WC1: Advances in Assessment of Dermal Exposure and Absorption I

WC1-01

Limitations and Challenges in Assessing Dermal Exposures Within the Workplace

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Abstract: Dermal exposures to chemicals represent significant health risks within many occupational settings. Despite its role as a primary exposure route, limited focus has been placed on measuring or understanding the impact of dermal exposure to chemicals on human health especially when compared to alternative routes, such as inhalation. Numerous limitations and challenges currently exist that restrict the ability of occupational health professionals from effectively assessing and controlling dermal exposures to chemicals. These limitations include: 1) the absence of validated dermal exposure assessment methods and guidelines; 2) incomplete toxicokinetics and toxicodynamics data for specific hazards via the dermal route; 3) deficiencies within the interpretation of available data; and 4) uncertainties associated with the selection of appropriate exposure metrics. When combined, these factors greatly inhibit occupational health professionals from developing authoritative workplace recommendations and risk management practices that account for the contribution of dermal exposures. This presentation will highlight the key limitations and challenges faced by occupational health professionals during the assessment of dermal exposures. Additional emphasis is placed on the refinement of tools and strategies, such as hazard notations and risk prioritization schemes, currently available to close the data gaps.

Keywords: A-aggregate exposure, A-risk assessment, A-workplace, D-occupational

WC1-02

Assessment and Evaluation of Finite Dose Dermal Exposure Data

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Abstract: Regulatory and advisory agencies in the US and Europe have advocated a fractional absorption approach to dermal risk assessment: dermal absorbed dose is calculated as the product of exposure and a fixed fractional absorption. The latter, a chemical-specific quantity, is the fraction of chemical in contact with skin that penetrates and is systemically available. The paradigm exhibits an appealing simplicity, but the fixed fractional absorption approach is problematic. Finite dose dermal absorption experiments offer a prototype of environmental/occupational exposures, and fractional absorption is one easily calculated result. The following observations have evolved from an analysis of finite dose dermal loading conditions: 1. Fractional absorption depends strongly on loading such that the fraction can range from 0 to 1 for a given chemical; 2. Fractional absorption depends on evaporation or sublimation of volatile compounds, which may mask the potential for high absorption of a chemical; 3. Fractional absorption depends on the residence time of the chemical on skin; and 4. Dermal absorption continues (hence fractional absorption increases) after removal of the load. Collectively, these lead to the conclusion that the use of a specified absorption fraction to estimate dermal absorption of a chemical is not valid. A set of analytical tools have been developed to assist in the evaluation and interpretation of finite dose dermal absorption data. These tools advance the science of dermal exposure by expanding the evaluation of such data beyond the examination of fractional absorption.

Keywords: A-risk assessment, D-occupational

WC1-03

A Finite Dose Skin Absorption Calculator for Dermal Risk Assessment

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Abstract: Skin absorption associated with sustained exposure to chemicals at a constant concentration is often estimated using steady-state permeability models, e.g. the Potts-Guy model, and associated maximum flux calculations. These models derive from a steady-state skin permeability database based largely on in vitro permeability studies with hydrated human skin. Various means are used to estimate absorption following transient dermal exposures to arbitrary chemical loads which may or may not significantly deplete during the exposure period. These methods tend to lack rigor and are difficult to apply over a wide range of exposure conditions. We discuss here a computer program, the Finite Dose Skin Absorption Calculator, developed in our laboratories and available on the NIOSH website at http://www.cdc.gov/niosh/topics/skin/finiteSkinPermCalc.html that offers a step forward for transient dermal exposure calculations. The program implements a diffusion/evaporation model incorporating three skin layers plus a vehicle layer that allows for a wide range of exposure conditions including open or occluded skin, wash off and multiple dose scenarios, and variable skin temperature and wind conditions. It is presently limited to neat chemical exposures or exposures involving chemicals in simple solvents such as water, alcohol and triglyceride oils. An Excel™ spreadsheet + add-on version of the program is available for those who desire more flexibility with program operation including batch processing. The program is ready for use, but will undergo stepwise improvements as more advanced components become available.

Keywords: A-exposure models, A-risk assessment, B-pesticides, C-personal care products

WD1: Combining Occupational and Environmental Inhalation Metrics in Pursuit of a Holistic Assessment of Lifetime Exposures I

WD1-01

Large Airborne Particles in the Workplace and Environment

M. Harper; NIOSH, Morgantown, WV

Abstract: Large particles are considered highly important in workplace exposure assessments for one or both of two reasons. Firstly, some particles have a site of health interaction in the nasopharyngeal region, and, secondly, large particles that are absorbed into the body contribute to the total dose in proportion to the cube of their diameter and so can be very influential in systemic poisoning. Particles up to 100 µm aerodynamic equivalent diameter are considered by the workplace size-selective standards of the International Organization for Standardisation (ISO), but even larger particles can be made airborne through energetic mechanisms such as grinding and be projected into a person's breathing zone. Metal grinding, sawing wood, and handling powders (e.g. pesticides) are typical processes that can produce large airborne particles that can have an effect on human health. Large particles have typically not been considered in environmental standards as they are typically thought of as either being absent or inert. However, when present, their potential impact on dose suggests that it might also be prudent to assess their occurrence outside of the workplace. Assessment of exposure to large particles requires careful consideration of the air flows around the person and within a sampler in the design of sampling apparatus.

Keywords: A-aggregate exposure, A-sampling methods, B-particulate matter, C-air

WD1-02

New ISO Aerosol Standard: Focused Fine Particle and Nanoparticle Deposition

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Abstract: Aerosol exposure assessment through sampling according to traditional conventions (inhalable, thoracic, or respirable) is only partially possible. The conventions were set up to give limits on aerosol reaching (rather than depositing in) quite general areas of the respiratory tract. The limits are conservative in covering, rather than pinpointing, a range of human characteristics. Furthermore, the conventions are tailored to fine particles, ignoring details on nanoparticles with diameters less than about 0.5 µm. The recently published international standard, ISO 13138, Sampling Conventions for Airborne Particle Deposition in the Human Respiratory System, may provide a beginning to broadening exposure estimation. Conventions are suggested

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Note: Sessions are numbered as follows:

- First one or two letters indicates day (S=Sunday, M=Monday, Tu=Tuesday, W=Wednesday, Th=Thursday)
- Next letter indicates track/room (A-G for oral sessions, P for posters). Oral session rooms are as follows: A=Grand II, B=5th Avenue, C=Grand Crescent, D=Elliot Bay, E=Vashon I&II, F=St. Helens, G=Puget Sound)
- First numeric digit indicates order of session in the day (1 = early morning, 2=late morning, 3=early afternoon, 4=late afternoon)
- Numeric digits after the dash are unique abstract numbers indicating order within the session

For example, MA1-1 is the first talk in a Monday early morning oral session in track A and will be held in Grand II.

SUNDAY, OCTOBER 28, 2012

MONDAY, OCTOBER 29, 2012