



## **Raga Avnansi, Ph.D.**

Senior Health Scientist

### **Summary of Experience**

Dr. Raga Avnansi is an interdisciplinary scientist with over a decade of experience in exposure science, regulatory strategy, and applied research across the domains of pesticides, environmental health, and chemical safety. He holds a B.Tech in Biotechnology, a M.S. in Environmental Toxicology, and a Ph.D. in Exposure Science and Risk Assessment. Dr. Avnansi's academic, industry, and consulting work has centered on the human health risk assessment of chemicals for product safety and regulatory acceptance, grounded in technical expertise spanning exposure science, toxicology, risk assessment, and environmental epidemiology. Previously, at Syngenta Crop Protection LLC, Dr. Avnansi led the human safety strategy for a portfolio of active ingredients under U.S. EPA (FIFRA) and Canadian PMRA regulatory frameworks, overseeing dietary, residential, and occupational exposure assessments and higher-tier model refinements to support registrations and re-evaluations. He has directed several innovative projects advancing pesticide risk assessment, including biomonitoring data integration with modeled exposures, higher-tier residential exposure model development, and seed treatment worker exposure mitigation. Dr. Avnansi also brings extensive experience in PFAS exposure reconstruction, uncertainty analysis, toxicology, and environmental epidemiology through his research with the C8 Health Project population. Additional areas of expertise include human health risk assessment of VOCs from oil and gas operations, systematic reviews of environmental health literature, nanomaterial fate and exposure analysis, and consumer product exposure modeling. Across academic, industry, and government collaborations, Dr. Avnansi's work bridges scientific rigor with regulatory impact—delivering data-driven insights that inform chemical safety decisions and protect public health.

### **Education**

Bachelor of Sciences (B.Tech.), Biotechnology, 2008, VIT University, India

Master of Science (M.S.), Environmental Toxicology, 2010, Texas Tech University, Lubbock

Doctor of Philosophy (Ph.D.), Exposure Science and Risk Assessment, 2016, University of California, Irvine

### **Project Experience**

#### **Pesticide Exposure and Regulatory Risk Assessment**

Managed a diverse portfolio of human health risk assessment projects for herbicide, insecticide, and fungicide active ingredients under US EPA (FIFRA/TSCA) and Canadian PMRA regulatory frameworks. Work included dietary, residential, and occupational pesticide exposure modeling, higher-tier refinements, and technical strategy development to support new registrations, re-evaluations, and label expansions.

Led a project in response to the US EPA's 2022 policy on occupational worker exposure to seed treatment workers. It involved a thorough deep dive into published seed treatment worker exposure studies and identifying key sources of dermal and inhalation exposure to seed treatment workers. Collaborated with a team of scientists and an industry task force to engage with the US EPA and advocated for a new PPE option (long gloves secured to the sleeve) for seed treatment cleaner workers, whose hands were being exposed during cleaning activities despite wearing wrist-length gloves. Demonstrated that this new PPE option will reduce the cleaner dermal exposure by a factor of 10.

Proposed and managed novel approach to integrating human biomonitoring data with model-predicted dietary exposures for the crop protection chemical lambda-cyhalothrin. The work bridged internal dose measurements (from urinary metabolite data) with external exposure estimates derived from probabilistic dietary models. By aligning predicted intakes with observed biomonitoring values, the study provided a more realistic and scientifically grounded characterization of human exposure.

Managed a project that involved the development of the FINE model—a user-friendly exposure prediction tool designed to improve the realism and usability of indoor residential pesticide exposure assessments. The model incorporates updated assumptions about pesticide use patterns, ventilation, and surface residues, aligning more closely with modern residential scenarios. By integrating empirical data with refined exposure algorithms, the FINE model allows for more representative estimates of indoor exposures across multiple routes (e.g., inhalation, dermal, and incidental ingestion).

Authored a commentary manuscript that critically evaluated the U.S. EPA pesticide risk assessment and registration process to determine how protective it is of human health. The paper systematically reviewed the regulatory framework's tiered approach, default assumptions, and safety factors, examining how they collectively contribute to conservatism in risk estimates. Through illustrative case studies and expert analysis, demonstrated that the U.S. EPA's processes generally incorporate substantial margins of safety, especially for dietary, residential, and occupational exposures.

### **PFAS Exposure Reconstruction, Epidemiology, Uncertainty and Variability Analysis**

Projects on the C8 Health Project population focused on understanding how various uncertainties in exposure/dose reconstruction influence the epidemiological association between perfluorooctanoate (PFOA) exposure and preeclampsia. Through Monte Carlo simulation in R programming, applied probabilistic approaches to examine the influence of chemical fate and transport model uncertainty (systematic and random error), inter-individual variability in water ingestion rates and pharmacokinetic parameters, and spatial uncertainty of participant location on the PFOA–preeclampsia epidemiological findings. Collectively, research advanced methods for quantifying and integrating exposure uncertainties into epidemiological analyses, providing a more reliable understanding of PFOA's role in adverse pregnancy outcomes.

### **Oil and Gas Human Health Risk Assessment**

A project for the client (the Colorado Department of Public Health and Environment) comprehensively evaluated potential human health risks associated with inhalation exposures to 47 volatile organic compounds (VOCs) emitted from oil and gas operations. The project employed advanced air dispersion modeling to estimate ambient concentrations of 47 VOCs, including benzene and formaldehyde, across a range of operational and meteorological scenarios. These modeled concentrations were integrated with microenvironmental penetration factors, human-activity diaries, and health-criteria levels to estimate distributions of incremental acute, sub chronic, and chronic inhalation non-cancer hazard quotients (HQs) and hazard indices (HIs), and inhalation lifetime cancer risks. The study emphasized the importance of scenario-based modeling for risk evaluation and highlighted the need for proactive monitoring and emission control measures in oil and gas regions. By combining robust environmental modeling with toxicological risk characterization, this work provides a valuable framework for regulatory agencies and community stakeholders to better understand, anticipate, and manage health risks related to oil and gas emissions.

### **Environmental Epidemiology and Systematic Review**

Reviewed and evaluated dozens of environmental epidemiology studies on PFAS through the C8 Health Study and related efforts. More recently, critically reviewed and evaluated the strengths and weaknesses of dozens of published/peer-reviewed environmental epidemiology studies on pesticides using the PECO criteria and the US EPA Office of Pesticide Programs' framework for incorporating human epidemiologic & incident data in risk assessments for pesticides. This work was utilized in making judgements on the safety of pesticide active ingredients in the market and responding to Business stakeholders and regulators.

As a member of HESI's Environmental Epidemiology committee, worked on a project exploring risk assessors' perspectives on effectively incorporating epidemiological data into quantitative risk assessment (QRA) and provided practical recommendations for improving evidence integration to support regulatory decision-making. An earlier project built the conceptual foundation for this work, outlining methodological considerations and best practices for harmonizing epidemiological and toxicological data streams, highlighting the importance of structured frameworks and transparent criteria for evidence synthesis in QRA.

### **Nanomaterials Fate, Transport, and Releasability for Exposure Assessment**

Evaluated engineered nanomaterials and the understanding their environmental fate, persistence, and potential exposure risks. Investigated the environmental fate of C60 fullerenes by examining their soil sorption, biodegradation potential, and plant uptake. Laboratory experiments revealed limited sorption of C60 to soils and minimal biodegradation under tested conditions, indicating its persistence in the environment. Plant uptake studies showed negligible translocation of C60 from roots to shoots, suggesting low potential for trophic transfer. These findings provide critical insights into the mobility and ecological risks of engineered nanomaterials in terrestrial environments.

In another project, analyzed published literature on carbon nanotube (CNT) release from nanocomposite materials, evaluating factors such as composite matrix type, surface treatment, mechanical stress, and weathering. The findings highlighted critical parameters influencing CNT releasability, informing risk assessments for occupational and environmental exposures.

Together, these studies contribute to the broader understanding of nanomaterial behavior, advancing approaches to evaluate their safety and potential impacts across environmental and human health contexts.

## **Professional Experience**

### **Senior Human Safety Project Expert, Syngenta Crop Protection LLC, August 2018 – June 2025**

Managed the human safety strategy for a portfolio of herbicide, insecticide, and fungicide active ingredients, conducting dietary and non-dietary exposure and risk evaluations under U.S. EPA (FIFRA) and Canadian PMRA pesticide regulatory frameworks, developing higher-tier refinements, and leading multi-functional technical teams. Stakeholder management, leadership, and advocacy experiences include chairing the CLA Epidemiology Working Group, leading the NA Occupational Exposure Technical Working Group and the U.S. EPA seed treatment policy response core team. My strategic science initiatives have secured funding and produced peer-reviewed outputs on integrating pesticide biomonitoring with dietary risk, improving indoor residential exposure models, and evaluating the health-protectiveness of U.S. pesticide regulation.

### **Senior Associate Environmental Health Scientist, ICF Consulting, Durham, August 2016 – July 2018.**

Provided consulting services to Government clients including the U.S. EPA, NIEHS, CDC, CDPHE involving exposure modeling and human health risk assessment. Work involved evaluating potential human health risks from modeled inhalation exposures to volatile organic compounds emitted from oil and gas operations for the CDPHE, conducting a systematic review of community health impacts of mountaintop removal mining for NIEHS, and developing source-to-dose high-throughput modeling of consumer product exposures for the US EPA Office of Research and Development.

### **Graduate Research Assistant, University of California, Irvine, September 2011 – May 2016.**

Focused on the C8 Health Project population exposure modeling, uncertainty analysis, and environmental epidemiology. I reviewed toxicology and epidemiology literature on Perfluorooctanoate (PFOA), communicated key findings at conferences, and published peer-reviewed manuscripts. For my dissertation project, I investigated the impact of exposure uncertainty on the association between PFOA and preeclampsia in the C8 Health Project population, with findings published in Environmental Health Perspectives and Environmental Research.

### **Health Scientist Intern, Cardno ChemRisk, Aliso Viejo, June 2012 – August 2013.**

Critically reviewed and summarized the current literature on nanomaterial hazard, exposure, risk assessment, and regulations. In addition, assisted with client consulting work and litigation support, and contributed to the publication of peer-reviewed manuscripts.

### **Environmental Chemist, ERMI Environmental Services, Allen, TX, August 2010 – May 2011.**

Executed US EPA's standard chemical analyses following GLP and SOP's for regulatory compliance

## Trainings and Certificates

- Creating a Winning Edge in Advocacy 5-day Program, Greensboro, NC (2023)
- Crucial Conversations Workshop, Research Triangle Park, NC (2019)
- Project Management Essentials, 3PM Academy, Research Triangle Park, NC (2018)
- From Scientist to CSO: Leadership and Management Development for Careers in Business and Industry (2015)

## Professional Membership and Service

- Society of Toxicology (SOT)
- International Society of Exposure Science (ISES)
- American Chemical Society (ACS)
- Society of Risk Analysis (SRA)
- Society of Environmental Toxicology And Chemistry (SETAC)

## Peer-Reviewed Publications

Zhou T, Huang Y, Avanasani R, Brain RA, Prosperi M, Bian J. Content hubs, information flows, and reactions for pesticide-related discussions on Twitter/X. *Integr Environ Assess Manag.* 2025 May 1;21(3):628-638. doi: 10.1093/inteam/vjaf032. PMID: 39999018; PMCID: PMC12047019.

Yaoping Wu, Gabriel Sinclair, Raghavendhran Avanasani, Alison Pecquet. Physiologically based kinetic (PBK) modeling of propiconazole using a machine learning-enhanced read-across approach for interspecies extrapolation. *Environment International*, Volume 189, 2024, 108804, ISSN 0160-4120, <https://doi.org/10.1016/j.envint.2024.108804>.

Carl V. Phillips, Igor Burstyn, David J. Miller, Ali K. Hamade, Raghavendhran Avanasani, Denali Boon, Saumitra V. Rege, Sandrine E. Déglin, Improving the integration of epidemiological data into human health risk assessment: What risk assessors told us they want, *Global Epidemiology*, Volume 8, 2024, 100167, ISSN 2590-1133, <https://doi.org/10.1016/j.gloepi.2024.100167>.

Cuvelier, N., Avanasani, R., Grunenwald, M., Tharacad, R., Wolf, D., Bartell, S. A Novel Approach to Integrate Human Biomonitoring Data with Model Predicted Dietary Exposures: A Crop Protection Chemical Case Study Using Lambda-Cyhalothrin. *Journal of Agricultural and Food Chemistry. J. Agric. Food Chem.* 2024, 72, 20, 11663–1167.1. <https://doi.org/10.1021/acs.jafc.3c07071>

Inyoung Jun, Zheng Feng, Raghavendhran Avanasani, Richard A. Brain, Mattia Prosperi, Jiang Bian. Evaluating the perceptions of pesticide use, safety, and regulation and identifying common pesticide-related topics on Twitter. *Integrated Environmental Assessment and Management* (2023). <https://doi.org/10.1002/ieam.4777>

Avanasani, R., Glover, A., Lord, C., Macari, J., Munday, M., McKillican, C., Algarin, N., McCaskill, A., Hampton, R., Brain, R., & Leiner, K. (2023). How protective is the pesticide risk assessment and registration process to humans in the United States? *Journal of Regulatory Science*, 11(1), 1–29.

- Sandrine E. Déglin, Igor Burstyn, Connie L. Chen, David J. Miller, Matthew O. Gribble, Ali K. Hamade, Ellen T. Chang, Raghavendhran Avanas, Denali Boon, Jennifer Reed. Considerations towards the better integration of epidemiology into quantitative risk assessment, *Global Epidemiology*, Volume 4, 2022, 100084, ISSN 2590-1133, <https://doi.org/10.1016/j.gloepi.2022.100084>
- Dwayne R.J. Moore, Caleb A. McCarroll-Butler, Raghavendhran Avanas, Wenlin Chen, Mark White, Richard A. Brain. How Protective to the Environment is the Pesticide Risk Assessment and Registration Process in the United States? *Journal of Regulatory Science* 9(2) (2021) 1–20
- Chris Holder, John Hader, Raga Avanas, Tao Hong, Ed Carr, Bill Mendez, Jessica Wignall, Graham Glen, Belle Guelden, Yihua Wei (2019). Evaluating potential human health risks from modeled inhalation exposures to volatile organic compounds emitted from oil and gas operations. *Journal of the Air & Waste Management Association*, 69(12), 1503–1524. <https://doi.org/10.1080/10962247.2019.1680459>
- A. Boyles, R. Blain, J. Rochester, R. Avanas, S. Goldhaber, S. McComb, S. Holmgren, S. Masten, K. Thayer. Systematic Review of Community Health Impacts of Mountaintop Removal Mining. *Environ Int.* 2017 Oct; 107: 163–172.
- R. Avanas, HM. Shin, V.M. Vieira, S.M. Bartell. Impact of geocoding uncertainty on the association between perfluorooctanoate and preeclampsia in the C8 Health Project Population. *Environ. Res.* Nov 2016; 151:505-512.
- Avanas, R., Shin, H.-M., Vieira, V.M., Bartell, S.M., 2016. Variability and epistemic uncertainty in water ingestion rates and pharmacokinetic parameters, and impact on the association between perfluorooctanoate and preeclampsia in the C8 Health Project population. *Environ. Res.* 146, 299–307. doi:10.1016/j.envres.2016.01.011
- Avanas, R., Shin, H.-M., Vieira, V.M., Savitz, D. A., Bartell, S.M., 2016. Impact of Exposure Uncertainty on the Association between Perfluorooctanoate and Preeclampsia in the C8 Health Project Population. *Environ. Health Perspect.* doi:10.1289/ehp.1409044
- Avanas R, Jackson WA, Sherwin B, Mudge J, Anderson TA. C60 fullerene soil sorption, biodegradation, and plant uptake. *Environ. Sci. Technol.*, 48 (5): 2792–2797 (2014)
- Kovochich M, Avanas R, Madl AK. Analysis of factors associated with the releasability of Carbon Nanotubes (CNTs) from materials containing nanocomposites. *Nanotech*, 3(5):485-488 (2013)

## **Selected Conference Presentations and Invited Lectures**

- The FINE model: A user-friendly prediction tool for more realistic indoor pesticide exposure assessment. N Kamal, R Avanas, C Huffman, A Killius, G Sinclair, R Saran, T Ramanarayanan, D Bennett, HM Shin. SOT 2025.
- Improving pesticide exposure assessment in an indoor residential environment via model refinement. N Kamal, R Avanas, C Huffman, A Killius, G Sinclair, R Saran, T Ramanarayanan, D Bennett, HM Shin. Indoor Air 2024.

Data-driven Approaches to Refine Seed Treatment Risk Assessment for Cleaners. A Szarka, R Avanas, E Morrow, A Killius, M Pais, T Ramanarayanan. ACS AGRO 2023.

Bayesian integration of monte carlo exposure and pharmacokinetic modeling for lambda-cyhalothrin with urinary 3PBA measurements. Cuvelier, N., Avanas, R., Grunenwald, M., Tharacad, R., Wolf, D., Bartell, S. ACS AGRO 2022.

Invited alumni speaker: UC Irvine Environmental Toxicology Graduate student retreat, 2019.

Panelist: SOT RASS webinar was on Evaluation of epidemiology and human studies for risk assessment, 2022.

## **Grants and Research Funding**

Co-Researcher, NIH R21: Bayesian integration of biomarkers and spatial exposure data for perfluorooctanoate in Ohio and West Virginia.

Lead Investigator, Syngenta strategic science internal grant program.

- Bayesian integration of Monte Carlo exposure and pharmacokinetic modeling for lambda-cyhalothrin with urinary 3PBA measurements
- The FINE model: A user-friendly prediction tool for more realistic indoor pesticide exposure assessment

Social media data analysis: public perception of pesticide uses and regulations, network analysis