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Principal, Summit Toxicology, L.L.P.**

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Fields of Expertise:

Dose-response assessment; Benchmark dose (BMD) modeling; Physiologically based pharmacokinetic (PK) modeling; Mode of action (MOA) assessment; Exposure assessment; Site risk assessment; Database management

Education:

M.S., Toxicology & Nutrition, Case Western Reserve University, 1991

B.A., Chemistry, Case Western Reserve University, 1990

Current and Previous Positions:

Principal, Summit Toxicology LLP, 2009-present

Program Manager, The Sapphire Group, Inc., 2000–2009

Sr. Associate Environmental Scientist, McLaren-Hart/ChemRisk, 1994–2000

Health Scientist, Life Systems, Inc., 1991-1994

Research Associate, Case Western Reserve University, 1989-1991

Professional Memberships:

Society for Risk Analysis

Awards:

Society of Toxicology, Risk Assessment Specialty Section Award for Outstanding Publication Demonstrating an Application of Risk Assessment, March, 2005.

Society of Toxicology, Risk Assessment Specialty Section Award for Outstanding Publication Demonstrating an Application of Risk Assessment, March, 2003.

Society of Toxicology, Risk Assessment Specialty Section Award for Best Presentation, March, 1999.

McLaren-Hart Award of Excellence, 1998.

McLaren-Hart Technical Achievement Award, 1997, 1998, 1999.

McLaren-Hart Award of Appreciation, 1995.

Peer-Reviewed Publications:

Aylward LL, **Kirman CR**, Blount BC, Hays SM. 2010, Chemical-specific screening criteria for interpretation of biomonitoring data for volatile organic compounds (VOCs) - Application of steady-state PBPK model solutions. *Regul Toxicol Pharmacol*. 58(1):33-44.

Tardiff RG, Gargas ML, **Kirman CR**, Carson ML, Sweeney LM. 2010. Estimation of safe dietary intake levels of acrylamide for humans. *Food Chem Toxicol*. 48(2):658-67.

Kirman CR, Albertini RJ, Sweeney LM, Gargas ML. (2010). 1,3-Butadiene: I. Review of Metabolism and the Implications to Human Health Risk Assessment. *Crit Rev Toxicol* (Accepted).

Albertini RJ, Carson ML, **Kirman CR**, Gargas ML. (2010). 1,3-Butadiene: II. Genotoxicity Profile. *Crit Rev Toxicol* (Accepted).

Kirman CR, Albertini RA, Gargas ML. (2009). 1,3-Butadiene: III. Assessing Carcinogenic Modes of Action. *Crit Rev Toxicol* (Accepted).

Sweeney, L.M., **Kirman, C.R.**, Albertini, R.J., Yan, Y., Clewell, H.J. III, Filser, J.G., Csanady, G., Pottenger, L.H., Banton, M.I., Graham, C.J., Andrews, L.S. II, Papciak, R.J. and Gargas, M.L. (2009). Derivation of inhalation toxicology

reference values for propylene oxide using mode of action analysis: Example of a threshold carcinogen. *Crit. Rev. Toxicol.*, accepted for publication.

Tardiff, R.G., Bevan, C., Carson, M.L., Sweeney, L.M., **Kirman, C.R.**, Tan, Y., Andersen, M. And Gargas, M.L. (2009). Derivation of a drinking water equivalent concentration and maximum contaminant level goal (MCLG) for perfluorooctanoic acid (PFOA), a persistent water soluble compound. *Fd. Chem. Toxicol.*, in preparation.

Sweeney, L.M., **C.R. Kirman**, M.L. Gargas, and R.G. Tardiff. (2009). Development of a physiologically-based toxicokinetic model of acrylamide and glycidamide in rats and humans. *Food Chem Toxicol.* 2010 Feb;48(2):668-85.

Kirman CR, Budinsky RA, Yost L, Baker BF, Zabik JM, Rowlands JC, Long TF, Simon T. (2010). Derivation of Soil Cleanup Levels for 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) Toxic Equivalence (TEQD/F) in Soil through Deterministic and Probabilistic Risk Assessment of Exposure and Toxicity. *Human and Ecological Risk Assessment* (Accepted).

Price PS, **Kirman CR**, Yost L, Hoelm, RR , Sorensen MT, Aylward, LL, Hubner RP, Landenberger B, Budinsky RA, Zabik J. (2009). Evaluation of Exposure to PCDD/Fs Toxic Equivalence (TEQD/F) from Consumption of Fish Harvested from Tittabawassee and Saginaw Rivers Based on Site-Specific Fishing Data and Recent Residue Measurements. (In prep)

Simon T, Aylward LL, **Kirman CR**, Rowlands JC, Budinsky RA. 2009. Estimates of cancer potency of 2,3,7,8-tetrachlorodibenzo(p)dioxin using linear and nonlinear dose-response modeling and toxicokinetics. *Toxicol Sci.* 112(2):490-506.

Poet TS, **Kirman CR**, Gargas ML, Hinderliter PD. (2009). Quantitative Risk Analysis for N-Methyl Pyrrolidone using Physiologically Based Pharmacokinetic and Benchmark Dose Modeling. *Toxicol Sci.* 2010 Feb;113(2):468-82.

Sweeney LM, **Kirman CR**, Gannon SA, Thrall KD, Gargas ML, Kinzell JH. (2009). Development of a physiologically based pharmacokinetic (PBPK) model for methyl iodide in rats, rabbits, and humans. *Inhal Toxicol.* 21(6):552-82.

Kirman CR, Sweeney LM, Gargas ML, Kinzell JH. (2009). Evaluation of possible modes of action for acute effects of methyl iodide in laboratory animals. *Inhal Toxicol.* 21(6):537-51.

Sweeney LM, **Kirman CR**, Gargas ML, Dugard PH. (2009). Contribution of trichloroacetic acid to liver tumors observed in perchloroethylene (perc)-exposed mice. *Toxicology.* 16;260(1-3):77-83.

Gargas ML, **Kirman CR**, Sweeney LM, Tardiff RG. (2009). Acrylamide: Consideration of species differences and nonlinear processes in estimating risk and safety for human ingestion. 2009. *Food Chem Toxicol.* Apr;47(4):760-8.

Kirman CR, Sweeney LM, Gargas ML, Strother DE, Collins JJ, Deskin R. (2008). Derivation of noncancer reference values for acrylonitrile. *Risk Anal.* 28(5):1375-94.

Simon T, **Kirman CR**, Aylward LL, Budinsky RA, Rowlands JC, Long TF. (2008). Estimates of cancer potency of 2,3,4,7,8-pentachlorodibenzofuran using both nonlinear and linear approaches. *Toxicol Sci.* 106(2):519-37.

Sielken RL Jr, Valdez-Flores C, Gargas ML, **Kirman CR**, Teta MJ, Delzell E. (2007). Cancer risk assessment for 1,3-butadiene: dose-response modeling from an epidemiological perspective. *Chem Biol Interact.*

Kirman, C.R., Sweeney, L.M., Corley, R. and Gargas, M.L. (2005). Using physiologically-based pharmacokinetic modeling to address nonlinear kinetics and changes in rodent physiology and metabolism due to aging and adaptation in deriving reference values for propylene glycol methyl ether and propylene glycol methyl ether acetate. *Risk Anal.*, 25(2), 271-284.

Kirman, C.R., Gargas, M.L., Marsh, G.M., Strother, D.E., Klaunig, J.E., Collins, J.J., and Deskin, R. (2005). Cancer dose-response assessment for acrylonitrile based upon rodent brain tumor incidence: Use of epidemiologic, mechanistic, and pharmacokinetic support for nonlinearity. *Reg. Toxicol. Pharmacol.*, 43, 85-103.

Kirman, C.R., Sweeney, L.M., Teta, M.J., Sielken, R.L., Valdez-Flora, C., Albertini, R. and Gargas, M.L. (2004). Addressing nonlinearity in the exposure-response relationship for a genotoxic carcinogen: Cancer potency estimates for ethylene oxide. *Risk Anal.*, 24(5), 1165-1183.

Sweeney, L.M., **Kirman, C.R.**, Morgott, D.A. and Gargas, M.L. (2004). Estimation of interindividual variation in oxidative metabolism of dichloromethane in human volunteers. *Toxicol Lett.*, 154(3), 201-216.

Kirman, C.R., Sweeney, LM, Meek ME, Gargas, ML. (2003). Assessing the dose dependency of allometric scaling performance using physiologically based pharmacokinetic modeling. *Reg. Toxicol. Pharmacol.*, 38, 345-367.

Kirman, C.R., Gargas, M.L., Deskin, R., Tonner-Navarro, L. and Andersen, M.E. (2003). A physiologically based pharmacokinetic model for acrylamide and its metabolite, glycidamide, in the rat. *J. Toxicol. Environ. Health*, 66(3), 253-274.

Sweeney, L.M., Tyler, T.R., **Kirman, C.R.**, Corley, R.A., Reitz, R.H., Paustenbach, D.J., Holson, J.F., Whorton, M.D., Thompson, K.M. and Gargas, M.L. (2001). Proposed occupational exposure limits for select ethylene glycol ethers using PBPK models and Monte Carlo simulations. *Tox. Sci.*, 62 (1), 124-139.

Kirman, C.R., Hays, S.M., Kedderis, G.L., Gargas, M.L., and Strother, D.E. (2000). Improving cancer dose-response characterization using physiologically based pharmacokinetic modeling: an analysis of pooled data for acrylonitrile-induced brain tumors to assess cancer potency in the rat. *Risk Anal.*, 20(1), 135-151.

Hays, S.M., Long, T.F., **Kirman, C.R.**, and Gargas, M.L. (1998). Potential uses of PBPK modeling to improve the regulation of exposure to toxic compounds. *Risk Policy Report*, December 18, 1998, Guest Perspectives.

Other Publications:

ATSDR. 1997. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Hydrazines. Atlanta, GA.

ATSDR. 1994. Agency for Toxic Substances and Disease Registry. Toxicological Profile for HMX. Atlanta, GA.

- ATSDR. 1994. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Methoxychlor. Atlanta, GA.
- ATSDR. 1994. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Hexachlorobenzene. Atlanta, GA.
- ATSDR. 1993. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Asbestos. Atlanta, GA.
- ATSDR. 1993. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Manganese. Atlanta, GA.
- ATSDR. 1993. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Arsenic. Atlanta, GA.
- ATSDR. 1993. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Carbon Tetrachloride. Atlanta, GA.
- ATSDR. 1993. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Styrene. Atlanta, GA.
- USEPA. 1992. U.S. Environmental Protection Agency. Drinking Water Quality Criteria Document for Trihalomethanes. Washington, DC.
- USEPA. 1992. U.S. Environmental Protection Agency. Drinking Water Quality Criteria Document for Arsenic. Washington, DC.
- USEPA. 1992. U.S. Environmental Protection Agency. Hazard Assessment Document for Aldicarb. Washington, D.C.
- USEPA. 1991. U.S. Environmental Protection Agency. Health Advisory for Nickel. Washington, DC.

Posters, Presentations, and Published Abstracts:

- Bevan C., Gargas, M., **Kirman, C.** And Vergnes, J. (2009). Mode of action (MOA) evaluation and derivation of a cancer and non-cancer reference value for 4-vinylcyclohexene Presented at the 48th Annual Meeting of the Society of Toxicology, Baltimore, MD, Toxicologist, abstract 839.
- Sweeney, L.M., **Kirman, C.R.**, Gargas, M.L. and Dugard, P.H. (2009). Contribution of trichloroacetic acid to liver tumors observed in perchloroethylene (PERC)-exposed mice. Presented at the 48th Annual Meeting of the Society of Toxicology, Baltimore, MD, Toxicologist, abstract 1491.
- Sweeney, L.M., Kirman, **C.R.**, Gargas, M.L. and Banton, M.I. (2008). Chronic noncancer toxicity reference values for use in ethylbenzene risk assessments. Presented at the 47th Annual Meeting of the Society of Toxicology, Seattle, WA, Toxicologist, abstract 1783.
- Kirman, C.**, Sweeney, L., Bus, J. And Gargas, M. (2008). Mode of action (MOA) evaluations and derivation of a cancer reference value for ethylbenzene.

Presented at the 47th Annual Meeting of the Society of Toxicology, Seattle, WA, Toxicologist, abstract 1784.

Kirman CR, Long TF, Tardiff RG. (2005). Identification of key decision points in dose-response assessment for 2,3,7,8-TCDD under USEPA's final guidelines for carcinogen risk assessment. Annual meeting of the Society for Risk Analysis, Orlando, FL, 5-7 December 2005.

Gargas, M.L., Sweeney, L.M., Strother, D.E., Deskin, R. and **Kirman, C.R.** (2005). Noncancer dose response assessments for acrylonitrile. Presented at the Annual Meeting of the Society for Risk Analysis, Dec. 4 7, 2005, Orlando, FLA, paper W5.5.

Sweeney LM, **Kirman CR**, Long TF, Tardiff RG. (2004). Adaptation and application of a physiologically-based-pharmacokinetic model for naphthalene to chronic human health risk assessment. Annual meeting of the Society for Risk Analysis, Palm Spring, CA, December 6-8, 2004.

Long TF, **Kirman CR**, Butala JH, Tardiff RG. (2004). Probabilistic cancer risk assessment of workers exposed to creosote during pressure treatment of wood. Annual meeting of the Society of Toxicology, Baltimore, MD, March 2004 [The Toxicologist, abstract 750].

Gargas, M.L., Collins, J.J., Marsh, G., Strother, D.E., Deskin, R. and **Kirman, CR.** (2004). Using epidemiology and mode of action data to support a nonlinear dose response assessment for acrylonitrile carcinogenicity. Presented at the Annual Meeting of the Society for Risk Analysis, Dec. 5 8, 2004, Palm Springs, CA, paper M8.5.

Gargas, M.L. and **Kirman, C.R.** (2003). Use of internal dose in assessing the potential risks from acrylamide in food. Presented at the Annual Meeting of the Society for Risk Analysis, Dec. 7 10, 2003, Baltimore, MD, paper No. T12.4.

Kirman, C.R., Gargas, M.L., Klaunig, J., Collins, J., Starr, T., Strother, D., and Deskin, R. (2004). Updated cancer risk assessment of acrylonitrile. Presented at the 43rd Annual Meeting of the Society of Toxicology, Baltimore, MD, Toxicologist, abstract 1787.

Kirman, C.R., Sweeney, L.M., Morgott, D. and Gargas, M.L. (2003). Estimating individual variation in physiologically based pharmacokinetic (PBPK) modeling parameters for dichloromethane metabolism in human volunteers. Presented at the 42nd Annual Meeting of the Society of Toxicology, Salt Lake City, UT. Toxicologist, abstract 865.

Kirman, C.R., Gargas, M.L., Deskin, R., Tonner Navarro, L. and Andersen, M.E. (2002). Using Monte Carlo sensitivity analyses to prioritize data needs in developing a physiologically based pharmacokinetic (PBPK) model for acrylamide. Presented at the 41st Annual Meeting of the Society of Toxicology, Nashville, TN. Toxicologist 66, abstract 754.

Dutton, D.R., Gargas, M.L., Long, T.F., **Kirman, C.R.** and Katona, M.A. (2001). A proposed occupational exposure limit for trimellitic anhydride. Presented at the 40th Annual Meeting of the Society of Toxicology, San Francisco, CA. Toxicologist, 60, abstract 2013.

Kirman, C.R., Sweeney, L.M. and Gargas, M.L. (2001). Weight of evidence supporting a non linear dose response relationship for ethylene oxide exposure and leukemia. Presented at the 40th Annual Meeting of the Society of Toxicology, San Francisco, CA. Toxicologist, 60, abstract 2087.

Katona, M.A., Long, T.F., **Kirman, C.R.**, Copley, C., Webb, D., Moomey, M. and Gargas, M.L. (2001). Incorporation of biomonitoring data into risk management decisions: lead and cadmium in soil. Presented at the 40th Annual Meeting of the Society of Toxicology, San Francisco, CA. Toxicologist, 60, abstract 1212.

Kirman, C.R., Long, T.R., Leber, A.P., Hays, S.M. and Gargas, M.L. (2000). Using pharmacokinetic modeling and Monte Carlo methods to improve bioconcentration factors and half lives for substituted diphenyl p phenylene diamines in carp. Presented at the 39th Annual Meeting of the Society of Toxicology, Philadelphia, PA., Toxicologist, 54, abstract 268.

Kirman, C.R., Sweeney, L.M., Pastino, G., Meek, B., and Gargas, M.L. (2000). An evaluation of body weight scaling for six chemicals using internal dose measures. Presented at the Annual Meeting of the Society for Risk Analysis, Dec. 3 6, 2000, Washington, D.C., paper No. P1.08.

Kirman CR, Sweeney LM, Pastino GM, Meek B, Gargas ML. 2000. An Evaluation of Body Weight Scaling Practices for Six Chemicals Using Internal Dose Measures as Determined by Physiologically Based Pharmacokinetic (PBPK) Modeling. Presented at the 39th Annual Meeting of the Society of Toxicology, Philadelphia, PA., Toxicologist 54, abstract 1181.

Sweeney, L.M, Tyler, T.R., **Kirman, C.R.**, and Gargas, M.L. 2000. "Development of Proposed Occupational Exposure Limits for Selected Glycol Ethers using PBPK Modeling and Monte Carlo Simulation." Presented at the 39th Annual Meeting of the Society of Toxicology, Philadelphia, PA., Toxicologist 54, abstract 1182.

Katona, M.A., Long, T.F., **Kirman, C.R.**, and Gargas, M.L. 2000. Derivation of a Cancer Potency Factor and Dermal Absorption Factor for Benzo(a)Pyrene. Presented at the 39th Annual Meeting of the Society of Toxicology, Philadelphia, PA.

Kirman, C.R., Hays, S.M., Gargas, M.L., Andersen, M.E., Reitz, R.H., Guengerich, F.P., Green, T., McConnell, E.E., Buckpit, A., Voytek, P., and Dugard, P.H. (1999). Using physiologically based pharmacokinetic modeling to assess non-linearity in the dose-response relationship for methylene chloride carcinogenesis. Toxicologist 48, Paper No. 386. Presented at the 38th Annual Meeting of the Society of Toxicology, New Orleans, LA.

Katona, M.A., Long, T.F., **Kirman, C.R.**, Golpashin, E.S., Bono, M.A., and Gargas, M.L. (1999). An alternative view of dermal absorption of hexachlorobenzene from soil. *Toxicologist* 48, Paper No. 396. Presented at the 38th Annual Meeting of the Society of Toxicology, New Orleans, LA.

Gargas, M.L., **Kirman, C.R.**, Hays, S.M., and Voytek, P. (1999). Using physiologically based pharmacokinetic modeling to minimize animal testing and associated costs under USEPA's hazardous air pollutants test rule. *Toxicologist* 48, Paper No. 661. Presented at the 38th Annual Meeting of the Society of Toxicology, New Orleans, LA.

Hays, S.M., Tyler, T.R., Snellings, W.M., Weitz, K.K., Corely, R.A., **Kirman, C.R.**, and Gargas, M.L. (1999). Physiologically based pharmacokinetics (PBPK) modeling of ethylene glycol ethers and acetates in pregnant rats. *Toxicologist* 48, Paper No. 668. Presented at the 38th Annual Meeting of the Society of Toxicology, New Orleans, LA.

Rish, W., **Kirman, C.R.**, Hays, S.M., Gargas, M.L., Andersen, M.E., Reitz, R.H., Guengerich, F.P., Green, T., McConnell, E.E., Buckpit, A., Voytek, P., and Dugard, P.H. (1999). Developing a physiologically based pharmacokinetic model to describe methylene chloride kinetics at the subcellular level. *Toxicologist* 48, Paper No. 671. Presented at the 38th Annual Meeting of the Society of Toxicology, New Orleans, LA.

Kirman, C.R., Brien, B.A., and Gargas, M.L. (1997). Reassessment of the oral cancer potency factor for hexachlorobenzene (HCB). *Toxicologist*, 36(1), Paper No. 868. Presented at the 36th Annual Meeting of the Society of Toxicology, Cincinnati, Ohio.

Hays, S.M., **Kirman, C.R.**, Czernek, J., Gargas, M.L., and Strother, D.E. (1997). Assessing the cancer potency of acrylonitrile in rats using internal dosimetry. Paper T2.2.04 at the Annual Meeting of the Society for Risk Analysis, Dec. 7-10, 1997, Washington, DC.

CR Kirman, 1997. A Heuristic Model for the Molecular Mechanism of Action for Dioxin-Like Chemicals. Dioxin '97 Conference.

CR Kirman. (1996). A "Weight-of-Evidence" Approach for Deriving Duration-Specific Reference Doses: Hexachlorobenzene as an example. Society of Risk Analysis, 1996.