucidate a possible pathway of penetration through the stratum corneum.

Conclusion: This novel flexing system may have the potential to substantially improve current dermal exposure risk assessment methodology.
Factors affecting particle adherence to bare skin and sampling substrates

Aleksandr B Stefaniak, Eleanor E Wade, Robert B Lawrence, Gregory A Day, M Abbas Virji (NIOSH)

Background and Purpose: Existing sampling substrates for dermal exposure assessment do not account for adhesion characteristics of human skin. The purpose of this study was to evaluate and compare factors affecting particle adherence to both human skin and sampling substrates.

Methodology: A fully factorial design was used to evaluate alumina powder adherence to human skin and cotton gloves at two anatomical locations (index finger tip, palm) in contact with three types of surfaces (smooth, semi-rough, rough) at three pressure levels, contact times, and mass loading levels. Multifactor ANOVA models with repeated measurements were used to analyze data.

Results: Significant factors influencing alumina adherence on the palm and finger tip of cotton glove were: surface type (rough > semi-rough > smooth), pressure (1.5 kg >= 1 kg > 0.5 kg), and powder mass level (high > medium > low). Only powder mass level was significant for bare palm skin; pressure and mass loading were significant for bare finger tip. The rank order of alumina adherence under all conditions was bare skin >= glove for palm and bare skin > glove for finger tip; p < 0.05.

Conclusions and Discussion: The mass of alumina that adhered to cotton gloves was generally lower than the mass adhering to bare skin. Adherence studies are being performed using cotton gloves with artificial sebum, moistened wipes, and a skin-like film substrate. Differences in substrate adherence characteristics may be important for accurate dermal exposure assessment.

Use of artificial sweat as an extraction solvent for quantification of biologically meaningful exposure to chromium

Matthew G Duling, Aleksandr B. Stefaniak, Gregory A. Day, M Abbas Virji (NIOSH)

Background and Purpose/Objectives: Current approaches to assessing dermal exposures to metal sensitizers are to either remove or intercept contaminants that are subsequently digested in strong acids and/or oxidizers prior to quantifying the total mass of contaminants without regards to the bioaccessible (water soluble) forms. This shortcoming is important because the bioaccessible form undergoes absorption through stratum corneum to reach the immunologically active epidermis.

Methodology: Chromium carbide (Cr3C2) particles were immersed in artificial sweat (pH 5.3) at varying temperatures (33, 36, 45 C) for 11 hours and the extract quantified for total soluble chromium (Cr-s) and soluble Cr(VI) content. For comparison, particles were either digested using HNO3/H2SO4 and H2O2 in accordance with OSHA Method 125G (Cr-s) or Na2CO3/NaHCO3 in accordance with OSHA Method 215 [Cr(VI)] and digestates quantified by atomic spectroscopy.

Results: In artificial sweat, Cr(VI) was unstable and quickly reduced to a soluble species with unknown valence state whereas Cr-s content of particles was 0.0035 +/- 0.0001%, 0.0024 +/- 0.0004%, and 0.0038 +/- 0.0001% at 33, 36, and 45 C, respectively. For particles subjected to acid digestion, the Cr-s content was 6.1 +/- 0.3% and Cr(VI) content was 0.0004 +/- 0.0001%.

Conclusions and Discussion: Use of HNO3/H2SO4/H2O2 digestion for quantification of Cr-s in Cr3C2 particles overestimated the sweat extracted level by more than a factor of 1000 under physiologically relevant skin conditions. Additional studies are being performed to speciate the reduced form of soluble Cr(VI) in artificial sweat. The sweat-extractable fraction of metal sensitizers such as chromium may provide more biologically meaningful exposure estimates than acid-extractable values.
Variation in allergen content over time of acrylates / methacrylates in patch test preparations

Anthony Goon (National Skin Centre, Singapore), Magnus Bruze (Skåne University Hospital, Sweden), Erik Zimerson (Skåne University Hospital, Sweden), Östen Sörensen (Skåne University Hospital, Sweden), Chee-Leok Goh (National Skin Centre, Singapore), David Koh (National University of Singapore, Singapore), Marléne Isaksson (Skåne University Hospital, Sweden)

Background: Acrylates / methacrylates are volatile substances. There might be a gradual decrease in acrylate / methacrylate allergen content over time in patch test preparations but this has not yet been documented. Objectives: To determine the allergen content of acrylate / methacrylates in patch test preparations over time under different storage conditions.

Methods: Five acrylate / methacrylate allergens (2-hydroxyethyl methacrylate (2-HEMA), methyl methacrylate (MMA), ethylene glycol dimethacrylate (EGDMA), triethylene glycol diacrylate (TREGDA), and 2-hydroxypropyl acrylate (2-HPA)) in syringes and IQ™ chambers (Chemotechnique Diagnostics, Vellinge, Sweden) were analysed using gel permeation chromatography (GPC) and high-performance liquid chromatography (HPLC) to measure the allergen content over time in samples stored in the freezer, refrigerator and under room temperature.

Results: The concentration of allergens in syringes decreased with time. Those stored at room temperature had the fastest rate of decrease, followed by those in the refrigerator and freezer. In most cases, in syringes or IQ™ chambers under all storage conditions, the MMA decreased most rapidly, followed by 2-HPA, 2-HEMA, EGDMA and TREGDA. The allergens in the IQ™ chambers rapidly disappeared with almost all samples reaching non-detectable levels by Day 8. In fact, MMA was the first to reach a non-detectable level at Day 2.

Conclusions: Acrylate / methacrylate allergens are lost rapidly from IQ™ chambers especially if stored under room temperatures. Allergens in syringes remain above 80% of their initial concentrations for longer periods compared to IQ™ chambers. In syringes and IQ™ chambers, there is a slower rate of decrease in concentration when the storage temperature is lower.

Dermal exposure and skin condition of workers co-exposed to cobalt and nickel at a South African base metal refinery

Johan Du Plessis, Fritz Eloff, Stephen Engelbrecht, Petrus Laubscher, Nico van Aarde, Anja Franken (North-West University, South Africa)

Objectives: To assess dermal co-exposure of workers to cobalt and nickel at a South African base metal refinery and to concurrently characterise their skin condition.

Methodology: The skin hydration (SH) index, Trans Epidermal Water Loss (TEWL) index and skin surface pH of the hands, wrist and forehead were measured. Dermal exposure samples were collected with GhostwipesTM from the dominant hand, wrist and forehead. Wipes were analysed according to NIOSH method 9102 using ICP-AES.

Results: SH indices for the hands and wrist, before and during the shift indicated various degrees of skin dryness and possible impaired barrier function. TEWL indices for the palm of the hand represented strained barrier function before and during the shift. Skin surface pH for all anatomical areas sampled decreased significantly during the shift, but remained in normal range. Cobalt and nickel were collected from the skin even before the start of the shift. Highly variable skin loading of the two metals occurred during the shift on all anatomical areas sampled. Furthermore, dermal exposure to nickel was consistently higher than that of cobalt for all anatomical areas and intervals sampled.

Discussion and Conclusions: Slightly damaged, compromised skin may lead to increased skin permeation and absorption of cobalt and nickel already present in high levels on the skin and thus increase the risk of developing allergic contact dermatitis (ACD). Despite the skin condition and high levels of dermal exposure reported, the incidence of ACD is very low. Ethnical differences in skin structure and function may decrease the likelihood of African workers developing ACD.
Abstracts

3814
Permeation of a hair dye compound through nitrile rubber gloves used by hairdressers and the influence of hydrogen peroxide

Marie-Louise Lind, Stina Johnsson, Carola Lidén, Birgitta Meding, Anders Boman (The Institute of Environmental Medicine (IMM), Karolinska Institutet, Stockholm, Sweden)

The study was supported with grants from AFA Insurance.

Background and Purpose/Objectives: Resorcinol (RES) is a compound present in several oxidative hair dyes on the world market today. Resorcinol is one of many known sensitizer in hair dyes. Here we present results from an ongoing study with the objective to investigate the influence on glove permeation of the hair dyes by hydrogen peroxide. The effect of hydrogen peroxide on the permeation through polyvinylchloride (PVC) and natural rubber latex gloves has been presented earlier [1]. In the present study the effect of hydrogen peroxide on the permeation of RES on nitrile rubber (NR) gloves is measured.

Methodology: The permeation of RES through protective gloves made of nitrile rubber (NR) was tested using a penetration cell LG-1084-SPC. Exposure solution was 30% RES in borate buffer with 0.2 M ascorbic acid. Samples were collected in 15 min intervals and analyzed by HPLC. The cumulative breakthrough, the “time lag breakthrough” (Lag-BT), and permeation rate at steady state (Ps) were determined for each glove. Gloves treated with 30% solutions of hydrogen peroxide were compared with untreated gloves.

Results/Impact/Outcomes: Preliminary results are: for the untreated glove Lag-BT = and Ps = 2.1 ± 1.1 and for the hydrogen peroxide treated glove Lag-BT = and Ps = 3.0 ± 1.2

Conclusions and Discussion: Preliminary results show no effect of hydrogen peroxide on Lag-BT, whereas there was a tendency that the permeation rate at steady state was higher for the treated glove.

3815
The skin penetration of organophosphorous compounds is highly dependent on agent concentration and hydrophilic properties

Bo L Koch, Lars Rittfeldt, Mona Koch, Anders Bucht (Swedish Defence Research Agency, FOI, CBRN Defence and Security, Umeå, Sweden)

Background and Purpose/Objectives: Factors affecting skin penetration could lead to altered effects on human health. The penetration through human epidermis of seven organophosphorous compounds, with approximately the same molecular size, was therefore studied to examine factors affecting the skin penetration properties.

Methodology: All tests were performed in vitro using human epidermal disks mounted in a diffusion cell, with a flow-through receptor compartment. The compounds were applied neat or diluted in water at different concentrations on the external side of the epidermis. The agent flux was monitored by analysis of the receptor fluid with GC-FID.

Results/Impact/Outcomes: The resulting penetration rate was dependent on both the agent concentration and on the hydrophilic properties of the compounds. A common characteristic of all tested compounds was that the penetration rate was highest in the concentration interval between 10 and 75 %, whereas outside this concentration range the penetration rate was relative low. The lipophilic compounds had almost symmetrical bell-shaped curves when the cumulative penetration was plotted against the agent concentration. The hydrophilic compounds, however, had clear maximum penetration rates when they were applied as 10 or 20 % solutions, showing more than 20 times higher penetration rate at these concentrations.

Conclusions and Discussion: These results clearly demonstrate that both hydrophilic properties of organophosphorous compounds and agent concentration on the skin should be considered in assessment of toxikokinetics. The findings are also of importance when decontamination of the skin is being evaluated. If the penetration rate is significantly increased, for instance due to dilution by sweating beneath clothing, the time for efficient decontamination is shortened.
3816  
Dermal and respiratory exposure to cobalt salts in a packaging area at a base metal refinery  
Fritz Eloff (North-West University), Lelani van der Westhuizen (North-West University), Johan Du Plessis (North-West University), Cas Badenhorst (Anglo American), Petrus Laubscher (North-West University), Nico van Aarde (North-West University), Anja Franken (North-West University)

Objectives: To assess dermal and respiratory exposure of workers to cobalt in a cobalt packaging area at a base metal refinery and to assess their skin condition.

Methodology: Dermal exposure, skin hydration (SH) index and trans epidermal water loss (TEWL) index were measured on the hand, forehead and wrist. Ghostwipes™ were used to collect dermal and contaminated workplace surface samples. Respiratory samples were taken by using the Institute of Occupational Medicine (IOM) inhalable aerosol sampler. Wipes and respiratory samples were analysed for cobalt according to NIOSH method 9102 using ICP-AES.

Results: The SH indices indicated that workers skin was slightly dry to normal at the beginning of the shift. The change in SH indices throughout the shift was different for each anatomical area. TEWL indices increased significantly during the work shift indicating a deteriorating skin barrier function throughout the shift. Dermal samples indicated significant dermal cobalt loading occurred during the shift. Workplace surfaces were also contaminated with cobalt including the outside surfaces of shipment bags intended for export. The cobalt respiratory exposure of most of the workers exceeded the 8 hour occupational exposure limit and half of the workers were exposed above the guidance limit for short term exposure.

Discussion and Conclusions: The deteriorating skin barrier function, high dermal and respiratory exposure to cobalt put the workers at greater risk to develop adverse respiratory and dermal health effects. The outside surface contamination on shipment bags is of concern with the possibility of impact on health and environment after shipment.

3817  
A biomarker for skin exposure to isocyanate  
Heather Greysen (Yale Occupational and Environmental Medicine Program), Meredith Stowe (Yale Occupational and Environmental Medicine Program), Adam Wisnewski (Yale Occupational and Environmental Medicine Program), Judy Sparer (Yale Occupational and Environmental Medicine Program), David Liss (Yale Occupational and Environmental Medicine Program), Dhimeter Bello (University of Massachusetts Lowell), Carrie Redlich (Yale Occupational and Environmental Medicine Program)

Background and Purpose: Methylene diphenyldiisocyanate (MDI) is commonly reported to cause Occupational Asthma. Skin exposure to uncured MDI coated products is emerging as an important route of exposure. The relative non-volatility of MDI makes it difficult to assess exposures using air monitoring. The urine biomarker has limited utility as it is highly time sensitive relative to time of exposure. We aim to demonstrate the use of a serum antibody biomarker (MDI-IgG) in workers with skin exposure to MDI.

Methodology: We conducted a cross-sectional study at a MDI fabric coating plant. MDI air sample data was gathered. Qualitative surface wipe sampling for MDI was performed. Workers completed questionnaires; serum donation; and a physical exam. Jobs were classified into three groups based on potential exposure to uncured MDI; “Wet Production” having the most exposure, “Dry Production” having little, and “Office Workers” having no exposure. Serum was analyzed for MDI-IgG by ELISA. SAS (9.1) was used for chi-square, Cochran-Mantel-Hansel, and t-test statistical analyses.

Results: 95 of 105 workers completed the study. MDI in the air was mostly undetectable or well below the federal limits for all samples. Of 75 surfaces sampled, 28 (37%) of wipes were positive. MDI-IgG positivity is significantly higher in people who reported touching the fabric with their bare hands and in job categories where potential for skin exposure to uncured MDI is the highest (Table 1).

Conclusions and Discussion: Despite negligible air levels, there is evidence of skin exposure to MDI from worker reports and positive surface wipe samples. The MDI-IgG serum biomarker results correspond well with skin exposures. MDI-IgG is a valuable biomarker for skin exposure to MDI.

Skin Exposure by Job Category:

<table>
<thead>
<tr>
<th>Type of workers</th>
<th>MDI-IgG +</th>
<th>Touching Fabric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet Production n=63</td>
<td>32 (51%)</td>
<td>47 (75%)</td>
</tr>
<tr>
<td>Dry Production n=20</td>
<td>6 (30%)</td>
<td>6 (30%)</td>
</tr>
<tr>
<td>Office n=12</td>
<td>0</td>
<td>1 (8%)</td>
</tr>
</tbody>
</table>

Research support was provided through NIOSH grant funding. NIEHS K24 was awarded to Carrie Redlich.
Abstracts

3818
Mathematical modeling of transdermal penetration after finite dosing

Arne Naegel (Goethe Center for Scientific Computing, Goethe-University, Frankfurt, Germany), Tsambika Hahn (Biopharmaceutics and Pharmaceutical Technology, Saarland University, Saarbruecken, Germany), Ulrich F Schaefer (Biopharmaceutics and Pharmaceutical Technology, Saarland University, Saarbruecken, Germany), Claus-Michael Lehr (Helmholtz-Institute for Pharmaceutical Research Saarland (HiPS), Saarbruecken, Germany), Gabriel Wittum (Goethe Center for Scientific Computing, Goethe-University, Frankfurt, Germany), Michael Heisig (Goethe Center for Scientific Computing, Goethe-University, Frankfurt, Germany)

Background and Purpose/Objectives: Over the last years several attempts have been made to reduce the number of in-vitro and in-vivo experiments for the prediction of dermal and transdermal drug absorption. This is, e.g., due to the fact that human skin is only available in limited amounts because of ethical difficulties, and the use of animal skin is limited by animal welfare regulations. Therefore, the so-called in-silico methods have evolved as an attractive alternative. We present a mathematical model of transdermal penetration of drugs after finite dosing.

Methodology – For research studies this should include study design, methods and analyses; for programs/innovation this should include development, implementation and evaluation. Transport is modeled by a set of partial differential equations, which describe not only the diffusion, but also additional effects such as different vehicles, adsorption, metabolism and enhancement by co-permeation. The presented model is formulated in two and three spatial dimensions respectively. In this context, we simulate a diffusion cell setup with finite dose conditions. In this case, skin is exposed to chemicals in small doses, i.e., the volume applied per area is small and exposure times are variable. The model is compared to an in-vitro experiment. Flufenamic acid (lipophilic) and caffeine (hydrophilic) are used as test compounds.

Results and Conclusions: The predictive quality of the model has successfully been validated in a comparative experimental in-vitro study. The results from the experiment and the simulation are in good agreement. Based on anatomical structure the stratum corneum should be modeled as two compartments, stratum disjunctum and stratum conjunctum. Moreover, the significance of lateral diffusion has been studied in a simplified model with a reduced computational complexity which was derived using the method of homogenization. The importance of lateral diffusion in the stratum corneum and in the deeper skin layers will be discussed.

3820
Surface to skin transfer of isocyanates in automotive refinishing

Thomas De Vries (Yale University School of Medicine, Occupational and Environmental Medicine Program), Meredith Stowe (Yale University School of Medicine, Occupational and Environmental Medicine Program), Carrie Redlich (Yale University School of Medicine, Occupational and Environmental Medicine Program), Homero Harari (University of Massachusetts Lowell, Department of Work Environment), Dhimiter Bello (University of Massachusetts Lowell, Department of Work Environment)

Background: Isocyanate (NCO) skin contact likely contributes to both sensitization and the development of asthma. Unbound NCO can persist on polyurethane (PU) spray-coated car parts even after appearing dried, yet whether human isocyanate skin exposure can result from contact with such surfaces remains unclear. The study objective was to assess free NCO transferability from recently PU coated car parts to human skin.

Methods: Test panels were sprayed with common isocyanate-containing coatings (primer or clearcoat) using standard practices. 18 workers in 5 shops participated in the study. Quantitative surface wipe sampling for total NCO was performed when surfaces appeared dry. Participants rubbed the test panels after which tape strip sampling of their fingers was performed. Samples were analyzed for isocyanates with the NIOSH Method 5525.

Results: Of the 30 surface samples tested when deemed dry, 80% showed detectable levels of NCO (GM total NCO=2.80µg). 4 samples tested 24 hrs post-drying were still positive for total NCO (GM total NCO=0.64µg). NCO was detected in 6 of the 48 skin tape strip samples obtained following hand contact with the dried car parts (GM total NCO=0.08µg) and in none of the 21 control samples.

Conclusions: This study confirms that free NCO species can persist even after the coated surfaces are considered dry and cured. Although unrepresentative of the majority of samples collected, several skin tape strip samples had detectable NCO levels, suggesting the transfer of free isocyanate species from the test panels to participants’ skin. Investigation of the tape strip sampling methods suggests a possible issue with NCO recovery from the tape strips.

Funded in part by a gift from the American Chemistry Council.
Evaluation of a newly developed wet-work sampler for quantification of wet-work exposure in nurses: final results

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Background: Occupational contact dermatitis (OCD) is an important work-related disease. A major cause of OCD is “wet work”: frequent contact of the skin with water, soap, detergents, or occlusive gloves. The German guidance TRGS 401 recommends that the duration of wet work (including use of occlusive gloves) should not exceed 2 hours per day, and the frequency of hand washing or hand disinfection should not exceed 20-25 times a day. This highlights the need for a reliable method to assess duration and frequency of wet work.

Recently, a wet work sampler has been presented (OEESC 2009), which uses the temperature difference (ΔT) generated by evaporative cooling between two sensors: one sensor on the skin and a second one placed 2mm above the skin. We have evaluated the use of this sampler in a health care setting, using direct observation as reference.

Methodology: Twenty-six nurses wore the sampler on the volar side of the middle finger for approximately 2 hours during their regular daily tasks, while being observed by a researcher. Sampler results were evaluated using various threshold values for ΔT to identify wet events of the hands.

Results: The optimal ΔT to discern wet and dry skin differed considerably between individual nurses. Overall the sampler was moderately accurate for identifying wetness of the skin (sensitivity 67%; specificity 86%) and less accurate for discerning glove use (sensitivity 75%; specificity 52%).

Conclusion: Agreement between observed wet work and device-reported wet events in health care settings is not high and further adaptations and developments may be required.

Exposure to wet-work in Australian workplaces

Tessa Keegel (Monash Centre for Occupational and Environmental Health (MonCOEH), Monash University), Rosemary Nixon (Occupational Dermatology Research and Education Centre, Skin and Cancer Foundation), Anthony D. LaMontagne (McCaughey Centre, School of Population Health, University of Melbourne)

Background and Purpose/Objectives: The Australian National Hazard Exposure Worker Surveillance (NHEWS) Survey was undertaken to inform the development of exposure prevention initiatives for occupational disease. The objective was to assess the occupational and demographic characteristics of workers reporting exposure to wet work in Australia.

Methodology: Computer assisted telephone interviewing was used to collect information from participants. There were two separate outcomes for wet work exposure: frequent washing of hands and duration of time spent with hands immersed in liquids.

Results/Impact/Outcomes: N= 4500 workers participated in NHEWS. For hand-washing 9.8% (95% Confidence Interval [95%CI]: 8.9-10.7%) reported washing their hands more than 20 times per day. For immersion of hands in liquids, 4.5% (95%CI: 3.9-5.1%) reported immersion more than two hours per day. Females were more likely to report exposure to frequent hand-washing (Odds Ratio [OR] 1.97, 95%CI:1.49-2.61). Workers in the lowest occupational skill level jobs, compared to the highest, were more likely to report increased exposure to hands immersed in liquids (OR 6.41, 95%CI:3.78-10.88). Workers reporting skin exposure to chemicals were more likely to report exposure to hand-washing (OR 3.68, 95%CI:2.91-4.66) and immersion of the hands in liquids (OR 4.09, 95%CI:2.92-5.74).

Conclusions and Discussion: Specific groups of workers were identified who reported high exposure to wet work. Of particular interest was the high correlation between wet work and chemical exposure. Findings from the NHEWS survey present an opportunity for development of targeted policy and practice interventions that will ultimately lead to a reduction in occupational irritant and allergic contact dermatitis.
Investigation of chemical uptake at low loads on skin

Alexander R Domesle, Jeffry H Shirai, John C Kissel (U of Washington)

Background and Purpose/Objectives: Traditionally dermal absorption experiments have been conducted at chemical loads of 1 µg/cm² and higher (sometimes much higher) even though many actual exposure scenarios involve delivery of lower loads to skin. Assumption of constant fractional absorption across disparate loads is common, but not well founded. Greater understanding of low-load dermal absorption is required to inform exposure and risk assessment.

Methodology: A glass and Teflon chamber was constructed to permit deposition of aerosols generated by a Collison nebulizer onto skin coupons. Fluorescent tracer and radio-labeled compounds were applied at loads of roughly 1-500 ng/cm².

Results/Impact/Outcomes: Experiments in which a fluorescent tracer was employed provide visual evidence that distribution of tracer on human cadaver skin following low-load aerosol deposition differs from that observed following application in solvent by pipette. Subsequent experiments involving nebulization of ethanol-based solutions of 14C-labeled pentachlorophenol and chlorpyrifos demonstrated that low loads could be reproducibly applied to, and quantitatively recovered from, human cadaver skin. Substantially incomplete removal following soap and water washing at 90 minutes was observed and confirmed by counting of solubilized skin.

Conclusions and Discussion: Absorption of two pesticides delivered at low loads revealed rapid penetration to depths at which soap and water washing was ineffective. Net fractional absorption exceeded results reported in the prior literature following higher load, longer duration experiments. Results should contribute to understanding of low-load absorption and potential for decontamination by washing.

Funding for this research was provided by NIOSH and by the U of WA DEOHS. Neither entity has reviewed the work and no endorsement should be inferred.

Simulation of removal of chemicals from skin by washing

John C Kissel, Elizabeth C Kilcline, Jeffry H Shirai (U of Washington)

Background and Purpose/Objectives: Washing of skin is an essential component of both industrial and personal hygiene. While many empirical studies of washing (especially hand washing) have been conducted, theoretical description of the process has been given less attention. The objective of this research is to create a model of washing that can inform decontamination strategies.

Methodology: A computer model that describes simultaneous transport of an agent of concern and water has been developed. The model describes one-dimensional transport in a two-layer membrane (stratum corneum and viable epidermis) by finite difference approximation. Water transport includes hydration and swelling of the stratum corneum, with concentration dependent diffusion. Water transport components of the model were evaluated independently by testing against hydration experiments reported in the prior literature. The integrated model will ultimately be tested against in vivo human experiments using DEET as a surrogate for chemical contaminants. In the interim a review of the washing literature was conducted to identify prior experiments most likely to be useful in evaluation of the washing model. Key prior experiments were selected based on appropriateness of experimental protocol and completeness of reporting.

Results/Impact/Outcomes: Predicted hydration of human skin shows good correspondence with prior results reported in the literature. Evaluation of predicted washing efficiency involves multiple penetrants and is ongoing.

Conclusions and Discussion: The model described here permits investigation of the effect of washing on ultimate penetration of skin contaminants. Results should be useful in evaluating recommendations for washing in both occupational and non-occupational scenarios.

This research was supported by NIOSH. NIOSH has not reviewed the work and no endorsement should be inferred.
Assessment of indoor dermal exposure to SVOCs
Amelia C Cousins, Jeffry H Shirai, John C Kissel (U of Washington)

Background and Purpose/Objectives: Increasingly available biomonitoring data provide evidence of widespread human exposure to large numbers of chemicals. In some cases, dominant exposure pathways are evident. However, in the case of non-occupational exposures to chemicals found in consumer products, multiple exposure pathways may be relatively important contributors. Although attempts to parse aggregate exposures are becoming common, data sets that actually permit use of a mass balance approach remain relatively rare. Even where mass balance is possible, use of uncertain or conservative estimates may conceal a gap between the sum of predicted inputs and observed outputs. Aggregate assessments often contain component estimates that vary dramatically in quality. Dermal exposures in particular are often dismissed on the basis of calculations that are not well considered.

Methodology: Potential exposures are evaluated using a fugacity-based indoor fate and transport model linked to a multi-component human PBPK model with a credible (i.e., membrane) skin barrier.

Results/Impact/Outcomes: Dermal exposures appear to contribute non-negligibly to expression of biomarkers for multiple indoor contaminants including pesticides, flame retardants, plasticizers and nicotine. Cross chemical comparisons can provide insight into exposure factor estimates that provide consistent explanations.

Conclusions and Discussion: In the case of SVOCs that persist in indoor environments, chronic dermal exposures are inevitable. Credible estimates of the magnitude of those exposures are needed to inform future consumer product regulations.

Support for this research was provided by NIOSH and US EPA. Neither agency has reviewed the work and no endorsement should be inferred.

Recognising risk factors for persistent post-occupational dermatitis
Rosemary Nixon, Amanda Palmer, Melisa Lau, Tessa Keegel, Melanie Matheson. (Occupational Dermatology Research and Education Centre, Skin and Cancer Foundation Victoria)

Objectives of study: Our aim was to identify adverse prognostic factors for persistent post-occupational dermatitis (PPOD), where dermatitis persists despite cessation of relevant causative exposures.

Methodology: We performed a follow up study of 650 patients from our Occupational Dermatology Clinic with a response rate of 34.6%. Of these, 123 interviewed in person formed the basis of a case-control study.

Results: We identified 23 workers with PPOD, with a mean age of 46.7 (standard deviation (sd) 13.5) and a mean duration of follow up 5.47 years (sd 1.8). The risk factors which were not significant included gender, age, atopy, disease duration and educational level. The workers’ severity at initial presentation was an important risk factor, associated with an odds ratio of 7.1 (p<0.0001). Severity was assessed using the Occupational Dermatitis Disease Severity Index (ODDI), which we have previously developed to incorporate a functional assessment of severity. Interestingly, smoking was also an extremely important risk factor, as were also the initial diagnosis of allergic contact dermatitis and a family history of atopy.

Conclusion: To our knowledge this is the first case-control study of PPOD. There has been little attention to severity as a prognostic factor in the occupational dermatitis literature previously. In addition, there has been little focus on the role of smoking in inflammatory dermatoses. These observations alert us to intervene more aggressively in workers with severe occupational dermatitis.
Abstracts

3827
Strategies for assessing and managing dermal exposures under the EU REACH Regulation
Jan Urbanus (Shell), Chris Money (ExxonMobil), Dook Noij (Dow), Alison Margary (Shell), Kees Hommes (LyondellBasell)

Background: The European Union’s REACH Regulation places an obligation on the manufacturer or importer of chemicals to register affected substances with the European Chemicals Agency (ECHA). One requirement of the Registration process is the need to undertake an assessment of the worker health risks arising from the use of the substance for dermal routes of exposures, preferably via using quantitative approaches to risk assessment. While the Technical Guidance supporting REACH includes some suggestions for how this might be accomplished, it provides no clear details.

Outcomes: The application of quantitative approaches to dermal risk assessment requires access to reliable estimates of exposure, suitable reference values, together with information on the comparative effectiveness of exposure control strategies. The European solvents industry has developed novel approaches for assessing workplace dermal risks with the objective that any advisable controls can be identified, communicated (in safety data sheets) and understood by users of these materials. Using examples, the presentation will illustrate how dermal risks have been evaluated for different solvent risks, enabling new insights to be obtained on the effectiveness of current exposure control strategies and the consequent need for better targeting of future data collection initiatives.

Conclusions: In support of its REACH obligations, European industry has identified and implemented approaches for assessing the dermal health risks presented from workplace exposures to chemicals. These registrations will result in enhanced mechanisms for the communication of exposure control strategies for many of the 3400 substances that have now been registered in the first Phase of REACH.

3828
Teledermatology in occupational skin health surveillance - diagnostic accuracy and reliability
Markus Steiner (University of Aberdeen), Anthony Ormerod (University of Aberdeen), Sean E. Semple (University of Aberdeen), Elizabeth Murphy (NHS Grampian), Jon G. Ayres (University of Birmingham), Finlay D. Dick (University of Aberdeen)

Aims: To establish the validity and diagnostic accuracy of a teledermatology tool using standardised photographic images to assess hand dermatitis in the workplace.

Methods: Development of a photographic toolkit taking standardised photographs of worker’s hands, which were assessed online for signs of hand dermatitis. Visual inspection by a physician was the criterion standard against which online assessment of the photographs was compared. The tool was tested in health care workers, engineering workers, hairdressers and nursery nurses. The visual inspection was done repetitively over a 7 month period and standardised photographs were taken at the same time. The photographs were then assessed online by a Dermatology Consultant (inter-rater assessment), and by the physician (intra-rater assessment) who undertook the visual inspection: the latter after a delay time of 18 months. The assessment used a) a categorical dermatitis classification and b) the Hand Eczema Severity Index (HECSI) and analysed by kappa and correlation coefficients.

Results: 336 participants were seen repeatedly over seven month generating, 1234 skin surveillance sessions. Kappa for ‘healthy skin’ and ‘dry skin’ against ‘hand dermatitis’ was > 0.8 for the intra-rater and 0.3 for the inter-rater assessment. The Spearman correlation for HECSI scores was 0.76 (p <0.001) in the intra-rater assessment.

Conclusions: Teledermatology offers an attractive method to provide skin surveillance in a standardised way. We have shown high intra-rater agreement between visual assessment and photographic assessment but poor agreement between two raters. The discrepancy is likely due to different diagnostic thresholds, and training issues for the photographic assessment rather than poor performance of the toolkit.
A review and evaluation of dermal exposure data in the context of dermal exposure modeling

Henk Goede, Suzanne Spaan, Rianda Gerritsen, Wouter Fransman, Erik Tielemans (TNO)

Objectives: This study aims to give an overview of the available occupational dermal exposure data, and to identify those areas that are inconsistent or inadequate, and need to be addressed in future research to be able to develop a generic dermal exposure model.

Methodology: Dermal exposure data from various sources were collated in a database, including pesticides and industrial chemicals. Sources ranged from initiatives like BEAT and RiskofDerm, unpublished data and public literature. Various aspects of dermal exposure were evaluated, e.g. potential & actual exposure, task(s), measuring methods & metrics, and exposure determinants.

Results: The review gives an overview of dermal exposure data and models, and provides insight of the type of data available (>100 studies) and its usefulness for future exposure assessment and modeling. Not only is exposure data limited, but evidence on the direction and magnitude of various exposure determinants is also scarce. Lacking evidence includes the relationship between different exposure routes and the interaction between different exposure compartments as proposed in the conceptual model for dermal exposure (Schneider et al., 1999).

Discussion & Conclusion: This review provides insight in the challenges facing researchers who are involved in the assessment and modeling of dermal exposure. Research efforts should focus on measurement strategies which incorporate exposure variability (temporal, body-location, day-to-day) and relevant exposure parameters. Furthermore, exposure determinants like worker behavior and personal hygiene should also receive more attention. Initiatives in the field of pesticide exposure modeling (BROWSE, EFSA) and (experimental) data collections are steps towards a generic dermal exposure model.

Study on working conditions and epidemiology of urticaria in workers producing and preliminarily treating rubber latex

Son Nguyen Van (National Institute of Occupational and Environmental Health, Vietnam)

Background and Purpose/Objectives: A study was conducted to evaluate the epidemiological characteristics of urticaria in workers exposed to natural rubber latex.

Methodology: The working conditions were evaluated, clinical examination and interview were conducted in 628 workers and 349 administrative staffs (the control group) in four Rubber Companies. The prick test with allergens of protein extracting from natural fresh rubber latex was also done.

Results/Impact/Outcomes: The results of this study showed that workers were working in hot and humid microclimate conditions, low air velocity and exposed to natural rubber latex. Among 628 workers exposed to natural rubber, there were 68 cases accounting for 10.82% having clinical symptoms of exposed urticaria. Number of workers having positive reaction to prick test of fresh rubber latex and protein allergen extracting from natural rubber were 64 cases (constituting 10.2%) in the exposed group and 4 cases (accounting for 1.15%) in the control group. The relative risk in the exposed group sensitive to natural rubber was significantly higher by 8.9 times (with $p<0.01$) than that in the control group. Among 628 workers exposed to natural rubber, there were 20 workers suffered from exposed urticaria, accounting for 3.31%, in the control group it was 0.29%.

Conclusions and Discussion: The risk of urticaria in exposed workers was significantly higher by 11.11 times ($p<0.01$) than that in the control group.
Measurement of dermal exposure to diisocyanates and exposure control measures in different work environments within the Swedish Motor Trade

Roger Lindahl (Umeå University, Sweden)

Background: There is a concern that isocyanate skin exposure can induce sensitization and contribute to isocyanate asthma by inducing systemic sensitization. The aim of this project is to perform a survey by measuring dermal exposure to isocyanates in different work environments within the Swedish motor trade. Together with the measurements, a shorter questionnaire regarding asthma and eczema is used. The project also includes a study of control measures and the usefulness of different colorimetric techniques as a tool for prevention.

Methodology: The dermal exposure measurements are performed with tape stripping technique. The Fixomull tapes are, after sampling, placed in glass vials containing a 1-(2-methoxyphenyl)piperazine solution. The analysis is performed with LC-MS/MS. The colorimetric methods used in the study are the commercially available methods Permea-Tec and SWYPE.

The measurements are performed on car body repair shop workers in different companies in the northern region of Sweden during work with different tasks involving possible isocyanate exposure.

Results and Discussion: We are now in the beginning of the study with only a few measurements performed. Dermal diisocyanate concentration of about 0.5 mg cm⁻² have been found in different work situations. Most of the measurements will be performed in the beginning of 2011, and the results will be presented at the conference.

Penetration patterns of monomeric and polymeric 1,6-hexamethylene diisocyanate in human skin

Jennifer Thomasen (University of North Carolina), Leena Nylander-French (University of North Carolina)

Objective: We investigated the time-dependent penetration patterns of monomeric and polymeric 1,6-hexamethylene diisocyanate (HDI) in excised human full-thickness skin.

Methods: HDI monomer [10 µl neat or 50 µl in ethyl acetate (2000 pmol/µl)] or a clearcoat mixture (monomeric and polymeric HDI) was applied to a skin cut to a size of 17.5 cm² and area occluded with foil for 5, 10, 30, or 60 min. Following exposure, the foil was removed and placed into derivatizing solution (5 ml). The surface of the skin was patted with gauze to remove excess not absorbed into the skin and gauze placed into derivatizing solution (5 ml). The skin was tape-stripped 30 times to remove HDI penetrated into stratum corneum and each tape placed into a separate vial containing derivatizing solution (5 ml). The foil underneath the exposed skin was placed into a vial containing derivatizing solution (5 ml) to investigate potential breakthrough. All samples were stored at -40°C until processed and analyzed by LC-MS.

Results: Our results indicate that HDI is readily absorbed and penetrated into the skin when applied neat or in ethyl acetate. At 5 min, 91±13% (average±standard deviation) of the total mass of HDI applied neat was recovered with the tape strips, gauze, and foils while 56±9% of the total mass applied was recovered after 60 min of exposure. A similar decreasing trend but significantly (paired t-test, p<0.001) lower recoveries (36±10% at 5 min and 12±13% at 60 min) were observed when HDI was applied in ethyl acetate. Since the skin was occluded during these experiments, loss through evaporation was limited. LC-MS analysis of the clearcoat experiments are underway.

Conclusion: HDI is readily absorbed into human skin and penetrates rapidly beyond the stratum corneum.
3837
The impact of a multidisciplinary team and a dedicated return to work co-ordinator for workers with work-related skin disease

D Linn Holness, Pilar Gomez, Irena Kudla, Grace Wozniak, Lynette Dilworth, Sandra Skotnicki. Joel DeKoven (University of Toronto, St Michael’s Hospital)

Introduction: Key objectives in the management of a worker who presents with possible work-related skin disease are: to make a correct diagnosis; to implement appropriate medical treatment and workplace management and to return the worker to function and work. Our clinic has a multidisciplinary team including dermatologists, occupational medicine physicians, occupational hygienist, nurse, patch test technician and an occupational therapist. We have instituted a specific return to work role within a multidisciplinary team model to assist workers with work-related skin disease to return to work. In addition to patient assessment, the program model facilitates educational activities and applied research.

Objectives: To review our experience with our multi-disciplinary team and our dedicated RTW Co-ordinator and for workers with work-related skin disease.

Methods: The team reviewed their experience with RTW services provided as part of their assessment at the Occupational Disease Specialty Clinic at St Michael’s Hospital. Processes, interventions, barriers and facilitators were identified.

Results: Common interventions employed included intensive worker education, case conferences, formal communication with the workplace and active follow-up of the workers including monitoring of skin status. Avoidance of the exposure was the mainstay of workplace prevention. A RTW trial or graduated RTW were commonly implemented. Barriers to RTW include disease factors (ongoing symptoms) and workplace factors (continued exposure, lack of suitable personal protective equipment, lack of permanent modified work). Facilitators to RTW included availability of modified work, good communication between the workplace parties and worker compliance with the treatment plan.

Conclusions: We have identified a number of components to the RTW process for workers with work-related skin disease as well as key barriers and facilitators. Programs that address these issues should enhance the RTW experience for workers with work-related skin disease.

3838
Workplace characteristics and prevention activities of workers being assessed for possible work-related skin disease

D Linn Holness, Irena Kudla (St Michael’s Hospital, University of Toronto)

Background: Though contact dermatitis is a common occupational disease, there is little information available regarding prevention activities present in the workplaces of workers with work-related skin disease.

Objectives: The objective of this study was to describe the workplace characteristics and prevention activities present in the workplace of workers being assessed for work-related skin disease.

Methods: 100 patients being assessed in the Occupational Health Clinic at St Michael’s Hospital were enrolled and followed for months post assessment. Information regarding workplace characteristics and prevention activities was collected at the time of assessment.

Results: 78 of the 100 workers were diagnosed with work-related skin disease. Their mean age was 40 and 64% were male. Median number of employees in the workplace was 100 with a range from 2 to 4500. 68% reported receiving training related to chemicals and 58% reported receiving general occupational health and safety training. 45% reported training related to gloves and 34% reported training related to skin care. Unionized workers were more likely to report training.

Conclusions: This descriptive information suggests that there are gaps in prevention programs for work-related skin disease in workplaces in Ontario. A clinical population provides a window to sample practices in a variety of workplaces.
Screening for hand dermatitis in health care workers

D Linn Holness (University of Toronto, St Michael’s Hospital), Sharon Shin (University of Toronto)

Introduction: Health care workers are at high risk for work-related contact dermatitis, either irritant or allergic in nature. Though screening has been suggested as a prevention strategy for work-related skin disease, there is little information in the literature regarding its use in the workplace.

Objectives: The objectives of this pilot study were to determine the feasibility of screening to identify workers with hand dermatitis in the health care sector and assess the prevalence of skin findings.

Methods: The study was a prospective, cross-sectional study of workers visiting the Employee Health Unit of St Michael’s Hospital, a tertiary academic hospital in Toronto over a two month period. A self administered questionnaire and hand examination were used for the assessment.

Results: 139 workers participated. Hand dermatitis was found in 31% based on either history or physical examination. 19% reported hand dermatitis in the previous 12 months while 18% had changes on examination and 6% had both. Workers who reported wet work, also reported more glove and hospital cleanser use and were 4.8 times more likely to report hand dermatitis in the past year than those who did not report wet work.

Conclusions: The use of a brief questionnaire and hand examination was feasible in this setting. The prevalence of changes was similar to those reported for health care workers in the literature.

The role of donor surface distribution in finite dose skin absorption experiments

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Objectives: Finite dose skin absorption experiments are much closer to the in vivo situation, applying only a limited amount of formulation to the skin, in contrast to an infinite dose of the formulation. By definition, finite dose skin absorption experiments require a dose of less than 10 µl/cm² to be applied to the skin. As this volume is quite small and the skin is not free of wrinkles, a homogeneous donor distribution over the total application area may be difficult to realize. Therefore, in this study, the permeability of caffeine was investigated in context with the effective application area.

Methodology: Permeation experiments were performed with human heat-separated epidermis in a Franz diffusion cell applying a finite dose of an aqueous caffeine donor. The donor solution was stained with methylene blue to allow for the determination of the effective application area after the experiment. The effective application area was calculated using planimetry and an automated computer-assisted approach.

Results: In the experiments, where the donor formulation had been distributed over a smaller area, lower drug permeation was found compared to experiments with an even distribution over the whole incubation area. Taking into account the different drug distributions on skin’s surface, the variability of the permeability data was reduced.

Conclusions and Discussion: The homogeneity of distribution of the donor formulation over the application area should be taken into account when analyzing the permeation data. By taking into account the effective application area, the intra- and interlaboratory variability of permeation experiments can be reduced. This is especially important when modelling finite dose experiments.
3841
Evaluation of the awareness of latex allergy and the appropriate use of gloves among healthcare workers
Firas Al-Niaimi, Nicole Chiang, Carol Chiang, Jason Williams, (Salford Royal Foundation Trust)
Aims: To evaluate the awareness of latex allergy and the appropriate indication for various types of gloves among healthcare workers in a large university hospital in England.
Method: A Questionnaire was designed and sent to healthcare professionals of various grades ranging from nurses to physicians. Questions were asked on the knowledge in recognizing various types of latex allergy and the implications this may have on patients’ care. Specific questions on the various types of gloves and their suitability for use in the care of patients were asked.
Results: More than 100 individual staff members responded. Our survey showed that a significant number of healthcare professionals were unable to identify signs of latex allergy. The results also showed that in many cases latex allergy was not even sought or asked for with few healthcare professionals witnessing adverse events in patients in whom latex allergy was not recognised at an early stage. The majority of our respondents received little or no training on latex allergy and lacked understanding on the differences between the immediate and delayed types of latex allergy. The majority of our respondents received little training on the various types of gloves and their indication use and were unaware of the significance of their chemical compounds.
Conclusion: Recognition and handling of latex allergy should be optimized through appropriate training including knowledge on the use of various types of gloves. Patients should be made aware of their allergies and how this should be handled in the hospital setting.

3842 - WITHDRAWN
In vitro percutaneous absorption of pesticides through rat and human skin for predictive transdermal models.
Darren Gullick (University of Georgia), Leah Costyn (University of Georgia), David Kim (Syngenta), Jim McDougal (Wright State University), Brian Cummings (University of Georgia)
Background and Purpose/Objectives: Commercially available pesticides have extensive environmental toxicological profiles, but little is known about their percutaneous absorption. The aim of this work was to produce in vitro skin permeability data that will be used for prediction of skin absorption. Seven pesticides were studied: mesotrione, molinate, thiamethoxam, pirimicarb, acetochlor, propiconazole and cyproconazole.
Methodology: Studies were performed using dermatomed male F344 rat skin (500 µm) mounted onto static Franz-type diffusion cells. Donor (pesticide) was added as either 75% or saturated solution, and samples (20 µL) were analyzed at 0, 0.5, 1, 2, 3, 4, 5, 6 and 24 hours from phosphate buffered saline receptor fluid (pH 7.4). Samples were analyzed using HPLC and quantified using external calibration to find concentration of pesticides that had traversed the skin. Concentration/time profiles were constructed, and the straight line portion from each profile was used to estimate the flux values. Permeability values were calculated using Fick’s first law of diffusion (n=16 for each pesticide).
Results/Impact/Outcomes: Results show that molinate was the fastest penetrant (24.52 µg/cm²/h) followed by pirimicarb (10.58 µg/cm²/h), while atrazine gave the lowest flux (0.12 µg/cm²/h). Permeability of thiamethoxam through rat skin (0.63 x10⁻³ cm/h) was found to be 33-fold higher than in human skin (0.019 x10⁻³ cm/h).
Conclusions and Discussion: These data will contribute to existing toxicological profiles for these pesticides, and suggest that faster penetrating compounds require further toxicological investigations (ADME).
Syngenta - Research Funding, Jim McDougal - Consultant.
Abstracts

3843
Knowledge translation of research in occupational skin disease - the CREOD experience

D Linn Holness (University of Toronto, St Michael's Hospital), Janet Brown (JDBrownfields), Emily Holton (JDBrownfields, St Michael's Hospital), Irena Kudla (St Michael's Hospital, University of Toronto), Victoria Arrandale (University of Toronto)

Introduction: Translation of research findings (i.e. knowledge translation) in occupational health is important, not only to health and safety professionals, but also to other system partners such as employers, workers, workplaces, insurers and policy makers.

Objective: One of the Centre for Research Expertise in Occupational Disease (CREOD)'s key strategic objectives is moving research findings into usable information and practice in the occupational health and safety system.

Methods: We have been working with a knowledge translation writer and our stakeholder-based Advisory Committee to develop information products for our Occupational Skin Disease Program that will address the needs of the different stakeholder groups.

Results: Research results have been synthesized into plain language documents, and have also been incorporated with the broader research literature. Directed projects to share evidence in other formats, including visual and multimedia, are also underway. Samples of the various knowledge translation products will be presented for viewing.

3844
Raising awareness for dermatitis in the service sector: slow steps to prevention

D Linn Holness (University of Toronto, St Michael's Hospital), Irena Kudla (St Michael's Hospital, University of Toronto), Janet Brown (JDBrownfields), Elizabeth Mills (Workplace Safety and Prevention Services), Sandra Miller (Workplace Safety and Prevention Services)

Introduction: As there is a high frequency of work-related skin disease in service sector, in 2007 the Centre for Research Expertise in Occupational Disease (CREOD) began working with the Ontario Service Safety Alliance (OSSA). OSSA was one of 12 sector-based health and safety associations (HSAs) whose mandate was to deliver prevention services. We conducted a survey of OSSA employees and employer representatives. Results showed that awareness about work-related skin disease was low. We agreed that a first step to improving prevention would be to increase awareness.

Objective: To describe the ongoing work to raise awareness in the service sector and to identify challenges and opportunities in promoting awareness of occupational skin disease.

Methods: Description of ongoing collaborative work between the CREOD and OSSA.

Results: Subsequent to the survey, one Advisory Committee indicated an interest in developing and testing awareness products. In 2009 the HSAs were re-organized, resulting in the amalgamation of OSSA, with two other HSAs to become Workplace Safety and Prevention Services. This resulted in new staff being added to the organization and substantive changes in the Advisory Committee structure. The collaborative research team lost some momentum during this period of change and had to step back to re-engage and build commitment for the project with the new Advisory Committees. During this period, the team continued to nurture their own collaborative relationship and to work on awareness materials for testing within the sectors of focus.

Conclusions: Long-term commitment between organizations in the health and safety system is necessary to persist and carry forward projects during significant organizational change.
**3845**

**Integration of bio-monitoring and dermal exposure assessment**

*Thomas Klingner (CLI Laboratories), Theodore Hogan (Univ Northern Illinois)*

**Background and Purpose/Objectives:** In 1976 OSHA regulated MOCA as a suspect carcinogen. The cast polyurethane industry worked with California OSHA to develop a Bio-monitoring standard to reflect best handling protocols. This standard has been voluntarily adopted as a guideline throughout the US and Canada and continues in effect.

Efforts to reduce skin exposure prompted the development of techniques to measure contamination on surfaces and skin. Common routes of exposure have been identified over the years and recommended work practices developed. The Industry periodically communicates these practices in its “Safe Handling for MOCA” document.

**Methodology:** For research studies this should include study design, methods and analyses; for programs/innovation this should include development, implementation and evaluation

Recently an extensive industry wide survey was conducted to assess the efficacy and implementation of these handling practices. This study included historical trends of worker exposure, compliance with safety protocols, and site visits for evaluation of current practices.

**Results/Impact/Outcomes:** 90% of worker exposures in 2008 were five times lower than the California standard, while less than 3% of workers tested exceeded this standard. The results showed exposure levels and industry practice compared favorably with a recently published HSE MOCA safe use protocol.

**Conclusions and Discussion:** The synergistic implementation of urine monitoring, assessment of exposure routes, changes in work practices and reassessment of biological exposure levels to evaluate the effectiveness of these changes has proven very successful. This approach can be applied to many areas where dermal exposures are a concern.

This study sponsored by the Polyurethane Manufacturers Association

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**3846**

**Characterizing dermal exposures to chemicals within emergency and workplace settings**

*G Scott Dotson (National Institute for Occupational Safety and Health), Andrew Maier (Toxicology Excellence for Risk Assessment (TERA)), H Fredrick Frasch (CDC/National Institute for Occupational Safety and Health), Heinz Ahlers (CDC/National Institute for Occupational Safety and Health)*

**Background and Purpose/Objectives:** Limited data are available to estimate the contribution of dermal uptake to total exposure and subsequent increased health risks associated with workplace activities and emergency settings. The purpose of this project is to develop a decision logic process (DLP) for assessing the health risks associated with dermal exposures using limited data resources.

**Methodology:** The DLP is a semi-quantitative approach that focuses on the further refinement of the rationale for the assignment of the NIOSH skin notations with the emphasis on predicting when dermal exposures may result in significant uptake of a substance and contribution to total body burden. Default guidelines, based on the physiochemical properties of a substance, potential for dermal uptake, environmental factors, in addition to anatomical and physiological factors, will be developed to guide users in the application of the DLP.

**Results/Impact/Outcomes:** The major outputs of this project include the DLP and a software-based system with guidance for personnel coordinating emergency preparedness planning or responding to an event where chemical exposures are expected.

**Conclusions and Discussion:** The DLP builds on the new NIOSH strategy for the assignment of skin notations and will aid in the assessment of dermal exposures. The DLP will serve as a valuable tool to aid in the development of risk assessment and risk management strategies designed to address the risk of chemical exposures where exposure is from multiple routes or where dermal uptake is the primary pathway.
Abstracts

3848
A decade of progress for research but what about the shop floor experience - an Ontario snapshot
Irena Kudla, Michael Sidoropoulos, D Linn Holness (University of Toronto, St Michael’s Hospital)

Introduction: The literature contains few references describing the prevention practices in place for workers who subsequently develop occupational contact dermatitis. We developed an Occupational Dermatitis (OD) Prevention Audit Tool. The tool addresses the presence or absence of health and safety components, such as: skin management policy, training, PPE, occupational health resources and accident and injury experience.

Objectives: To trial the use of the Occupational Dermatitis Prevention Audit Tool.

Methods: A survey was developed by the clinical team referred to as the Occupational Dermatitis Prevention Audit and administered to patch test patients with possible occupational contact dermatitis.

Results: A total of 17 workers were enrolled with the majority from the manufacturing sector. 75% reported having general health and safety training and having access to MSDS. The most common exposures reported were: metals, oils and lubricants, solvents, mechanical irritation, metalworking fluids, corrosives and wet work. 65% reported that skin problems were common at work while only 12% reported there being a skin protection program in place. 35% reported workplace housekeeping: as being excellent. Only 12% reported having had specific skin education. 12% were screened for active skin disease prior to job placement. 82% of employers provided gloves while 29% provided skin conditioning creams.

Conclusions: Information obtained from this pilot study will be used to refine the OD Prevention Audit tool to assist workplace parties and their partners in the development of targeted prevention strategies for the reduction and elimination of occupational contact dermatitis.

3849
Reduction of occupational skin exposure to hazards: first voluntary agreement by European social partners in a high risk profession (hairdressing)
Swen Malte John, Antje Braumann, Flora Sonsmann, Britta Wulffhorst (Dept Dermatology, Environmental Medicine, Health Theory, University of Osnabrueck)

In 2010, the in Europe the “Healthy skin@work”/europreventioncampaignwas started; kick-off had been in the EU-parliament Nov. 2009. It seeks to raise public and political awareness on the issue of occupational skin diseases (OSD). OSD are a leading cause of work related health problems, hairdressers by their exposure to wet work and chemicals are particularly affected (incidence rate > 30%). In 2010, the EU-commission granted an unprecedented research project “SafeHair”, which runs in the framework of the campaign. It aims at OSD-prevention by defining common standards of safety and health in the high risk profession of hair-dressing. It includes implementing of teaching curricula for apprentices’ and masters’ courses, in order to make adequate skin protection and skin care a habit in the trade from early on. It also includes manufacturers to ensure better product safety. In a series of meetings the basis for a scientifically guided consensus on prevention amongst all stakeholders, including the hairdressers’ employers’ associations and trade unions, as well as suppliers and safety engineers has been established. Recently, on Sept. 28th 2010 in Dresden a voluntary agreement (“Declaration of Dresden”) was signed by the European social partners in the trade as a unique commitment to OSD prevention. This is the first such EU-initiative in the field of OSD and it is expected that other professions at risk will follow. It is remarkable that this project was solely initiated by the social partners. This underlines that industries affected by OSD are getting increasingly aware (a) of the disease burden and (b) that prevention works.
The distance between theory and practice - glove use and education in the workplace

Sharon Switzer-McIntyre (University of Toronto), Kyle Rowley (University of Toronto), Daana Ajami (University of Toronto), Denise Gervais (University of Toronto), Lindsay Mooney (University of Toronto), Amy Solheim (University of Toronto), Irena Kudla (St Michael’s Hospital, University of Toronto), D Linn Holness (University of Toronto, St Michael’s Hospital)

Introduction: Occupational contact dermatitis (OCD) is a common occupational disease. Gloves are a commonly used preventative strategy. There is little detailed information available about the actual practices related to glove education in the workplace.

Objectives: The objective of this study was to examine worker reporting of glove use and educational practices related to glove use amongst workers presenting for investigation of OCD involving the hands.

Methods: A self-administered questionnaire containing 38 questions was developed to collect information including demographics, workplace characteristics, glove use, provision of glove use education, and glove supply characteristics. Patients were eligible if they had hand dermatitis and were or had been working.

Results: 101 workers with possible OCD were enrolled in the study. In addition to demographic information about work status, workplace characteristics, glove use and glove training is being analysed.

Conclusions: This study illustrates the lack of glove use education provided to workers and supports the need to integrate preventative glove use education both in schooling environments as well as in the workplace.

An integrated inpatient/outpatient rehabilitation program - the German approach

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Background and Purpose: Occupational skin diseases (OSD) represent up to 25% of occupational diseases. OSD cost >5 billion €/year in the EU by loss of productivity and cause extensive suffering for workers. Long sick leave by OSD especially jeopardizes competitiveness of small & medium sized enterprises (SME).

Methodology: For optimising medical rehabilitation and job reintegration a prospective multicentre study is carried out using a specific interdisciplinary in-patient rehabilitation scheme in N=1800 affected individuals with severe OSD. It comprises 3 weeks in-pt. diagnostics and treatment plus intensive health-pedagogic counselling, and a seamless consecutive 3 weeks out-pt. treatment by the local dermatologists. Each pt will stay off work for a total of 6 weeks to allow barrier recovery. Dermatological follow up in order to assess sustainability of this rehabilitation measure is 5 years (grant by statutory German accident insurance DGUV).

Results: So far we have already followed up 983 pts. 1 yr after the measure; drop out rate: 5%. Most patients (28%) were from health sector, 27% from metal industry, and 10% hairdressers. 84% had fully resumed working; 73% (p<0.0001) showed significant reduction of severity of skin disease (OHSI). LQ 1 year after the measure had greatly improved (DLQI, p<0.001; LIOD; p<0.001). Frequency of sick leave was reduced by 61%; in 79% of pts. no sick leave due to OSD occurred in the 1yr-observation period.

Conclusion: This interdisciplinary (medical/educational) rehabilitation program in seamless cooperation of clinics and practices is effective. The health economic potential of this rehab-measure becomes apparent, e.g. for competitiveness of SME. Presently, a European initiative aims at evaluating transferability (“healthy skin @work” campaign).
Dermal absorption of benzene in occupational settings: estimating flux and applications for risk assessment

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Background and Objectives: There is growing emphasis in the United States and Europe regarding the quantification of dermal exposures to chemical mixtures and other substances. The objective of our study was to determine the dermal flux of benzene in neat form, in organic solvents, and in aqueous solutions based on a critical review and analysis of the published literature, and to discuss appropriate applications for using benzene dermal absorption data in occupational risk assessments.

Methodology: We analyzed data for 77 experimental results taken from 16 studies of benzene skin absorption. We also assessed the chemical activity of benzene in simple hydrocarbon solvent mixtures using a thermodynamic modeling software tool.

Results: Based on the collective human in vivo, human in vitro, and animal in vitro data sets, we found that the steady-state dermal flux for neat benzene (and benzene-saturated aqueous solutions) ranged consistently from approximately 0.2 to 0.4 mg/(cm²·h). A handful of observed outlier values for some of the animal in vivo data sets were possibly due to test species or study conditions. Because relatively few dermal absorption studies have been conducted on benzene-containing organic solvents, it was not possible to use these data to quantify the dermal flux of benzene in solvent mixtures.

Discussion and Conclusions: We evaluated and proposed several approaches that may be used to derive a rough approximation of the steady-state benzene dermal flux for benzene-containing mixtures, depending on the application. Limitations with respect to quantifying and evaluating the significance of dermal exposures to benzene in occupational settings include a lack of data on (1) factors that affect dermal uptake, (2) dermal flux of benzene for solvent mixtures, (3) consistent metrics for evaluating dermal uptake, (4) steady-state versus non-steady-state dermal flux values, (5) effect of skin damage on the dermal flux, (6) standardized test methods for estimating the dermal flux, and (7) robust estimates of the evaporation rate of benzene from different liquid vehicles.

Assessing effectiveness of dermal exposure control work practices in the castable polyurethane industry

Theodore Hogan (Northern Illinois University)

Background: Polyurethane casting industry workers regularly hand mix isocyanates and MOCA (amine curative). Work practices were evaluated for effectiveness in dermal exposure control.

Methodology: 20 companies answered a 60-question survey of their implementation of Castable Industry voluntary guidelines initially developed in the early 1990’s. We compared timing/scope of guideline implementation determine if there was a significant decrease in MOCA in urine.

Results/Outcomes: The majority of companies were following most of the recommended practices but the timing and implementation of specific guidelines was not associated with a decrease in MOCA in urine. This is probably because we also found that companies that consistently performed urinalyses have kept mean MOCA levels below 14 ug/L since 1992. Four site visits revealed newer technologies for weighing, melting and mixing that dramatically decrease the potential for exposure for workers who still hand pour polyurethanes. Castable Industry Guidelines are being updated to take into account these changes and to make the recommendations more usable by the shop floor worker.

Funding was by the Polyurethane Manufacturers Association which did not approve or control the study design, and did not provide prior review or approval of the report or any presentations/publications. Dr. Hogan is a paid consultant to the PMA.
Abstracts

3854
Housekeeping worker - case study
Pilar Gomez, Grace Wozniak, Sandra Skotnicki, Irena Kudla, Lynette Dilworth, D Linn Holness (St Michael's Hospital, Department of Occupational and Environmental Health)

Department of Occupational and Environmental Health and Keenan Research Centre in the Li KaShing Knowledge Institute, St Michael's Hospital, Department of Medicine and the Dalla Lana School of Public Health, University of Toronto.

Introduction: Our interprofessional team focuses on assessment and management recommendations including RTW for workers with occupational skin disease. The goal of the team is to achieve optimal skin condition of the hands to enable work performance within their work setting and vocational skills.

Description: A case study of a housekeeping worker exposed to cleaning agents who was referred to the clinic with severe contact dermatitis of the upper extremities, neck, face and scalp, areas of the upper back and lower legs by the workers' compensation board. Assessment included exposure history by clinical occupational hygienist, medical assessment by the dermatologist and patch testing. Diagnosis of allergic contact dermatitis (rubber accelerators, chromium, nickel and cobalt) and irritant contact dermatitis was made. Management was carried out by the team including dermatologist, nurse, clinical occupational hygienist and return to work co-ordinator. Management included topical medications, skin care management education and 3 months away from work to allow clearing of skin. A workplace prescription included gloves free of accelerators, avoidance of allergens and graduated RTW. Monitoring of RTW via skin diary and photographs were reviewed regularly by the team.

Conclusion: The team based approach facilitates direct problem solving with respect to implementation of precautions as the worker progresses back into the workplace. It provides consistent messaging to all parties. Enhanced patient compliance with recommendations results from ongoing monitoring with questions addressed by the right professional at the right time. The glove prescription was adopted as a standard practice for dry work at the workplace.

3855
Skin and respiratory exposure prevention in a clinical population with suspected work-related disease
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Background: Many workers are exposed to chemicals through both their skin and lungs and many of these exposures are capable of causing both skin and respiratory disease. We know very little about the prevention of inhalation and skin exposures in the workplace. The goal of this study was to describe exposure prevention practices in workers with suspected skin and respiratory disease.

Methods: Patients suspected of having work-related skin or respiratory disease were recruited from a hospital out-patient occupational health clinic in Toronto, ON. Data on skin symptoms, respiratory symptoms, allergies, exposure prevention practices and workplace characteristics was collected via an interviewer-administered questionnaire.

Results: Of the 220 subjects in total, 44% were female and the mean age was 44.6 years (SD 11.6 years). The majority (80%) of subjects were referred for dermatologic assessment (Derm), the remainder for asthma/allergy assessment (AA). Almost half of patients reported ever wearing a respirator at work; 44% of AA subjects and 60% of Derm subjects who wore a respirator reported having been fit tested. Wearing a respirator ‘often or always’ was reported by 22% of AA and 11% of Derm subjects. Over half of subjects reported ever using gloves at work; training on glove use and selection was more common among Derm subjects than AA subjects (52% vs. 33%). Wearing gloves ‘often or always’ was reported by 78% of Derm subjects and 43% of AA subjects.

Conclusions: The majority of subjects reported using personal protective equipment. Glove use was more common than respirator use in both groups. Derm subjects reported more glove use while AA subjects reported more respirator use. Whether this PPE use is in response to exposures in the workplace, or in response to the health complaints that led them to be present in the clinic cannot be determined from this data.
Exposure-response relationships for skin symptoms among bakery and isocyanate-exposed workers

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Background: Bakery workers and car body shop repair workers are at high risk of occupational asthma and both have inhalation and dermal allergen exposures. We have previously demonstrated exposure-response relationships in cross-sectional studies in both industries. The goal of this study was to explore and contrast exposure-dermal symptom relationships in bakery workers (B) and isocyanate-exposed car body repair shop workers (I).

Methods: Average airborne exposures to flour dust (B) and isocyanates (I) were estimated based on exposure assessment studies. Specific IgE to common aeroallergens (atopy) and workplace allergens (specific sensitization) were measured. Dermal symptoms were reported on a self-completed questionnaire. Relative risks (RR) for dermal symptoms were estimated using logit models with adjustment for age, sex and smoking. The effects of atopy and specific sensitization were investigated in logit models.

Results: In total, 723 bakery workers and 473 isocyanate-exposed workers were included. Isocyanate workers reported more work-related skin itchiness (17% vs. 8.5%) while bakery workers tended to report more work-related asthma symptoms (4.2% vs. 2.1%). Rates of atopy were similar in both groups (B:36%; I:34%); specific-sensitization differed between groups (B:18%; I:2.1%). Work-related skin symptoms were associated with airborne exposure in car body repair shop workers (RR 1.97, 1.17-3.31) but not in bakers (RR 1.09, 0.88-1.34). These relationships were unchanged after adjustment for atopy and specific sensitization.

Discussion: Dermal symptoms were associated with airborne exposure to allergens in car body repair shop workers but not in bakery workers. It is possible that inhaled dust exposure was not correlated with dermal exposure, or that the flour dust was not the casual exposure for dermal symptoms. Further investigation of exposure-response relationships for dermal symptoms using dermal exposure estimates is needed.

Single nucleotide polymorphisms associated with skin naphthyl-keratin adduct levels among jet fuel exposed workers

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Background: Individual responses to naphthalene exposure may be dependent upon inherited genetic variations that affect homeostasis and disease susceptibility. Currently, the genetic basis for individual responses to exposure and biomarker levels is not factored into exposure assessment models.

Methodology: We investigated the individual variation in SNPs as genetic markers associated statistically with skin naphthyl-keratin adduct (NKA) biomarker levels measured in workers exposed to jet fuel containing naphthalene. Individual SNPs and skin NKA levels were correlated by candidate gene or a genome-wide association analyses using PLINK and multivariate linear regression modelling. Highly significant SNP-associated candidate genes that were correlated with NKA levels were identified using NCBI Entrez Gene and Ensemble BioMart.

Results: Significant individual differences in NKA levels were observed in response to naphthalene exposure. The candidate gene results identified a cluster of SNPs associated with CYP26B1 that explained about 45% of the total variation in the 2NKA levels after controlling for covariates. In the genome wide analysis, 8 SNP-associated genes (ADD3, CD47, RPS6KA2, KLF6, PARK2, MSRA, NRSN1, and NRXN1) were identified that explained 73% of the total variation in total NKA levels. Potential protein-protein interactions were determined using MetaCore (genego.com) to predict 3 networks associated with skin NKA level involving cell proliferation, differentiation, and communication.

Conclusions: This research strategy allowed us to investigate the impact of individual genetic differences that modify biomarker levels for naphthalene exposure to the skin and demonstrate a potential role for incorporation of individual genetic differences in exposure assessment.

This work was supported by the U.S. Air Force (Texas Tech University subcontract 1331/0489-01), NEHS (P42ES05948 and the Division of Intramural Research), and NIOSH (T42/CCT422952, T42/008673).
Estimating occupational exposure to skin carcinogens in Canada
Cheryl E. Peters (University of British Columbia), Paul A Demers (Occupational Cancer Research Center, Cancer Care Ontario), Anne-Marie Nicol (University of British Columbia)

Background & Purpose: Although the first occupational cancer link (soot exposure and skin cancer) identified was a dermal exposure, almost all occupational cancer epidemiology in recent decades focuses on respiratory exposure. The purpose of this project is to estimate the number of Canadian workers exposed to skin carcinogens.

Methods: The CAREX Canada project integrates a wide range of sources, including regulatory and census data, to generate estimates of the number of workers exposed to carcinogens. These methods were developed in Finland and have been modified and updated to focus on carcinogens found in Canadian workplaces. The CAREX database was searched to identify carcinogens that are associated with skin cancer. Numbers of people exposed were calculated by industry, occupation, province and sex.

Results: Five compounds were identified, including solar exposure, artificial UV, creosotes, arsenic, and PAHs. Three of these fell in the top 10 most important carcinogens in Canada in terms of size of exposed group (solar exposure=1.5 million, PAHs=307,000, artificial UV=152,000). Arsenic and creosotes were also important exposures (25,000 & 1,200 exposed, respectively). Construction and farming industries were major sectors for creosote, arsenic, and solar exposure, indicating that there is significant potential for multiple-chemical exposures that lead to skin cancer.

Conclusions & Discussion: Many Canadian workers are potentially exposed to agents that are known to or suspected of causing skin cancer. In addition, these carcinogens may be encountered together in some workplaces. Further research is required to assess the skin toxicity of chemical/radiation mixtures. Next steps will include generating estimates of the levels of exposure where data is available.

Patient safety tools including check lists in occupational medicine and dermatology
James S Taylor (Cleveland Clinic)

Background and Purpose/Objectives: Public and professional efforts to improve patient safety which began more than 20 years ago have now moved from the hospital to the ambulatory setting. My objective is to apply current patient safety principles to occupational medicine and dermatology.

Methodology: Describe specific examples of major patient safety issues identified by the US Joint Commission, the Canadian Medical Protective Association, the American Academy of Dermatology and the WHO.

Results/Impact/Outcomes: Patient safety issues in occupational medicine and dermatology practice include: 1) correct patient identification using at least two identifiers; 2) misdiagnosis, delayed diagnosis and complications during office procedures; 3) errors in medication prescribing, dispensing and administration; 4) laboratory processing errors; 5) avoiding wrong site procedures and use of check lists such as the Universal Protocol for time outs; 6) avoiding fires from flammable chemicals used in the office; 7) office safety including avoiding falls; 8) availability of emergency procedures in ambulatory setting

Conclusions and Discussion: Current patient safety principles should be adopted by professional societies. An audit of relevant procedures and near misses is a next step.
Inventory of the chemicals and the exposure of the workers’ skin to these at two leather factories in Indonesia

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Background and Purpose/Objectives: Tannery workers are exposed to hazardous chemicals. Tannery work is extensively outsourced to newly industrialized countries (NIC) where attention to occupational health hazards is limited. This study investigated the skin exposure to hazardous chemicals in tannery workers and determined the prevalence of occupational skin diseases (OSD) at tanneries in a NIC.

Methodology: Observation of the working process, inventory and risk assessment of chemicals used. Classification of chemicals as potential sensitizers/irritants and a qualitative assessment of exposure to these chemicals. Workers were examined and interviewed using NOSQ-2002/LONG

Results/Impact/Outcomes: The risk of OSD in tannery workers was mainly related to the exposure of the workers’ skin to chemical substances, hot and humid environmental conditions, and machinery equipment. In 472 workers (112 females and 360 males) 12% had current OSD; 9% had a history of OSD; and 10% had an OSD diagnosed by a dermatologist.

Conclusions and Discussion: Tannery workers are exposed to many skin hazardous factors at a high frequency and for a prolonged period. We observed a high point-prevalence of OSD but not as high as expected in this high risk environment in a NIC. This result may be related to a relatively high implementation of PPE and by a healthy worker effect in this population. Our study showed the need for assessment and management of occupational health risks when hazardous work is exported to the NIC.

Hand eczema in Danish hairdressers

Susan Hovmand Lysdal (Research Centre for hairdressers and beauticians, Copenhagen University Hospital Gentofte)

Background and Purpose/Objectives: Occupational hand eczema is common in hairdressers due to their daily exposure to water and different chemical substances. The objective of this study was to estimate the prevalence of hand eczema among hairdressers in Denmark and to assess to what extent hairdressers change career because of hand eczema.

Methodology: A register based study was conducted including all graduates from hairdressing vocational schools in Denmark between 1985 and 2007 (n=7 840). The participants received a self-administered postal questionnaire including questions on hand eczema, atopic dermatitis and career change. A response rate of 67.9 % (n = 5 324) was obtained. 2 918 respondents still worked as hairdressers, whereas 2 321 respondents had left the profession. These two groups (n= 5 239) are the basis of this study.

Results/Impact/Outcomes: 44.3% no longer worked as hairdressers. Significantly more ex-hairdressers (23.7%) than current hairdressers (21.0%) had atopic dermatitis (P=0.017). Significantly more ex-hairdressers had ever had hand eczema (48.4%) than current hairdressers (37.6%) (P=0.000). 75% of all the respondents with hand eczema were between 15 and 24 years of age by the time of onset. Significantly more ex-hairdressers had chronic hand eczema (26.8%) than current hairdressers did (15.7%) (P=0.000). Averagely, ex-hairdressers worked 8.4 years in the profession before leaving it; hand eczema being a contributory cause in 45.5% of the ex-hairdressers. Logistic regression analysis proved chronic hand eczema to contribute the most to this decision (OR 50.12; P=0.000; CI 18.3-137).

Conclusions and Discussion: On average hairdressers change career after 8.4 years; a significant part of which is caused by hand eczema.
3902
Exposure assessment tool for early diagnosis of occupational eczema
Ulrik Fischer Friis (National Allergy Research Centre, Copenhagen University Hospital Gentofte), Jeanne Duus Johansen (National Allergy Research Centre, Copenhagen University Hospital Gentofte), Mari-Ann Flyvholm (The National Research Centre for Working Environment), Jens Peter Bonde (Dept of Occup and Environ Med, Copenhagen University Hospital Bispebjerg), Torkil Menné (Dermato-Allergology, Copenhagen University Hospital Gentofte)

Background: Approximately 2,000 new cases of occupational hand eczema are declared each year in Denmark. Occupational hand eczema often affects young people and women twice as often as men. Hand eczema is often chronic, and may lead to job changes, job loss or early retirement. The cost is estimated to approximately 1 billion dkk annually. Delayed diagnosis and treatment may lead to a worse prognosis. Information on occurrence of contact allergens is crucial for prevention of allergic contact dermatitis. Unfortunately, product ingredients lists and Material Safety Data Sheets (MSDS) may be incorrect or incomplete and can be difficult to understand. Allergic substances are only labelled if present in more than 1%, unless there is given an individual limit.

Aim: The project develops a tool to assist in early and precise diagnosis and treatment of hand eczema. The goal is that eczema patients quickly recover and return to work.

Method: The project includes 150 patients in the development of a guideline for exposure mapping. The patients’ work tasks are mapped along with information from ingredients lists, data sheets, manufacturers, the product register, work place and chemical analysis. From these data individual patch test series are set up. We have produced a reference book which describes the various rules, notices, directives and regulations for various chemical substances and products.

Preliminary results: In 56% of cases contact allergy was identified. In 31% of the cases we have contacted either, manufacture, workplace, the Danish Product Register or made a spot-test on the product of interest because the MSDS or the ingredients lists have been incomplete.

Conclusion: Exposure analysis is time consuming, but may lead to identification of more cases of contact allergy.

3909
Dermal absorption of products of combustion encountered during firefighter training exercises
Brian McCarry (McMaster University) Sujan Fernando (McMaster University) Lorraine Shaw (McMaster University) Don Shaw (McMaster University)

Background and Purpose/Objectives of study: To determine whether absorption of organic compounds in smoke through the skin is a significant route of exposure for firefighters during firefighter training exercises.

Methodology: Airborne levels of organic compounds, as well as levels on the skin, were measured during fire training exercises. Skin sampling was performed by taking pre- and post-exposure skin wipes using filter papers with isopropanol. Samples were taken from skin on the forearm, neck, back, hands and forehead. The skin wipe samples were extracted using dichloromethane and accelerated solvent extraction (ASE); the extracts were concentrated, derivatized and analysed using gas-chromatography-mass spectrometry (GC-MS). In addition, a range of urinary metabolites of smoke markers were measured in urines collected prior to the exposures and in all urines collected over the 24-hour period post-exposure. The analysis of urinary metabolites involved a solid phase extraction (SPE) cleanup of urine followed by derivatization and analysis by GC-MS/MS. Tandem mass spectrometry analyses was used were necessary to get the best quality data.

Results/Impact/Outcomes: Preliminary results show that target analytes are found both in the air and skin samples. The urinary metabolites of the several smoke marker compounds are present in the urine samples.

Conclusions and Discussion: Penetration of the chemicals through the skin appears to be a route of exposure for firefighters.

Grant funded by WSIB
Tape stripping for aliphatic polyisocyanates: A laboratory investigation examines recovery.

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Background: Skin exposure assessment to isocyanates has become necessary as skin is suspected to be a major exposure route and appears to be involved in sensitization. Tape stripping (TS) offers several methodological advantages, but because isocyanates represent a diverse class of chemically reactive species, concerns exist over isocyanate losses during sample collection. This investigation focused on isocyanate recovery from the tape strip in a controlled (laboratory) setting.

Methods: Three experiments were conducted to assess isocyanate recoveries from tape strips. A well-characterized commercial aliphatic polyisocyanate (DuPont DCX-61, 15.3% total NCO), a blend of polymeric hexamethylene diisocyanate (pHDI) and isophorone diisocyanate species (pIPDI), was used. Tape strips were Cover-Roll (BSN Medical), 2x5cm. First experiment consisted of spiking isocyanates (0.6µg-1.2µg total NCO) on aluminum foil, followed by TS at 1 and 5 min (triplicates) and separate chemical analysis of tape strip and Al foil. A second experiment consisted of spiking isocyanates (0.6µg-1.2µg) directly onto the tape strip. Isocyanates were analyzed similarly at 1 and 5 min (triplicates). A third experiment investigated isocyanate reaction with the tape strip by using ATR-FTIR spectroscopy at different concentrations.

Results: Isocyanate species were quantitated individually, however, for simplicity only results for HDI isocyanurate (major component) and pIPDI are presented. Recoveries for the first two experiments were low and species dependent (<50% and <21% for HDI isocyanurate and pIPDI respectively). ATR-FTIR investigation confirmed that isocyanates reacted with the tape strip material.

Conclusions: This laboratory study suggests that tape stripping sample collection may be highly inefficient due to losses during reaction of the isocyanates with the tape materials. This suggests that tape stripping may not be suitable for accurate isocyanate skin exposure assessment in workplace settings.
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