Foundation for Chemistry
RESEARCH & INITIATIVES

Workshop 4:
Dermal Exposure and Risk Assessment Approaches – Not Just Scratching the Surface

September 21, 2023
11:00 am-1:00 pm EDT

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Moderator Introduction

- Andrew Maier, MS, PhD, CIH, DABT, Fellow AIHA
  - Director of the OARS WEEL Committee
  - Principal Health Scientist at Stantec ChemRisk
  - Former IH in petrochemical industry, associate professor at University of Cincinnati
  - NIOSH Toxicology Fellow

Many Paths, One Goal – Protecting Worker Health

- The goal is to enhance the understanding and appreciation of others' approaches so that each one can leverage insights and data generated by others to most effectively meet their needs.

- Key topics to be covered include identifying data and assessing quality, exposure models, dermal exposure assessment, and risk characterization and management.

Click Here for AIHA Workshop Webpage

Disclaimer

- We are conducting this meeting under the Chatham House Rule. We understand that there might be members of the press in the audience. Audience members are free to use the information received during the workshop, but we ask that neither the identity nor the affiliation of any speaker be attributed to specific information.

- Speakers and panel members are sharing their individual expertise and not representing their employer or other organizations with which they are affiliated.

Workshop Logistics

- Everyone is on mute except for speakers and discussants.
- The chat is disabled.
- Please use the Q&A function to submit any questions or comments during the workshop for follow up by the moderator.
- There will be poll questions later in the program that will appear as a pop-up box. Please participate!
- An evaluation will be available when the workshop ends.
- If you experience technical difficulties, please email Schubert_Fabros@americanchemistry.com

Workshop Hosts

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Workshop Agenda

Time	Topic	Presenters
11:00 am - 11:05 am	Opening remarks	Andrew Maier
11:05 am - 11:30 am	Speaker presentation	Jennifer Sahmel
11:30 am - 11:40 am	Speaker presentation	Andrew Maier
11:40 am - 11:55 am	Speaker presentation	Aaron Murray
11:55 am – 12:00 pm	Break	
12:00 pm – 12:50 pm	Discussion and Audience polls	Facilitated Discussion
12:50 pm - 1:00 pm	Q&A and Next Steps	Andrew Maier

Workshop Topics

- Tools to Estimate Dermal Exposure
- Approaches to Setting Health-Based Benchmarks
- Optimizing Exposure Control Strategies

Speakers and Discussants

Speakers

- Jennifer Sahmel, PhD, CIH, CSP, FAIHA
- Andrew Maier, MS, PhD, CIH, DABT, Fellow AIHA
- J. Aaron Murray

Discussants

- John Allran, MS, DABT
- Rebecca Burton, CIH, CSP
- Naomi Hudson, MPH, Dr.P.H.
- Mark Maddaloni, Dr.P.H., DABT
- Dr. Karen S. Galea

*Dr. Karen Galea was unable to participate in today's workshop as a panelist; however, she contributed discussion points and resources to the presentation.

Meet the Speaker

Jennifer Sahmel, PhD, CIH, CSP, FAIHA
Managing Principal Scientist
Insight Exposure & Risk Sciences

- Managing Principal Scientist with Insight Exposure and Risk Sciences in Boulder, Colorado, with over 25 years of experience in exposure assessment science and workplace health and safety.
- Co-authored over 40 peer-reviewed papers and book chapters on exposure and risk assessment, and given presentations in multiple regions of the world on topics related to exposure assessment.
- Prior to Insight, worked at Cardno ChemRisk, LLC, the U.S. EPA's Office of Pollution Prevention and Toxics, the National Park Service, Comprehensive Health Services at NASA's Goddard Space Flight Center, and FMC Corporation.
- Earned her MPH degree in Environmental Health and Industrial Hygiene from the University of California at Berkeley and her PhD in Environmental Health at the University of Minnesota.

Top 10 List: State of the Science for Dermal Exposure and Risk Assessment

Jennifer Sahmel, PhD, CIH, CSP, FAIHA
Managing Principal Scientist
Insight Exposure and Risk Sciences
Boulder, CO

1. Skin exposures can pose a bigger concern than inhalation exposures

Skin vs. Inhalation Exposures

- Inhalation exposures - traditionally perceived as most important exposure pathway for chemicals
  - Quantitative risk-based OELs (RELs, PELs, TLVs)
  - Control methods
  - Sampling and analytical methods

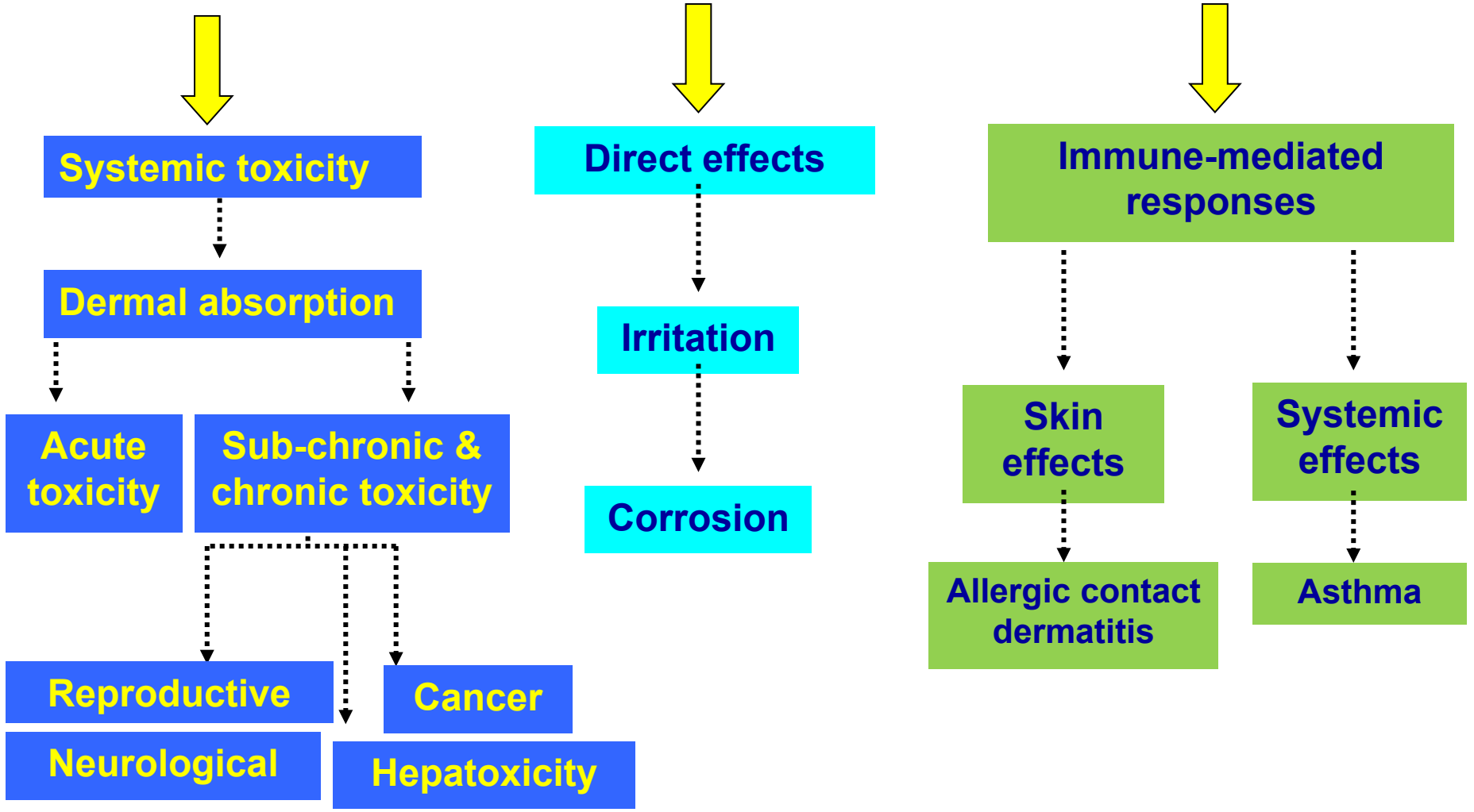
- Skin contact - often perceived to be a secondary exposure pathway
  - OELs not available to indicate a “safe” level of skin exposure
  - Few OSHA Standards, NIOSH Criteria documents
  - Controls: Use chemical protective clothing (?)
    - A professor of chemistry at Dartmouth College died in 1997, less than a year after two drops of dimethylmercury spilled onto her latex gloved hand

Bureau of Labor Statistics (BLS) Data, 2012

- Over 13 million workers in the US are potentially exposed to chemicals that can be absorbed through the skin
- Largest category of non-fatal occupational illness; 15% of all non-fatal occupational illness.
- According to NIOSH, “Standardized methods are currently lacking for measuring and assessing skin exposures”

2. The skin can be either an *exposure route* or a *target organ*

Skin as Exposure Route or Target Organ



Stratum Corneum (SC)

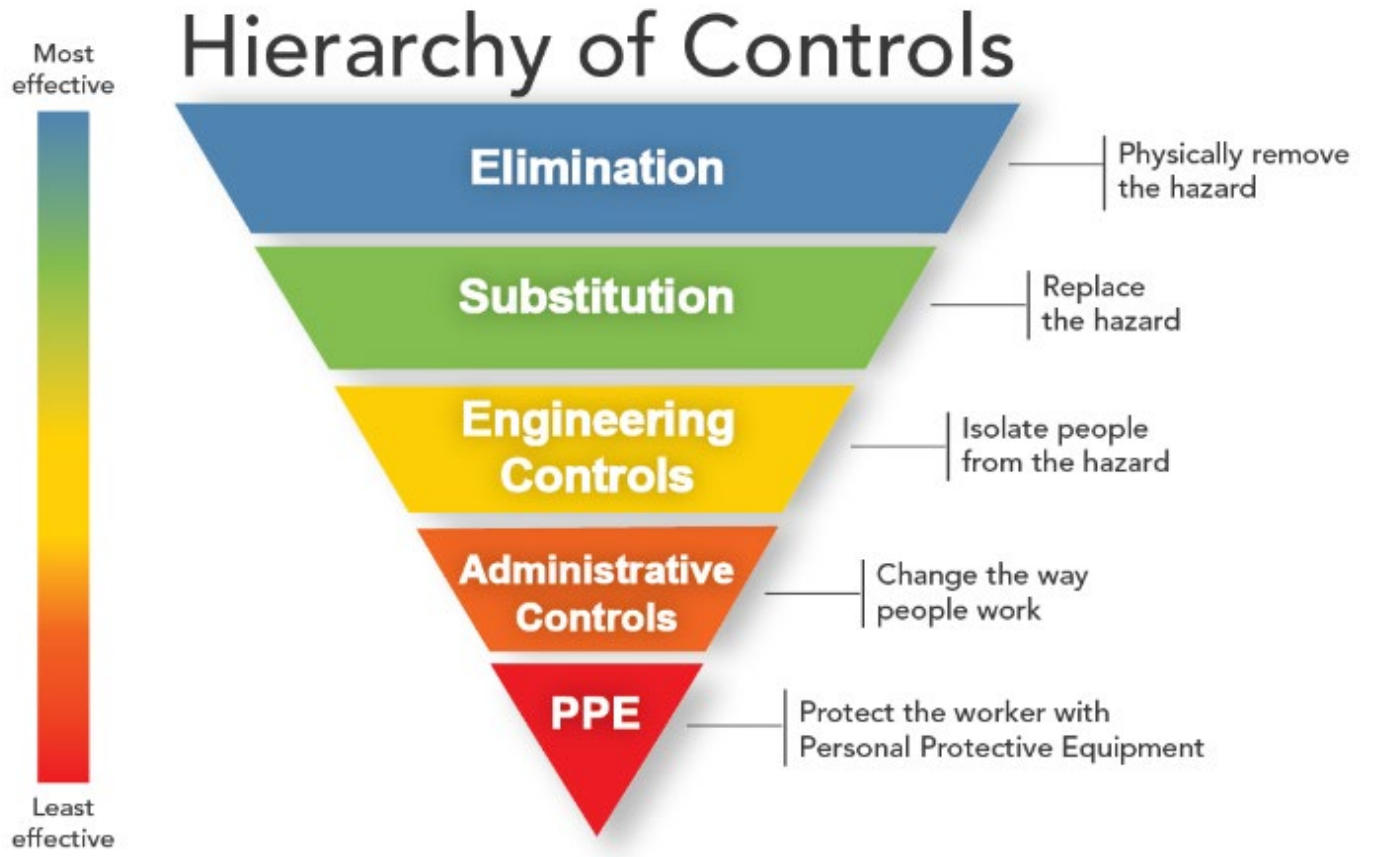
- Principal barrier
  - Comprised of dead flattened cells
  - SC is a thin porous membrane; not a solid impenetrable membrane
- The thickness of the SC varies across the body, but only ~15 μm thick on most of the body
  - In comparison, the typical human hair is 50-70 μm thick and 3M Scotch© tape is 25 μm thick
  - Palms and soles thicker, ~600 μm

Exposed Dose vs. Absorbed Dose

- Many studies simulate high dermal loads
- As loading increases, percent absorbed decreases
- Low dermal loads that are typical of occupational exposures can be difficult to mimic in a study
- Limits of detection can be an issue for low dermal loads

3. True or False? PPE is the right control for dermal hazards

The Hierarchy of Controls and Dermal Risk Assessment



?

https://vula.uct.ac.za/access/content/group/9c29ba04-b1ee-49b9-8c85-9a468b556ce2/DOh/Module%204%20_Toxom%20II_/toxom2/GTODD/Gloves3.htm

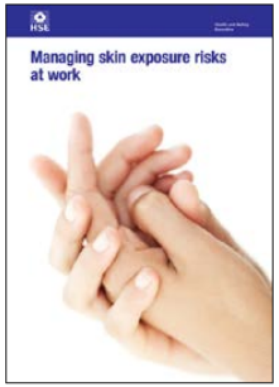
https://www.cdc.gov/niosh/topics/hierarchy/default.html

HSE Dermal Exposure Prevention

HSE

Health and Safety Executive

Managing skin exposure risks at work



HSG262 (Second edition)
Published 2015

Many materials used at work can affect the skin or can pass through the skin and cause diseases elsewhere in the body. If you are an employer, health and safety adviser, trainer or safety representative, this book provides practical advice to help you prevent these disabling diseases. It covers the protective role of the skin, ill health arising from skin exposure, recognising potential skin exposure in your workplace, and managing skin exposure to prevent disease.

Many employers don't realise they have legal duties to assess the health risks from skin exposure to hazardous substances at work. This book can help you comply with those duties by preventing or controlling exposure to the hazards by using and maintaining suitable controls.

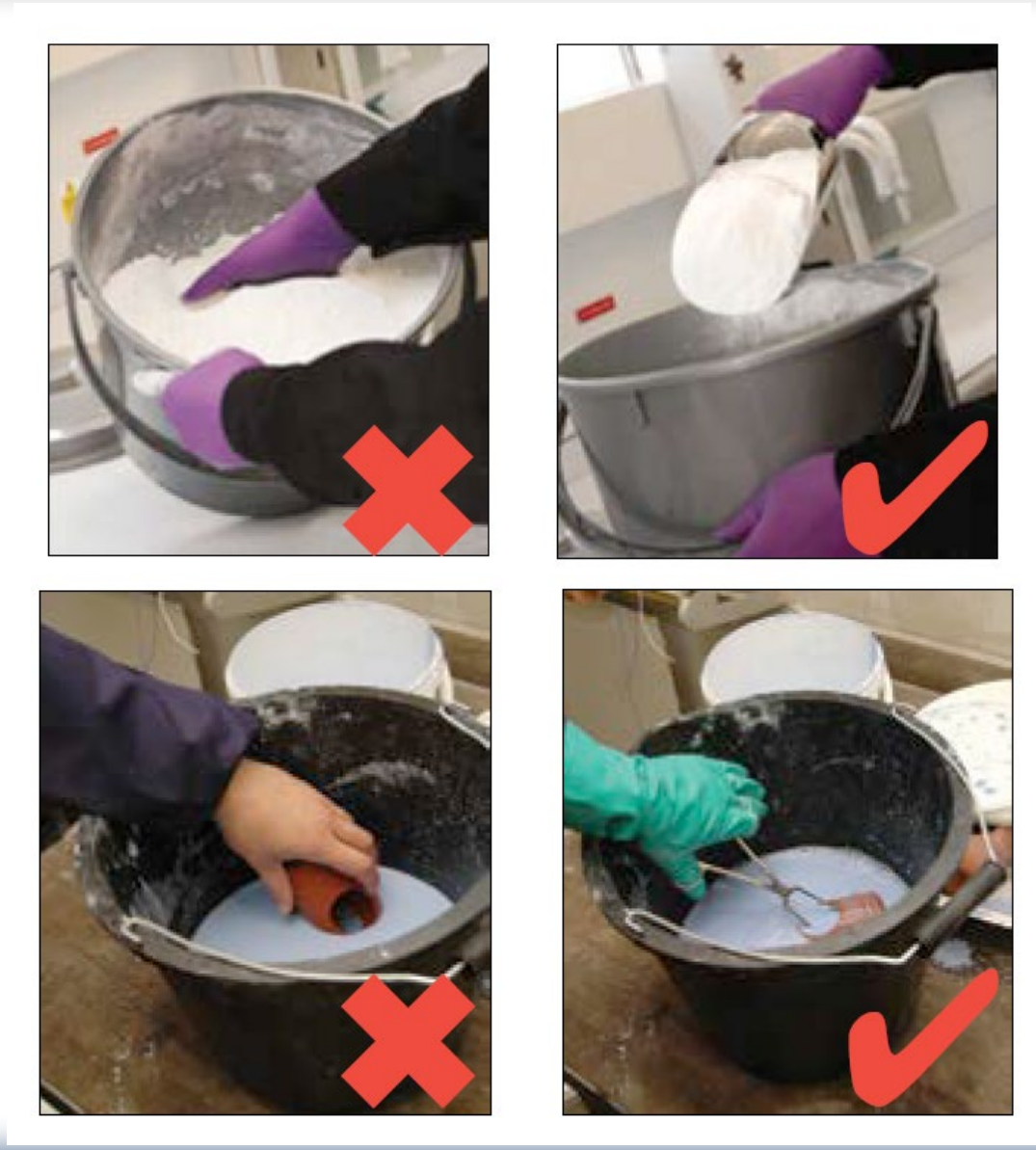
There is advice on assessing and managing risks, reducing contact with harmful materials, choosing the right protective equipment and skincare products, and checking for early signs of skin disease.

The document also contains a series of case studies drawn from a wide range of industries.

The guidance in this edition has been refreshed and references updated.

https://www.hse.gov.uk/pubns/priced/hsg262.pdf

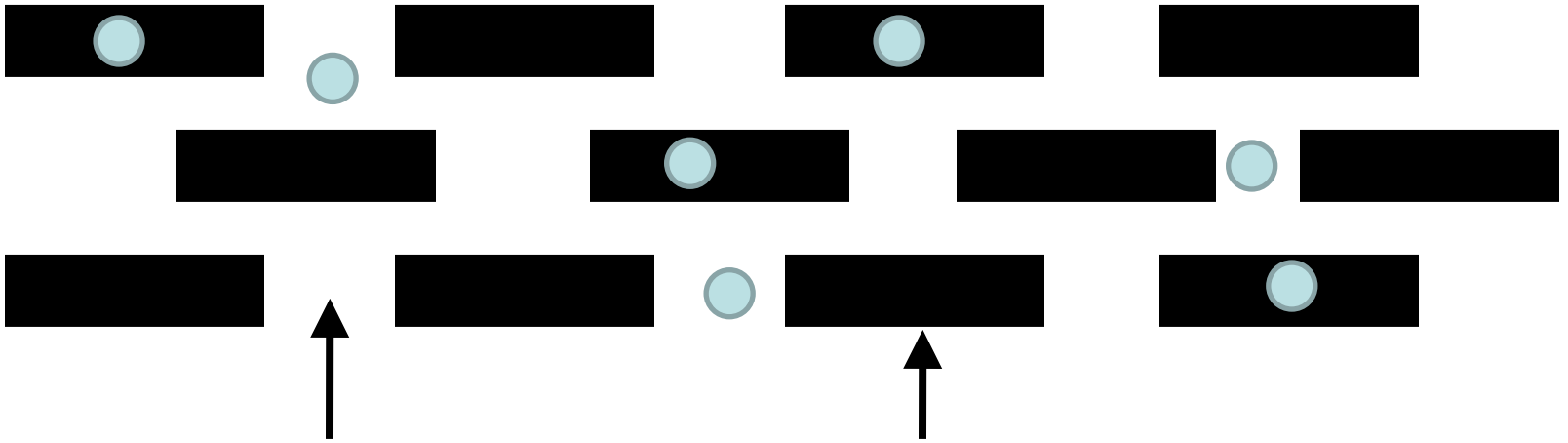
HSE: Dermal Hazard Controls



4. Substances that have both water solubility and fat solubility properties are often the most readily absorbed into the skin

Skin Absorption: Bricks and Mortar

- Multiple pathways for skin absorption
  - Fat-soluble (lipophilic) chemicals
  - Water-soluble (hydrophilic) chemicals



Factors that affect dermal penetration:

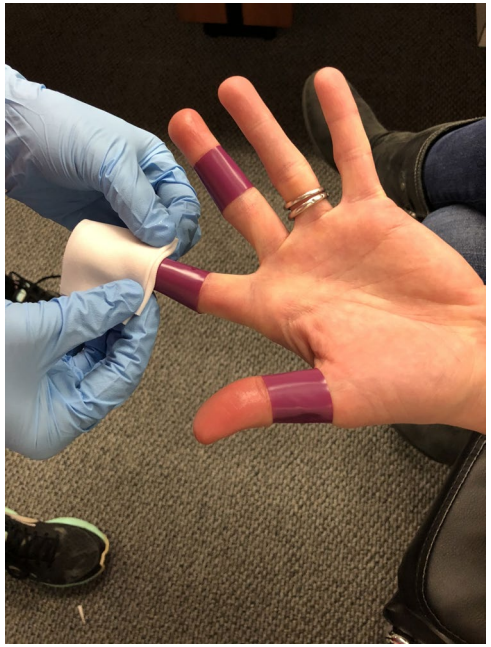
- Vapor pressure (<5 mmHg)
- Molecular weight/size (< 200)
- Solubility (log $K_{o/w}$) (1-3)
- Condition of the skin
- Covered vs. uncovered
- Exposure conditions

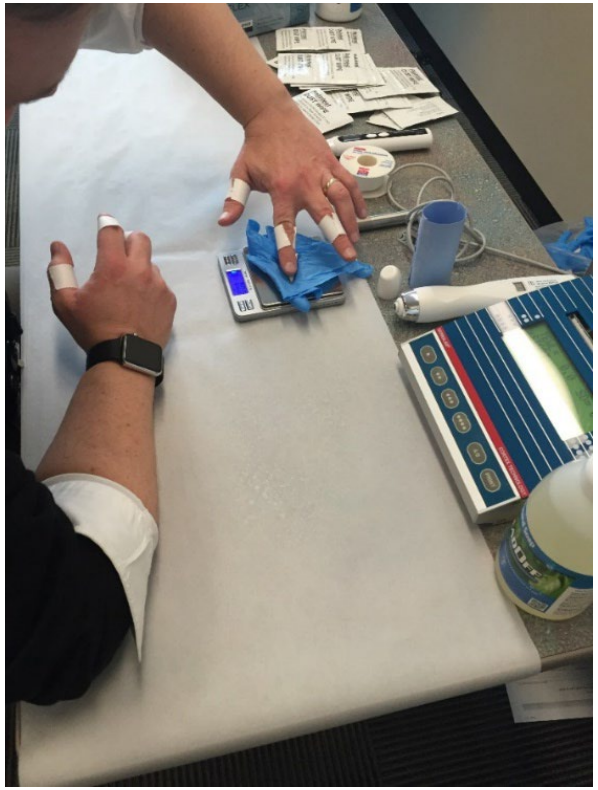
- In general, a log $K_{o/w}$ value between 1 and 3 suggests good dermal absorption potential

5. The mass of dermal loading is a key factor in accurate dermal exposure and risk assessment

Pathways for Dermal Transfer

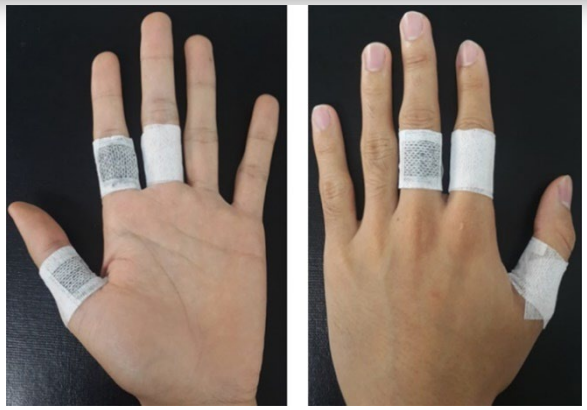
1. Skin-to-saliva
2. Object-to-skin
3. Skin-to-skin
4. Skin-to-clothing
5. Skin-to-surface
6. Skin-to-gloves

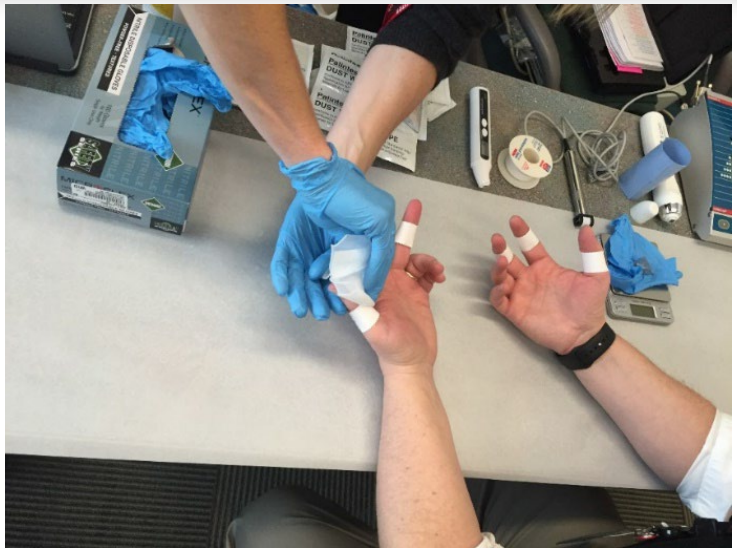


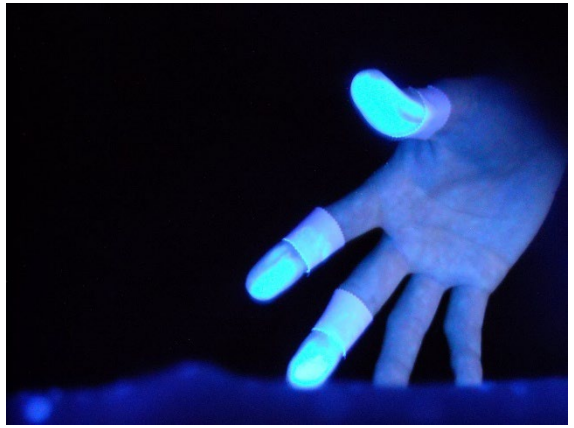


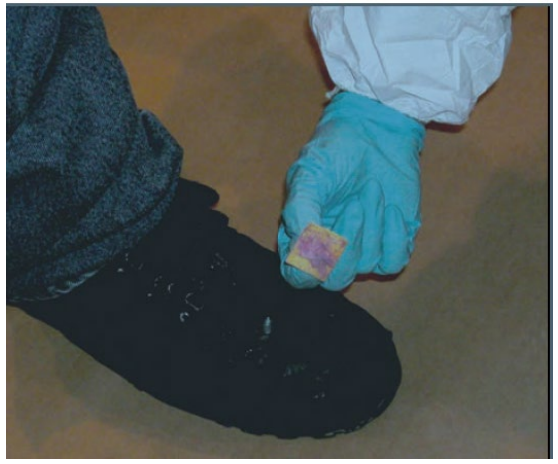
Methods for Sampling of Dermal Transfer

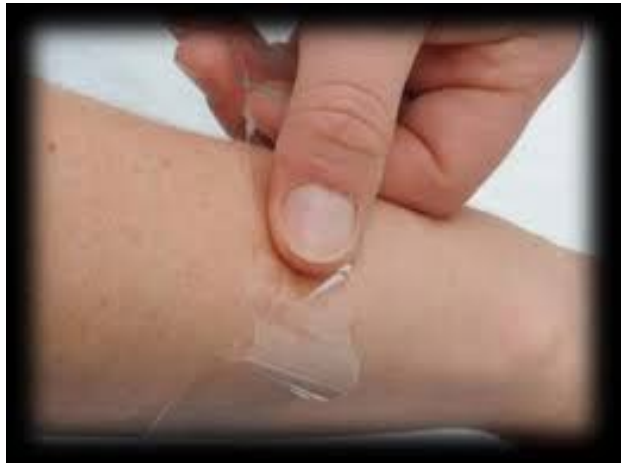
- Dermal sampling
  - Skin Wiping
  - Skin Washing
  - Tape Stripping
  - Interception methods
  - Colorimetric indicators
  - Fluorescent tracers
- Biological monitoring
  - Urine
  - Saliva
  - Blood
- NIOSH methods available for surface skin loading of lead
- ACGIH BEI limits available for biological monitoring





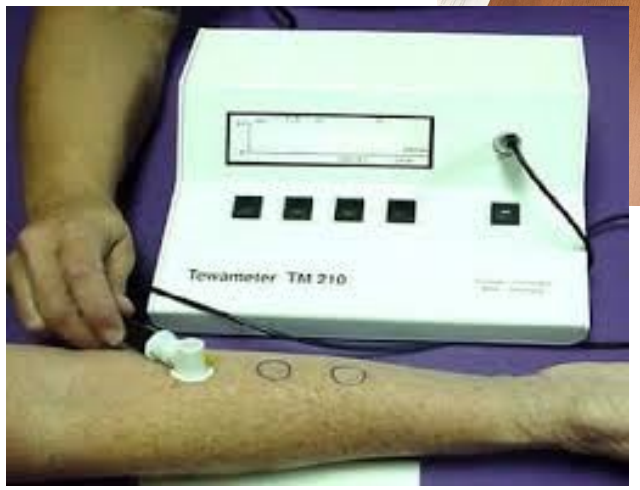






Potential Influences on Dermal Transfer

- Physical Nature of a Solid Material
- Texture of Contact Surface
- Skin Contamination by Body Location
- Contact Duration
- Contact Pressure
- Nature or Motion of Contact
- Repeated Contacts
- Skin or Surface Hydration (or Wetting)
- Surface Loading
- Relative Influence of Key Effects on Surface Loading



6. Repeated dermal contacts is an important, but often complex, factor in dermal exposure and risk assessment

Why are Repeated Contacts Important?

- Several studies have reported a statistically significant association between dermal transfer and the number of contacts
- Transfer has been reported to be approximately linear for the first 5 to 7 contacts, and then appears to approach a mass balance

Brouwer et al. (1999); Zainudin and Semple (2004); Christopher et al. (2007); Sleeuwenhoek et al. (2006); Cohen Hubal (2005, 2008); Rodes et al. (2001)

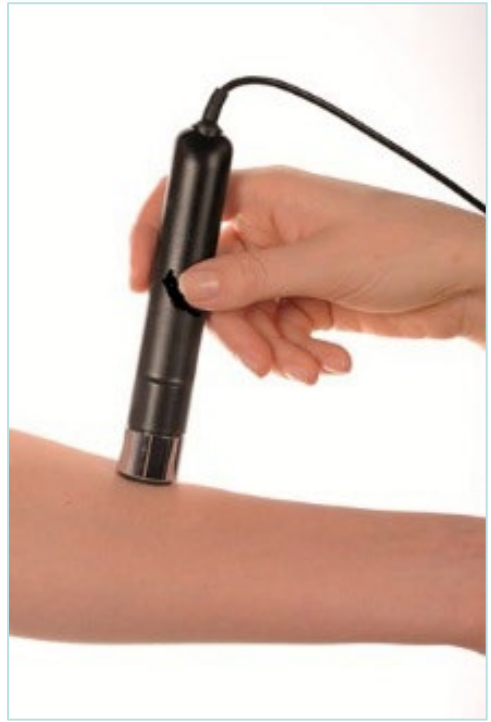
Dermal Transfer Efficiency Sampling: Key Findings for Elemental Lead

- For repeated contacts, transfer showed non-linear increases from one contact to five contacts, and appeared to approach a mass balance with ten contacts
- No measurable transfer occurred for skin-to-surface and skin-to-clothing following repeated contacts
- For skin-to-gloves, transfer was consistently measurable after one or more contacts

7. The skin hydration level can have effects on dermal risk assessment

Transepidermal Water Loss (TEWL) and Skin Hydration

- TEWL represents the diffusion of condensed water through the SC
- Skin hydration reflects the water content of the SC
- An altered skin barrier function marked by an elevated TEWL and observed in skin diseases (e.g. atopic dermatitis and psoriasis) and applications of solvents and detergents
- Elevated TEWL values in a disturbed skin barrier can be correlated with low hydration of the SC
- Disturbed, compromised skin barrier may increase dermal absorption of chemicals and other large substances (e.g. particulates), which cannot penetrate the intact skin



TEWL and HI Measurement Comparisons

- Baseline TEWL is independent of age among persons in their working years
- TEWL values may be slightly lower in persons over 60 years old
- Insufficient evidence for gender affects on TEWL
- Influence of race/ethnicity on both TEWL and skin hydration is unknown.
- TEWL values vary among anatomical regions of the body
- TEWL values tend to be highest on the palm and may be higher on the dominant forearm

- Skin hydration, however, decreases slowly but steadily with age
- Insufficient evidence for gender affects on skin hydration
- Influence of race/ethnicity on both TEWL and skin hydration is unknown
- It appears as though there are no apparent differences between skin hydration of symmetrical sites of the body.

8. There are a number of established methods for dermal exposure and risk assessments

Deterministic vs. Knowledge-Based Models

- Deterministic and Knowledge-Based Models
- Models often based on simplistic assumptions and default loading data for dissimilar substances or unknown relevance
- Although uptake has been a focus of dermal models, dermal loading on the skin is a critical parameter that can result in substantial uncertainty

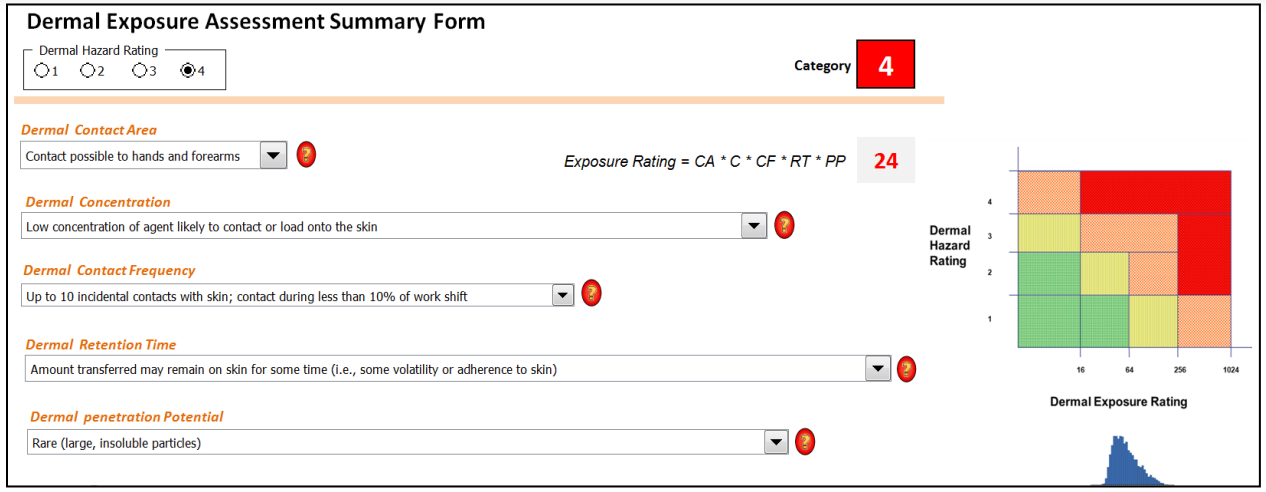
Some Common Dermal Exposure Assessment Models

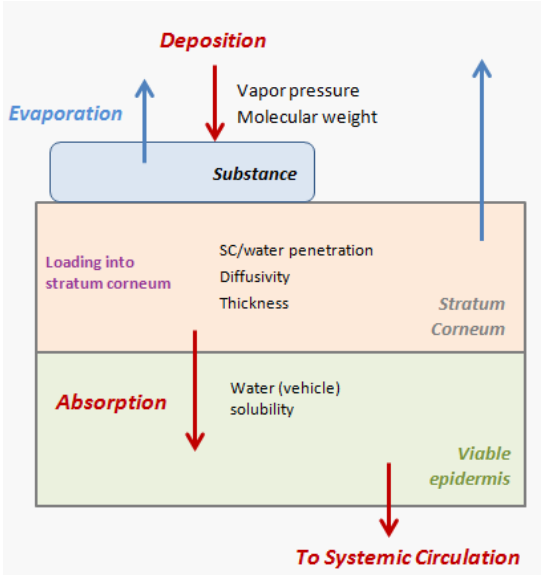
- EPA 1992: dermal uptake based on simple molecule properties (Potts and Guy; revised Robinson) (ABSORPTION, also LOADING)
- RISKOFDERM 2002: dermal contact and uptake based on description of workplace using default descriptors (LOADING and ABSORPTION)
- DREAM 2003: semi-quantitative model based on dermal contact and uptake characteristics (LOADING and ABSORPTION)
- EPA models by office: various approaches to dermal exposure, mainly to soil and water
- AIHA models: qualitative model and simple additive quantitative loading model (LOADING); IH SkinPerm (ABSORPTION)
- Dermal DNELs: worst case surface area and uptake model

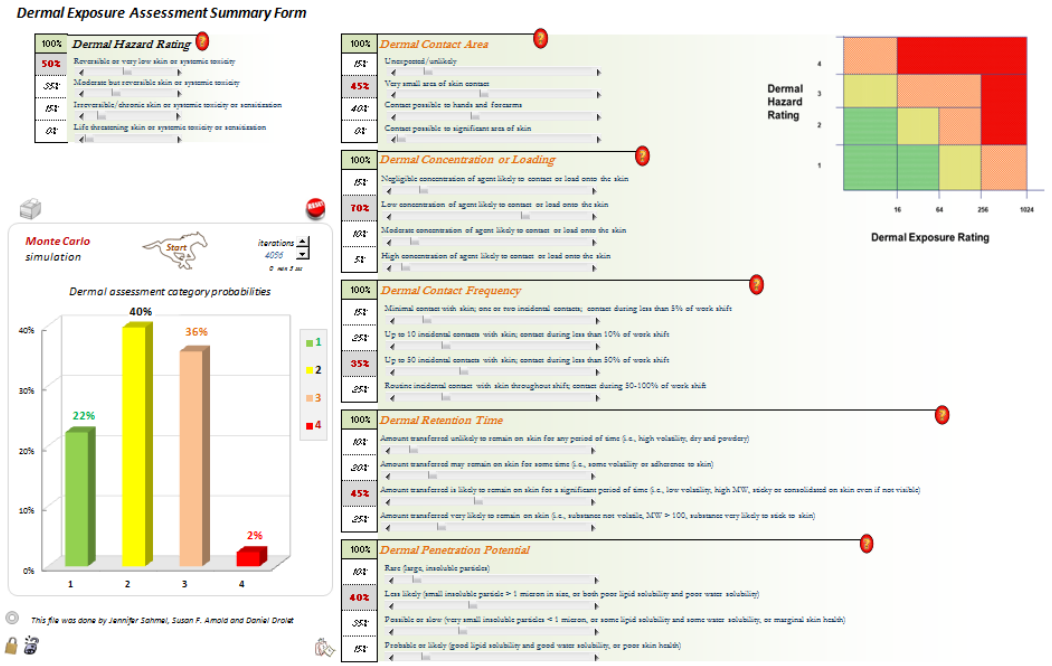
Tools & Resources

- Multiple tools and resources are available:
  - SDS, Flow process diagrams, etc.
  - *Globally Harmonized System* (*GHS*) of Classification and Labeling of Chemicals
  - Skin Notations (NIOSH, ACGIH, OSHA, SCOEL, AIHA)
  - TOXNET
  - EU Risk Phrases
  - REACH
  - Published and unpublished studies

AIHA Dermal Tools



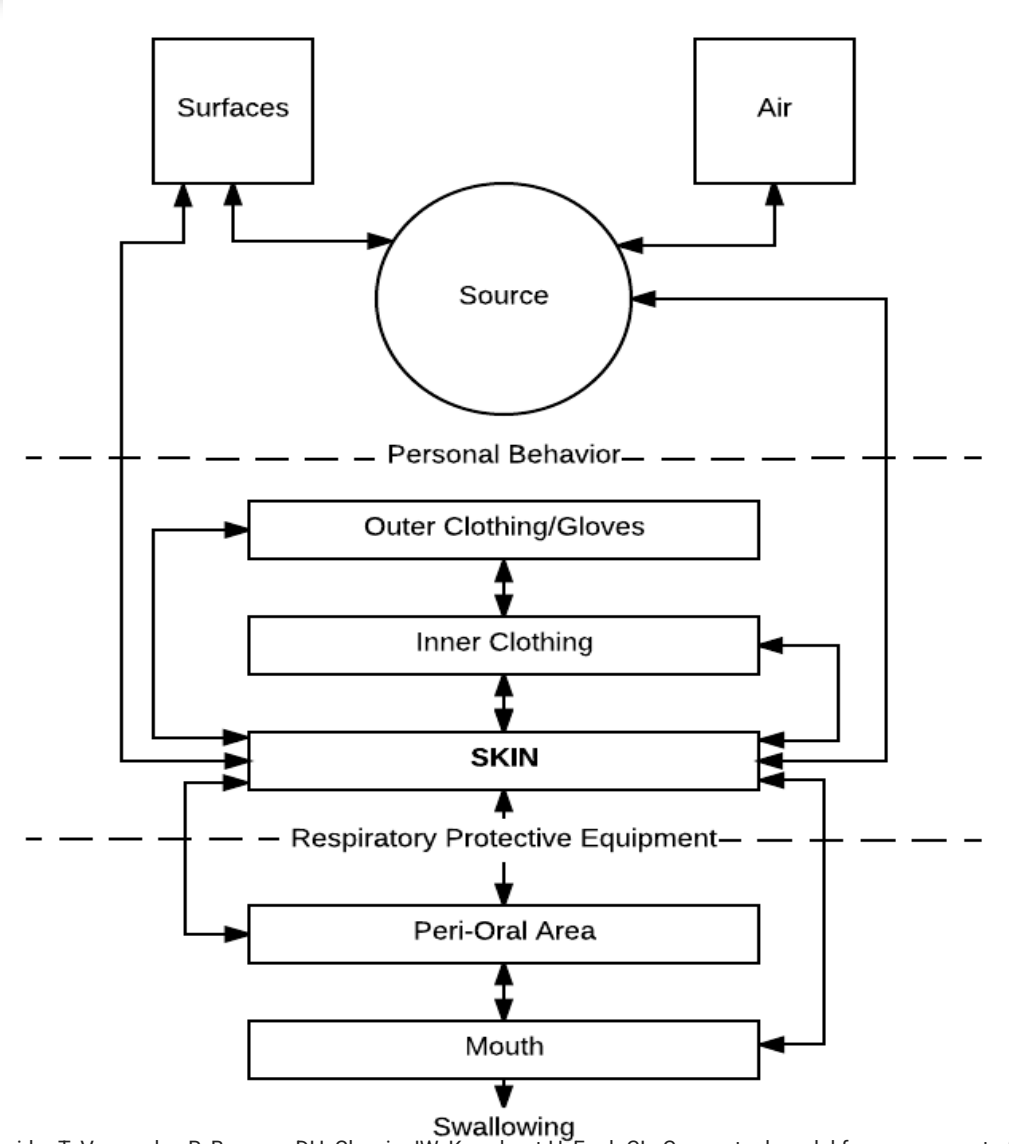




https://www.aiha.org/public-resources/consumer-resources/apps-and-tools-resource-center/aiha-risk-assessment-tools

9. The dermal risk assessment process can be improved using a systematic approach

Refined Dermal Conceptual Model: Schneider et al./Gorman Ng et al.



The dermal exposure conceptual model developed by Schneider *et al. (1999) consists* of six compartments:

- source
- surface contaminant layer
- air
- outer clothing contaminant layer
- inner clothing contaminant layer
- the skin contaminant layer

In both the conceptual models, substances can move between compartments, be absorbed or exit the system by 'decontamination'

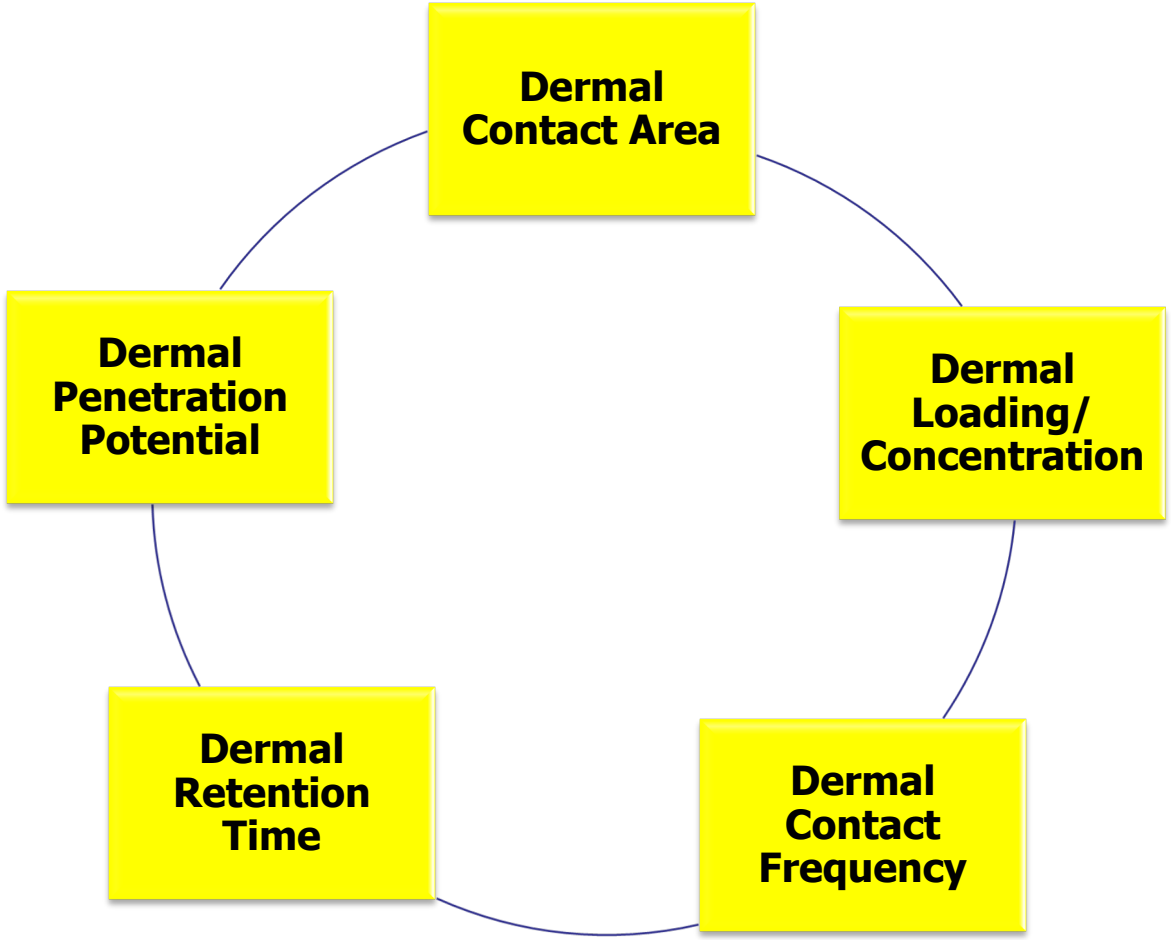
Updated by Gorman Ng et al., 2013 to include inadvertent ingestion pathways

Schneider T, Vermeulen R, Brouwer DH, Cherrie JW, Kromhout H, Fogh CL. Conceptual model for assessment of dermal exposure. Occup Environ Med. 1999 Nov;56(11):765-73. doi: 10.1136/oem.56.11.765. PMID: 10658563; PMCID: PMC1757678.

Gorman Ng M, Semple S, Cherrie JW, Christopher Y, Northage C, Tielemans E, Veroughstraete V, Van Tongeren M. The relationship between inadvertent ingestion and dermal exposure pathways: a new integrated conceptual model and a database of dermal and oral transfer efficiencies. Ann Occup Hyg. 2012 Nov;56(9):1000-12. doi: 10.1093/annhyg/mes041. Epub 2012 Jul 17. PMID: 22805749.

Dermal Exposure Assessment Heuristics

Use a *Heuristics* approach to characterize the following five dermal exposure determinants:



10. There are resources readily available to assist with dermal risk assessment parameters

Semi-Quantitative Model: Dermal Exposure

$$D = (S)(Q)(WF)(FQ)(ABS)$$

D = potential dose (mg/day)
S = surface area of contact (cm^2)
Q = amount retained on the skin (mg/cm^2)
WF = C = concentration of chemical (percent by weight)
FQ = number of contact events per day (**additive**)
ABS = absorption (default 100% absorption into skin; or empirically derived data may be appropriate)

Ignacio and Bullock, eds. A Strategy for Assessing and Managing Occupational Exposures, 3rd ed. Fairfax, VA: AIHA Press, 2006. Appendix II: Dermal Exposure Assessments.

Default Dermal Model Parameters

1. Frequency of contact (FQ) can be readily counted or estimated through observation

2. Weight fraction (WF) of the chemical may be listed on the MSDS or can be estimated

3. Surface area (S) can be estimated using the EPA's Exposure Factors Handbook (EFH)

4. Amount retained/loading (Q) can be measured through dermal sampling

5. Absorption (ABS) can be estimated using a tool called IH SkinPerm

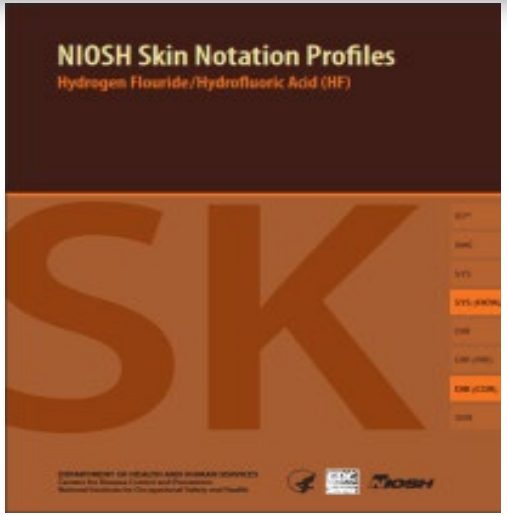
Example SK Assignments

HF

Table 1. Summary of the SK assignment for HF

Skin notation	Critical effect(s)	Available data
SK: SYS (FATAL)	Cardiac arrhythmia; systemic fluorosis; hypocalcemia, hyperkalemia; hypomagnesemia	Sufficient human data; sufficient animal data
SK: DIR (COR)	Skin corrosivity	Sufficient human data; sufficient animal data

https://www.cdc.gov/niosh/topics/skin/skin-notation_profiles.html

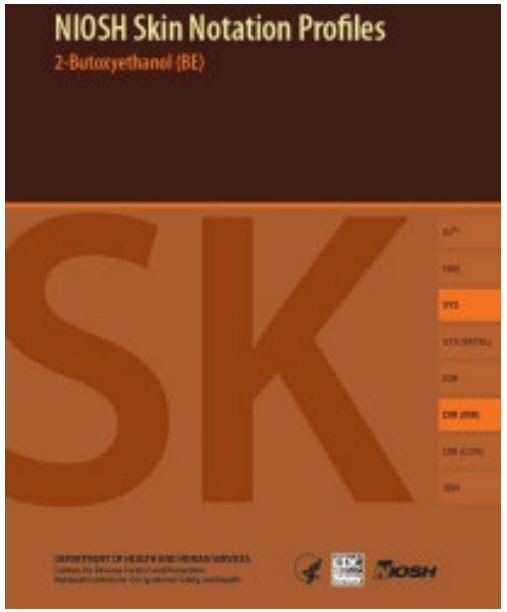


2-Butoxyethanol (BE)

Table 1. Summary of the SK assignment for BE

Skin notation	Critical effect	Data available
SK: SYS	Hemoglobinuria (and other blood effects)	Limited human data; sufficient animal data
SK: DIR (IRR)	Skin irritation	Limited human data; sufficient animal data

https://www.cdc.gov/niosh/docs/2011-152/default.html



Ten Points: Dermal Exposure and Risk Assessment

1. Skin exposures can pose a bigger concern than inhalation exposures
2. The skin can be either an *exposure route* or a *target organ*
3. True or False? PPE is the right control for dermal hazards
4. Substances that have both water solubility and fat solubility properties are often the most readily absorbed into the skin
5. The mass of dermal loading is a key factor in accurate dermal exposure and risk assessment
6. Repeated dermal contacts is an important, but often complex, factor in dermal exposure and risk assessment
7. The skin hydration level can have effects on dermal risk assessment
8. There are established methods for dermal exposure and risk assessments
9. The dermal risk assessment process can be improved using a systematic approach
10. There are resources readily available to assist with dermal risk assessment parameters

Questions?

Jennifer Sahmel, PhD, CIH, CSP, FAIHA

Jennifer.Sahmel@InsightRisk.com

Meet the Speaker

- Andrew Maier, MS, PhD, CIH, DABT, Fellow AIHA
  - Director of the OARS WEEL Committee
  - Principal Health Scientist at Stantec ChemRisk
  - Former IH in petrochemical industry, associate professor at University of Cincinnati
  - NIOSH Toxicology Fellow

Status and Choices of Dermal Health Benchmarks

Andrew Maier, MS, PhD, CIH, DABT, Fellow AIHA

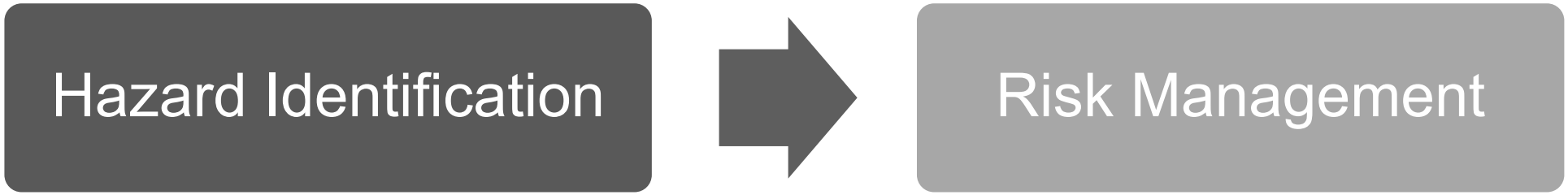
Director of the Occupational Alliance for Risk Science, WEEL Committee

Principal Health Scientist at Stantec ChemRisk

September 21, 2023

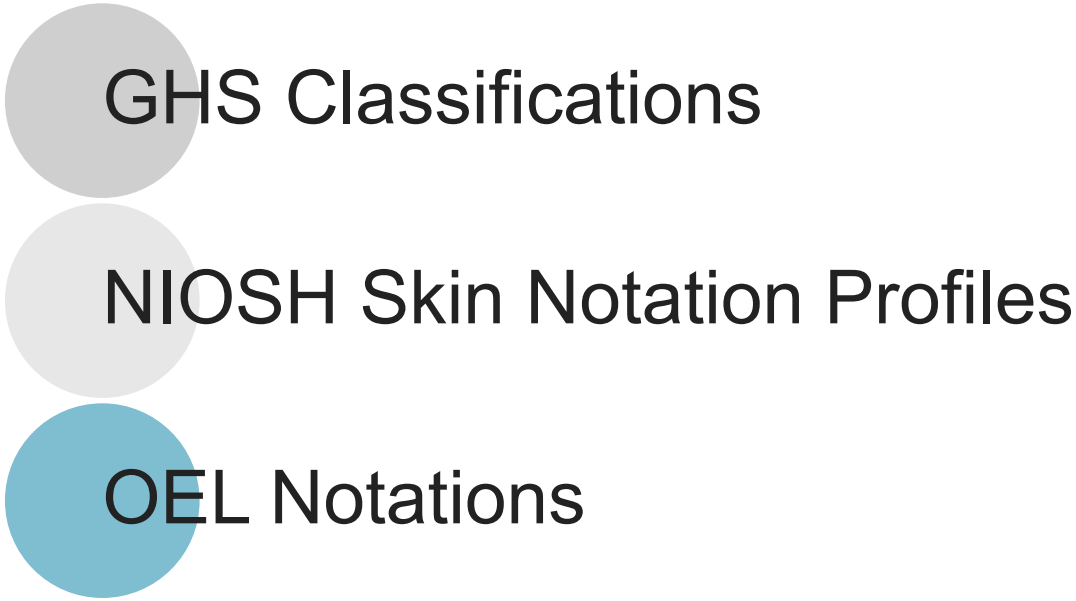
Dermal Risk Assessment has Evolved

Traditionally…



Moving toward…

Hazard Assessment Tools



Existing methodology are not interchangeable.
User must know the criteria for each.

Dose Response Approaches

Systemic Dose	µg/kg/day
Skin Dose	µg/cm^2/skin
Surface Limits	µg/cm^2/surface
Internal Dose	Biological Exposure Index

ACGIH TLV-SL Methodology

Threshold Limit Value-Surface Limit

Intended to supplement airborne TLVs®

https://www.acgih.org/science/tlv-bei-guidelines/tlv-chemical-substances-introduction/

EPA Approaches

- Most approaches involve systemic dose, many are factors based
- Slightly variable across program offices

Pesticides

Superfund

TSCA

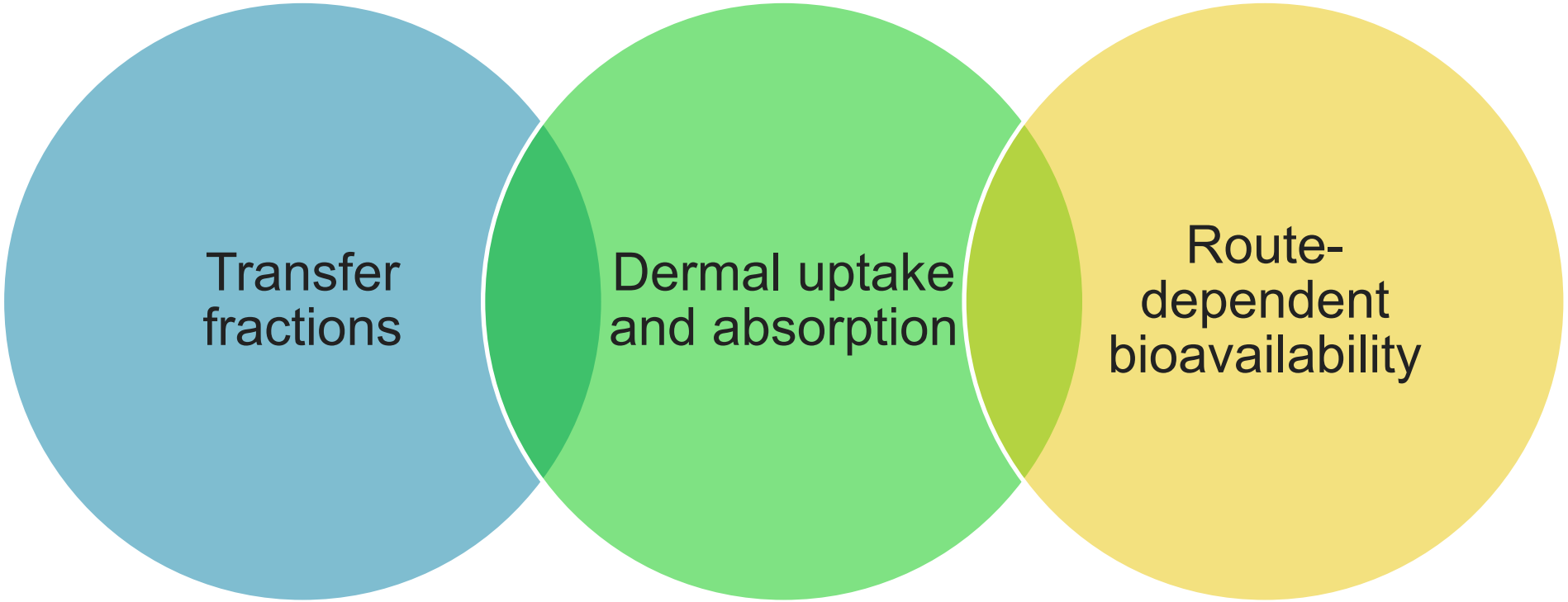
REACH DNELs

- Derived No-Effect Level (DNEL)
- Derived for dermal exposure

https://www.ecetoc.org/wp-content/uploads/2014/08/ECETOC-TR-110-Guidance-on-assessment-factors-to-derive-a-DNEL.pdf

https://echa.europa.eu/documents/10162/17224/information_requirements_r8_en.pdf

Key Assumptions



Meet the Speaker

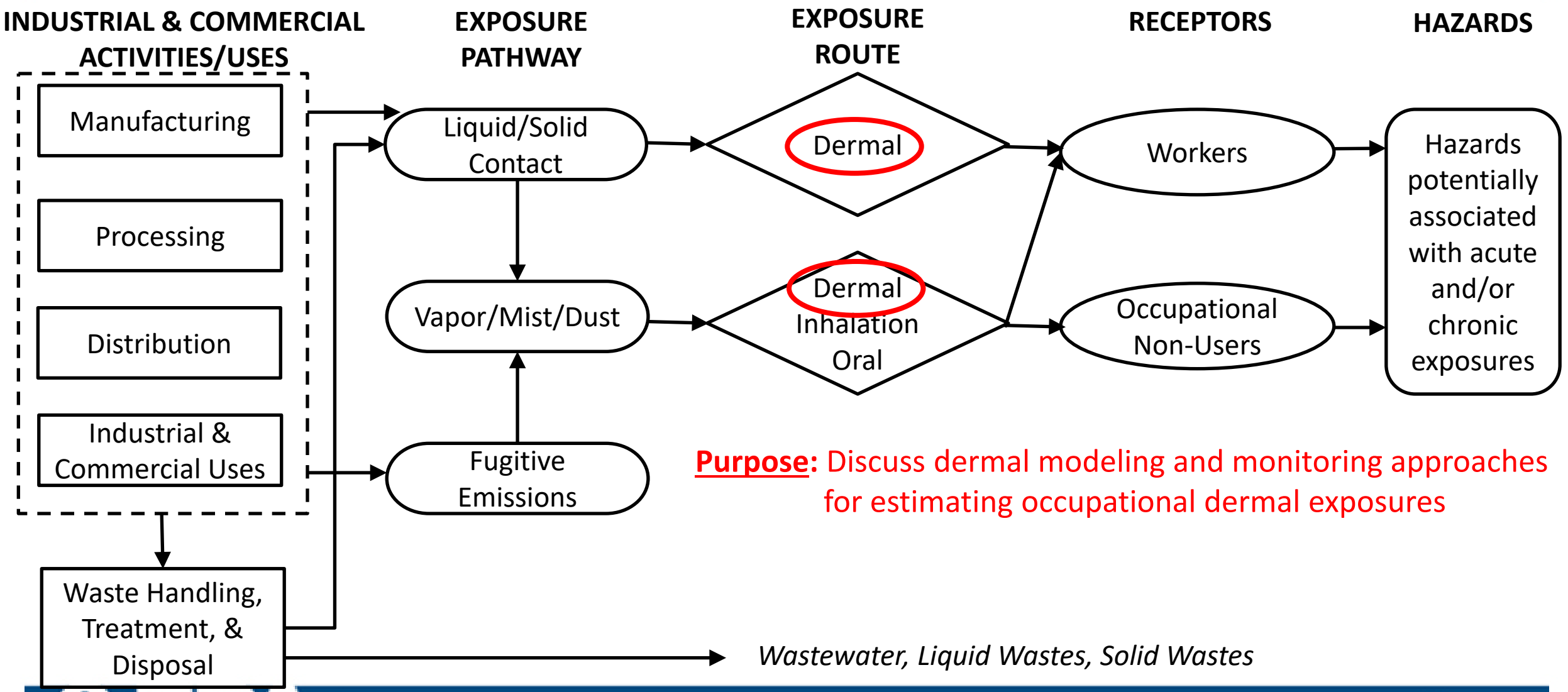
J. Aaron Murray
Chemical Engineer
U.S. Environmental Protection Agency

- Originally from Cleveland, Ohio
- B.S. in Chemical Engineering from Rose-Hulman Institute of Technology
- M.S. in Chemical Engineering from the University of Colorado, Boulder
- U.S. Peace Corps service in southwestern Uganda
- Recent industrial experience
  - Technical Director for snowmaking technology company
  - Process Engineer for high-precision steel component manufacturer

Dermal Exposure Modeling and Monitoring for Occupational Exposure Assessments

J. Aaron Murray
U.S. Environmental Protection Agency
Office of Chemical Safety and Pollution Prevention

Pathways and Routes of Exposure



Purpose: Discuss dermal modeling and monitoring approaches for estimating occupational dermal exposures

Models for Assessing Dermal Exposure

Dermal Model for Finite Doses – Fractional Absorption

Model Applicability

- "Splash-type" exposures
- Non-immersive and non-occluded scenarios
- Liquids: < 10 µL/cm^2, Solids: 1 – 5 mg/ cm^2
  (OECD 428 Guideline for Skin Absorption Testing)

$$D_{exp} = Q_u \times f_{abs} \times SA \times FT \times Y_{derm}$$

D_{exp} = Dermal Exposure (mg/day)
Q_u = Dermal Loading (mg/cm^2-event)
f_{abs} = Fractional Absorption
SA = Area of Contact (cm^2)
FT = Frequency of Contact (events/day)
Y_{derm} = Weight Fraction of Chemical

Challenge:
Choice of model for a given scenario is not always obvious

Dermal Model for Infinite Doses – Flux-Based Permeability

Model Applicability

- Continuous supply of chemical against skin
- Immersive or occluded scenarios
  - *Example:* Material trapped under glove
- Liquids: >100 µL/cm^2, Solids >10 mg/ cm^2
  (OECD 28 Guidance Document for the Conduct of Skin Absorption Studies)

$$D_{exp} = K_p \times C \times SA \times t_{exp}$$

D_{exp} = Dermal Exposure (mg/day)
K_p = Skin Permeability Coefficent (cm/hr)
C = Chemical Concentration (mg/cm^3)
SA = Area of Contact (cm^2)
t_{exp} = Contact Time (hrs/day)

Modeling and Monitoring Parameters of Dermal Exposure

PARAMETER	MODELING APPROACH	MONITORING APPROACH
DERMAL LOADING	**Knowledge-based models**: RISKOFDERM, DREAM **Study Examples**: Cinalli 1992, Lansink 1996 **Challenge**: Models and studies may not be applicable to all representative conditions	**Interception methods**: Gauze, Charcoal pad **Removal methods**: Wiping, washing **Challenges**: • Monitoring of volatile substances • Representativeness of monitoring data
FRACTIONAL ABSORPTION	**NIOSH model**: Finite Dose Skin Permeation Calculator **AIHA model**: IH Skin Perm **Challenge**: Models may not be applicable to all representative conditions	***In vitro* absorption testing**: Human & Animal Skin ***In vivo* absorption testing**: Animal with PBPK modeling **Challenges**: • Study conditions (*e.g.*, diluents) • Utilization of data (*e.g.*, *in vitro*/*in vivo* extrapolation)
SKIN PERMEABILITY COEFFICIENT	**Statistical regression**: Model using p-chem properties (Kow, MW) and regression analysis of chemical dataset **Regression Example**: Potts & Guy 1992 **Challenge**: Models may not be applicable to all representative conditions	

Challenges and Opportunities in Occupational Dermal Exposure Assessment

Challenge 1: Selecting appropriate dermal exposure model for given exposure scenario

- ***Opportunity*** *- Development of clear decision logic for choosing appropriate dermal model*

Challenge 2: Modeling dermal exposure parameters

- ***Opportunity*** *- Development of more robust models that are applicable to broad range of conditions*

Challenge 3: Dermal monitoring in the workplace

- ***Opportunity*** *- Protocol development for dermal monitoring of volatile substances*
  - Clear decision logic for representative monitoring based on condition of use

Challenge 4: Utilization of *in vitro* and *in vivo* dermal absorption testing data

- ***Opportunity*** *- Dermal absorption testing that accounts for representative conditions*
  - Further studies to compare in vitro and in vivo absorption results

Challenge 5: Incorporation of tiered approach for occupational dermal exposure assessments

TIER 1: Conservative Assumptions, TIER 2**:** Published Literature Values, TIER 3: Condition-Specific Evaluation

- ***Opportunity*** *- Streamline dermal exposure assessments through efficient tiered approach*

THANK YOU FOR ATTENDING

QUESTIONS/COMMENTS/DISCUSSION

Foundation for Chemistry
RESEARCH & INITIATIVES

BREAK

11:55am – 12:00pm

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Workshop Discussants

- John Allran, MS, DABT, Existing Chemicals Risk Assessment Division, U.S. EPA
- Rebecca Burton, CIH, CSP, Apple
- Naomi Hudson, MPH, Dr.P.H., Science Applications Branch, Division of Science Integration, NIOSH
- Mark Maddaloni, Dr.P.H., DABT, Stantec ChemRisk
- Dr. Karen S. Galea, Institute of Occupational Medicine (IOM), Edinburgh

*Dr. Karen Galea was unable to participate in today's workshop as a panelist; however, she contributed discussion points and resources to the presentation.

Discussion Questions

1. What resources and tools are available for exposure estimation and assessment? What are the opportunities to improve existing resources?

2. What approaches exist for setting health-based benchmarks for dermal exposure? What are the opportunities to improve these approaches?

3. How can we optimize exposure control strategies and assess efficacy of existing controls such as personal protective equipment?

Poll Question #1a

How often do you conduct *quantitative* dermal exposure assessments in your workplace?

A. Often

B. Periodically

C. Infrequently

D. Rarely

Poll Question #1b

Which of these methods do you primarily use to collect dermal empirical exposure data?

A. Direct sampling (e.g., surface or wipe sampling, etc.)

B. Indirect sampling (e.g., patches, activated carbon pads, etc.)

C. Observations with exposure factors

D. I do not conduct quantitative dermal exposure monitoring

Poll Question #1c

Which of these resources do you primarily use to assist your dermal risk assessment efforts?

A. AIHA Tools (e.g., IH SkinPerm, DRAM)

B. EU Tools (e.g., ART, RISKOFDERM)

C. EPA CHemSTEER

D. None of these

Discussion Question #1

What resources and tools are available for exposure estimation and assessment? What are the opportunities to improve existing resources?

Poll Question #2a

Do you use quantitative dose benchmarks to assist your dermal risk assessment efforts?

A. I primarily use hazard data

B. I supplement hazard data with dose benchmarks

C. I primarily use dose benchmarks

D. I do not conduct dermal risk assessments

Poll Question #2b

Which of the following do you most often rely upon to manage potential risks to dermal exposure in your workplace?

A. Skin Notations or Hazard Profiles (e.g., ACGIH TLV, WEEL, NIOSH, etc.)

B. Surface Limits (e.g., ACGIH TLV-SL, etc.)

C. A dermal equivalent dose (e.g., dermal DNEL, EPA dermal RfD, etc.)

D. Other benchmarks

Discussion Question #2

What approaches exist for setting health-based benchmarks for dermal exposure? What are the opportunities to improve these approaches?

Poll Question #3a

Which control strategy from the hierarchy of controls do you most often implement to manage risks of potential dermal exposure?

A. Elimination or Substitution

B. Engineering Controls

C. Administrative Controls

D. Personal Protective Equipment

Poll Question #3b

With regard to assessing effectiveness of PPE and reducing exposure, I typically:

A. Use selection guidance for a particular chemical from the manufacturer combined with active worker training

B. Measure glove performance empirically (e.g., with wipe sampling)

C. Use biological exposure monitoring

D. Apply other techniques

Discussion Question #3

How can we optimize exposure control strategies and assess efficacy of existing controls such as personal protective equipment?

Questions?

Next steps

- The slides will be available to download following the workshop.
  - Please take advantage of the additional resources provided at the end of the presentation slide deck.
- Please complete your evaluation, available immediately following the end of this webinar and by email. Thank you!
- Look for an article in The Synergist covering today's webinar.
- Consider joining us for the final workshop in the series:
  - **November 9, 2023:** Risk Characterization and Risk Management

Thank You

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Web Models and Resources

- NIOSH Skin Notation Profiles
- Dermal Risk Assessment Model (DRAM)
- IH Skin Perm
- IH Mod 2.0
- Advanced Reach Tool (ART)
- Chemical Screening Tool for Exposures and Environmental Releases (ChemSTEER)
- EPA ExpoBox ToolsStoffenmanager (Developed by TNO)
- European Centre for Ecotoxicology and Toxicology of Chemicals Targeted Risk Assessment (ECETOC-TRA)
  - HESI Tables

Key Literature

- A Strategy for Assessing and Managing Occupational Exposures, 4th Edition. S.D. Jahn, W.H. Bullock and J.S. Ignacio. AIHA Press 2015.
- Naumann BD, Arnold SF. Setting surface wipe limits for skin sensitizers. *Toxicology and Industrial Health*. 2019;35(9):614-625. doi:10.1177/0748233719875365
- Kimmel, Tracy & Sussman, Robert & Ku, Robert & Ader, Allan & Brisson, Michael & Ashley, K. & Lesage, J. & Dean, S.. (2011). Developing Acceptable Surface Limits for Occupational Exposure to Pharmaceutical Substances. Journal of ASTM International. 8. 103480. 10.1520/JAI103480.
- Risk Assessment Guidance for Superfund (RAGS): Part E