Biological Monitoring Without Limits
What is $N_q$

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Topics for Discussion

• Biological monitoring and BEIs®
• What about BEIs® without numbers?
• Definition of N_q
• Rationale for N_q
• Examples
• A case study
• Other guidelines
General Reasons for Biological Monitoring

• Assess exposure and uptake by all routes
  • TLV® not protective for systematic effects from skin absorption - skin
  • Includes workload
  • More closely related to systemic effects
• Assess effectiveness of PPE
• Legal or ethical drivers
  • Regulations
  • Control workers’ compensation costs
Basis of BEIs® -Traditional

- Relationship between airborne exposure at TLV® and biomarker of exposure
  - Most volatile organics
- Relationship between health effects and biomarker of exposure
  - Lead, Cadmium, Mercury
What About These Cases?

• Chemicals readily absorbed through the skin or carcinogens with long lag times between exposure and cancer
  • EGME, Cyclohexanol, MBOCA, PAHs
• Cannot relate to airborne limits
  • Irrelevant
• Cannot relate to health effect
  • Wrong timeline
• Chemicals with good BM methods and “associations” with health effects or exposure
BEIs® without numbers – $N_q$

Biological monitoring should be considered for this compound based on the Committee’s review of the literature; however, a specific BEI® could not be determined due to insufficient data.
Criteria for an $N_q$

- Dermal route of exposure significant
- Good measurement methods
- Good qualitative data on human exposure and biomarker concentration
- Poor quantitative data relating exposure and biomarker
  - Dermal exposure and biomarker
  - Long lag time between exposure and early health effect
Rationale for use

• There are good analytical methods
• There are documented human workplace studies showing efficacy of biomarkers of exposure
• Background levels are low
• Dermal exposure may be the principal route of exposure
• Suggestions often given from literature
  • Not sufficient data for a numerical BEI®
Examples - Cyclohexanol

- **BEI®** - 1,2-Cyclohexanediol and Cyclohexanol in urine
- Primary route of exposure – dermal
- Good methods and data on exposure
- Limited data on dose-response
2-Methoxyethanol (EGME)

- BEI® - 2-Methoxyacetic acid in urine
- Primary route of exposure - dermal
- Good methods and data on exposure
- Limited laboratory data on human hematological & reproductive effects
- Limited human field data
4,4’-Methylene-Bis (2-Chloroaniline) [MBOCA]

- **BEI®** - MBOCA in urine
- Principle route of exposure - dermal
- Alleged health effect in humans - cancer
- Good methods and human data on exposure, good practice & controls
- Industry practice guidance from the UK HSE
Polycyclic Aromatic Hydrocarbons (PAHs)

- BEI® - 1-Hydroxypyrene in urine
- Human health effects – cancer
- 1-HP a marker of pyrene content
- Association with 1-HP and smoking
- Good methods and human data on exposure - response
- More info – concurrent roundtable
A Case Study, Methyl Parathion

- Inappropriate use of methyl parathion as a household insecticide
- Metabolized like parathion to p-nitrophenol
- BEI® for parathion – applicability to MP?
  - Pharmacokinetics differences?
- Assess exposure – above NHANES II baseline (< 2 µg/g creatinine, 90th percentile)
- Evaluate residents – if exceed baseline, look for source
Other Guidelines

- Levels in the general population (NHANES)
  - 1-Hydroxypyrene (<0.4 µg/g creat 90th percentile)
- Biological monitoring guidance values developed by HSE
  - MbOCA (< 35 µg/g creatinine)
- German EKA for carcinogens
  - No N_q substances listed
The Benchmark or Biological Monitoring Guidance Value - HSE

• Good analytical methods
• All specimens analyzed by one laboratory or with a single method
• Establish “good industry practice" using an upper 90% confidence limit of the “good" industries
• Benchmark or biological monitoring guidance value - provide users with assessment of their results
Questions

• How to deal with an $N_q$ BEI®?
• What do I tell workers/managers that results mean?
• How do BEIs® with Nq relate to TLVs®?
• What actions are appropriate?