Matt Wheeler, Ph.D.

SENIOR SCIENCE ADVISOR

CONTACT INFORMATION

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PROFESSIONAL PROFILE

Dr. Matthew Wheeler is a Senior Science Advisor in ToxStrategies' Health Sciences practice. He specializes in Bayesian statistical machine learning and AI methods, focusing on toxicology and epidemiological data. With over twenty years of experience as a biostatistician in the health sciences field, Dr. Wheeler's expertise involves analyzing large data sets requiring extensive computational resources. He is an internationally recognized expert in dose-response risk assessment. His work is used by the U.S. Environmental Protection Agency (EPA), Health Canada, the World Health Organization (WHO), and the European Food Safety Authority (EFSA), among others, to perform chemical risk assessments. He was awarded the Presidential Early Career Award for Scientists and Engineers for his work. Additionally, his experience includes developing novel statistical methods related to chemical and non-chemical risk assessments; he has most recently developed biological pathway-based techniques for transcriptomic points of departure. His software is central to BMD Express 3.0 and the EPA's benchmark dose online platform.

To perform complex data and statistical analyses, Dr. Wheeler uses his expertise in statistics and machine learning algorithms to develop efficient computational approaches. He focuses on developing software that allows other scientists to utilize these approaches, enabling translational dissemination and transparency. His skill set includes expertise in analyzing epidemiological data, model averaging in toxicology, Bayesian analysis, probabilistic analysis, model uncertainty, and bias assessment. He readily tailors novel modeling solutions to meet scientific needs using this knowledge.

Before joining ToxStrategies, Dr. Wheeler served as a Staff Scientist at the National Institute of Environmental Health Sciences (NIEHS), as a Statistician at the National Institute for Occupational Safety and Health (NIOSH), and as a Health Statistician at the Centers for Disease Control and Prevention (CDC). Between 2016 and 2025, he was a scientific expert on the Joint FAO/WHO Expert Committee on Food Additives. He is consulted by both the EPA and the EFSA on benchmark dose modeling.

EDUCATION AND DEGREES EARNED

2013 Ph.D., Biostatistics, University of North Carolina at Chapel Hill

2002 M.S., Statistics, Miami University, Oxford, OH

2000 B.A.S., Systems Analysis and Computer Science, Miami University, Oxford, OH

SELECTED PROFESSIONAL EXPERIENCE

Toxicological Modeling

Developed a novel point of departure methodology superior to BMD Express and other 'omic' high-throughput methodologies in relating biological pathways to chemical exposure.

Designed major updates to BMD Express.

Chief developer of EPA's benchmark dose software. Consulted on EPA's updated guidance on point of departure modeling.

Chaired the EFSA European Parliament Article 40 disagreement on EFSA modeling recommendations.

Chaired the WHO rewriting of Chapter 5 of the Environmental Health Criterion for Food Contaminants and Additives.

Researched and developed current world gold standard methods for human health toxicological risk assessment.

Developed software package (ToxicR) for dose-response modeling.

Developed multidimensional approach to toxicogenomic risk assessment and dose-response.

Machine Learning and Data Science

Developed fast logistic regression package (FastReg), which is 18% faster than closest competitor and almost 200 times faster than base R.

During the COVID-19 pandemic, developed COVID-19 county level two-week forecasts used by CDC.

Mentorship and Teaching

Mentored NIEHS post-doctoral trainees, three Ph.D. candidates, and two master of science students.

Assisted instruction of base R regression class at NIEHS (summers, 2020 and 2021).

Taught benchmark dose modeling and ToxicR seminar at Society of Risk Analysis annual meetings (2018-2024).

Served as adjunct instructor in Data Science at North Carolina State University: taught Cluster Analysis and Design of Experiments (2018- 2019).

COMPUTATIONAL AND MACHINE LEARNING SKILLS

R and R package development with Rcpp

C++ development for package development, including Armadillo and Eigen libraries for fast linear algebra for statistics and machine learning tasks, and BLAS libraries (OpenBLAS and Intel MKL) for R and C++ program2000

Python for machine learning (SciPy, Numpy, scikitlearn, torch, etc.)

Structured Query Language (SQL)

PROFESSIONAL HONORS/AWARDS

2024 NIEHS Peer Award

2024 NIEHS Individual Service Award

2018 NIOSH Early Career Scientist Award

2016 U.S. Presidential Award for Early Career Scientists

PROFESSIONAL SERVICE

2025 Panelist, 102nd Joint FAO-WHO Expert Committee on Food Additives (JECFA)

2024 Panelist, U.S. EPA Probabilistic Risk Assessment Workshop

2023 Chair, EFSA Article 40 Meeting on the Dose Response Modeling Disagreement between EFSA and RIVM

2023 Panelist, 97th Joint FAO-WHO Expert Committee on Food Additives (JECFA)

2022 Statistical Expert, WHO Dioxin Relative Potency Reevaluation

2022 Panelist, 93rd Joint FAO-WHO Expert Committee on Food Additives (JECFA)

2021 Associate Editor, *Toxicology and Pathology*

2021 Leader, International Environmetrics Society (TIES) Workgroup: Bayesian Methods for Complex Environmental Systems

2020 Chair, Society for Risk Analysis Dose Response Specialty Group

2019 Rapporteur, Update of WHO 240 Chapter 5

2017 Chair, American Statistical Association (ASA) Section on Risk Analysis

2016 Panelist, 83rd Joint FAO-WHO Expert Committee on Food Additives (JECFA)

2015 Joint Statistical Meeting (JSM) Program Chair, Section on Risk Analysis

2015 Lead Discussant, EPA's Expert Panel Investigating Model Averaging for Dose Response Estimation in Risk Assessment

BOOK CHAPTERS

WHO/IPCS (World Health Organization/ International Programme on Chemical Safety). 2023. Safety evaluation of certain contaminants in food: Prepared by the 97th Meeting of the Joint FAO/WHO Expert Committee on Food Additives (JECFA). World Health Organization.

WHO/IPCS (World Health Organization/ International Programme on Chemical Safety). 2022. Safety evaluation of certain contaminants in food: Prepared by the 93rd Meeting of the Joint FAO/WHO Expert Committee on Food Additives (JECFA). World Health Organization.

WHO/IPCS (World Health Organization/ International Programme on Chemical Safety). 2021. Chapter 5 update. In: Principles and Methods for the Risk Assessment in Food: IPCS Environmental Health Criteria 240. World Health Organization.

WHO/IPCS (World Health Organization/ International Programme on Chemical Safety). 2018. Safety evaluation of certain contaminants in food: Prepared by the 83rd Meeting of the Joint FAO/WHO Expert Committee on Food Additives (JECFA). World Health Organization.

PEER-REVIEWED PUBLICATIONS

DeVito M, Bokkers B, van Duursen MB, van Ede K, Feeley M, Gáspár EAF, Haws L, Kennedy S, Peterson RE, Hoogenboom R, **Wheeler MW**, et al. 2024. The 2022 world health organization reevaluation of human and mammalian toxic equivalency factors for polychlorinated dioxins, dibenzofurans and biphenyls. Regul Toxicol Pharmacol 146(Jan):105525; doi: 10.1016/j.yrtph.2023.105525. PMCID: PMC10870838.

Fitch S, Blanchette A, Haws L, Franke K, Ring C, DeVito M, **Wheeler MW**, Walker N, Birnbaum L, Van Ede K. 2024. Systematic update to the mammalian relative potency estimate database and development of best estimate toxic equivalency factors for dioxin-like compounds. Regul Toxicol Pharmacol147(Feb):105571; doi: 10.1016/j.yrtph.2024.105571. PMCID: PMC11059105.

O'Brien J, Mitchell C, Auerbach S, Doonan L, Ewald J, Everett L, Faranda A, Johnson K, Reardon A, Rooney J., **Wheeler MW**, et al. 2024. Bioinformatic workflows for deriving transcriptomic points of departure: Current status, data gaps, and research priorities. Toxicol Sci 203(2):147-159; doi: 10.1093/toxsci/kfae145. PMCID: PMC11775421.

Pennell ML, **Wheeler MW**, Auerbach SS. 2024. A hierarchical constrained density regression model for predicting cluster-level dose-response. Environmetrics 35(7):e2880; doi: 10.1002/env.2880.

Zilber D, Messier KP, House J, Parham F, Auerbach SS, **Wheeler MW**. 2024. Bayesian gene set benchmark dose estimation for "omic" responses. Bioinformatics 41(1):btaf008; doi: 10.1093/bioinformatics/btaf008. PMCID: PMC11783320.

Ring C, Blanchette A, Klaren WD, Fitch S, Haws L, **Wheeler MW**, DeVito M, Walker N, Wikoff D. 2023. A multi-tiered hierarchical Bayesian approach to derive toxic equivalency factors for dioxin-like compounds. Regul Toxicol Pharmacol143(Sept):105464; doi: 10.1016/j.yrtph.2023.105464. PMCID: PMC11110530.

Wheeler MW. 2023. An investigation of non-informative priors for Bayesian dose-response modeling. Regul Toxicol Pharmacol 141(June):105389; doi: 10.1016/j.yrtph.2023.105389. PMCID: PMC10436774.

Wheeler MW, Lim S, House JS, Shockley KR, Bailer AJ, Fostel J, Yang L, Talley D, Raghuraman A, Gift JS. 2023. ToxicR: A computational platform in R for computational toxicology and dose–response analyses. Comp Toxicol 25(Feb):100259; doi: 10.1016/j.comtox.2022.100259. PMCID: PMC9997717.

Davidson SE, **Wheeler MW**, Auerbach SS, Sivaganesan S, Medvedovic M. 2022. ALOHA: Aggregated local extrema splines for high-throughput dose–response analysis. Comp Toxicol. 21(Feb):100196; doi: 10.1016/j.comtox.2021.100196. PMCID: PMC8785973.

Moran KR, **Wheeler MW**. 2022. Fast increased fidelity samplers for approximate Bayesian Gaussian process regression. J Roy Stat Soc B 84(4):1198-228; doi: 10.1111/rssb.12494. PMCID: 36570797.

Wheeler MW, Cortiñas Abrahantes J, Aerts M, Gift JS, Allen Davis J. 2022. Continuous model averaging for benchmark dose analysis: Averaging over distributional forms. Environmetrics 33(5):e2728; doi: 10.1002/env.2728. PMCID: PMC9799099.

Marvel SW, House JS, **Wheeler MW**, Song K, Zhou Y-H, Wright FA, Chiu WA, Rusyn I, Motsinger-Reif A, Reif DM. 2021. The COVID-19 Pandemic Vulnerability Index (PVI) Dashboard: Monitoring county-level vulnerability using visualization, statistical modeling, and machine learning. Environ Health Perspect 129(1):017701; doi: 10.1289/EHP8690. PMCID: PMC7430608.

Moran KR, Dunson D, **Wheeler MW**, Herring AH. 2021. Bayesian joint modeling of chemical structure and dose response curves. Annn Appl Stat 15(3):1405; doi: 10.214/21-aoas1461. PMCID: PMC9236276.

Wheeler MW, Westerhout J, Baumert JL, Remington BC. 2021. Bayesian stacked parametric survival with frailty components and interval-censored failure times: An application to food allergy risk. Risk Anal 41(1):56-66; doi: 10.1111/risa.13585. PMCID: PMC7894991.

Aerts M, **Wheeler MW**, Abrahantes JC. 2020. An extended and unified modeling framework for benchmark dose estimation for both continuous and binary data. Environmetrics 31(7):e2630; doi: 10.1002/env.2630. PMCID: PMC9432821.

Houben GF, Baumert JL, Blom WM, Kruizinga AG, Meima MY, Remington BC, **Wheeler MW**, Westerhout J, Taylor SL. 2020. Full range of population eliciting dose values for 14 priority allergenic foods and recommendations for use in risk characterization. Food Chem Toxicol 146(Dec)111831; doi: 10.1016/j.fct.2020.111831. PMCID: PMC7864389.

Remington BC, Westerhout J, Meima MY, Blom WM, Kruizinga AG, **Wheeler MW**, Taylor SL, Houben GF, Baumert JL. 2020. Updated population minimal eliciting dose distributions for use in risk assessment of 14 priority food allergens. Food Chem Toxicol 139(May):111259; doi: 10.1016/j.fct.2020.111259. PMCID: PMC7748293.

Wheeler MW, Blessinger T, Shao K, Allen BC, Olszyk L, Davis JA, Gift JS. 2020. Quantitative risk assessment: Developing a Bayesian approach to dichotomous dose–response uncertainty. Risk Anal 40(9):1706-22; doi: 10.1111/risa.13537. PMCID: PMC7722241.

Wheeler MW. 2019. Bayesian additive adaptive basis tensor product models for modeling high dimensional surfaces: An application to high-throughput toxicity testing. Biometrics 75(1):193-201; doi: 10.1111/biom.12942. PMCID: PMC6363906.

Wheeler MW, Piegorsch WW, Bailer AJ. 2019. Quantal risk assessment database: A database for exploring patterns in quantal dose-response data in risk assessment and its application to develop priors for Bayesian dose-response analysis. Risk Anal 39(3):616-29; doi: 10.1111/risa.13218. PMCID: PMC6408269.

Pandalai SP, **Wheeler MW**, Lu M-L. 2017. Non-chemical risk assessment for lifting and low back pain based on Bayesian threshold models. Saf Health Work 8(2):206-11; doi: 10.1016/j.shaw.2016.10.001. PMCID: PMC5447412.

Shao K, Allen BC, **Wheeler MW**. 2017. Bayesian hierarchical structure for quantifying population variability to inform probabilistic health risk assessments. Risk Anal 37(10):1865-78; doi: 10.1111/risa.12751.PMCID: PMC6151353.

Wheeler MW, Bailer AJ, Cole T, Park RM, Shao K. 2017. Bayesian quantile impairment threshold benchmark dose estimation for continuous endpoints. Risk Anal 37(11):2107-18; doi: 10.1111/risa.12762. PMCID: PMC5740488.

Wheeler MW, Dunson DB, Herring AH. 2017. Bayesian local extremum splines. Biometrika 104(4):939-52; doi: 10.1093/biomet/asx039. PMCID: PMC5798493.

Wheeler MW, Park R, Bailer A, Whittaker C. 2015. Historical context and recent advances in exposure-response estimation for deriving occupational exposure limits. J Occup Environ Hyg 12(sup1):S7-S17; doi: 10.1080/15459624.2015.1076934. PMCID: PMC4685605.

Wheeler MW, Shao K, Bailer AJ. 2015. Quantile benchmark dose estimation for continuous endpoints. Environmetrics 26(5):363-72; doi: 10.1002/env.2432. PMCID: PMC5740488.

Wheeler MW, Dunson DB, Pandalai SP, Baker BA, Herring AH. 2014. Mechanistic hierarchical Gaussian processes. J Amer Stat Assoc 109(507):894-904; doi: 10.1080/01621459.2014.899234. PMCID: PMC4273873.

Wheeler MW, Bailer AJ. 2013. An empirical comparison of low-dose extrapolation from points of departure (PoD) compared to extrapolations based upon methods that account for model uncertainty. Regul Toxicol Pharmacol 67(1):75-82; doi: 10.1016/j.yrtph.2013.06.006. PMCID: PMC4724873.

Wheeler MW, Bailer AJ. 2012. Monotonic Bayesian semiparametric benchmark dose analysis. Risk Anal 32(7):1207-18; doi: 10.1111/j.1539-6924.2011.01786.x. PMCID: 22385024.

Kuempel ED, **Wheeler MW**, Smith RJ, Vallyathan V, Green FH. 2009. Contributions of dust exposure and cigarette smoking to emphysema severity in coal miners in the United States. Amer J Resp Crit Care Med 180(3):257-64; doi: 10.1164/rccm.200806-840OC. PMID: 19423717.

Loomis D, Schulman MD, Bailer AJ, Stainback K, **Wheeler MW**, Richardson DB, Marshall SW. 2009. Political economy of US states and rates of fatal occupational injury. Amer J Pub Health 99(8):1400-8; doi: 10.2105/AJPH.2007.131409. PMCID: PMC2707476.

Wheeler MW, Bailer AJ. 2009. Benchmark dose estimation incorporating multiple data sources. Risk Anal 29(2):249-56; doi: 10.1111/j.1539-6924.2008.01144x. PMCID: 19000080.

Wheeler MW, Bailer AJ. 2009. Comparing model averaging with other model selection strategies for benchmark dose estimation. Environ Ecol Stat 16:37-51; doi: 10.1007/s10651-007-0071-7.

Wheeler MW, Bailer AJ. 2008. Model averaging software for dichotomous dose response risk estimation. J Stat Software 26(5):1-15; doi: 10.18637jss.v026.i05.

Dankovic D, Kuempel E, **Wheeler MW**. 2007. An approach to risk assessment for TiO2. Inhal Toxicol 19(sup1):205-12; doi: 10.1080/08958370701497754. PMID: 17886069.

Wheeler MW, Bailer AJ. 2007. Properties of model-averaged BMDLs: A study of model averaging in dichotomous response risk estimation. Risk Anal 7(3):659-70; doi: 10.1111/j.1539-6924.2007.0090.x. PMCID: 17640214.

Wheeler MW, Fadel W, Robertson J, John Bailer A. 2007. Confidence interval construction for relative toxicity endpoints such as LD_{50} or LD_{90} ratios. J Econ Entomol 100(6):1945-9; doi: 10.1093/jee/100.6.1945. PMCID: 18232415.

Wheeler MW, Park RM, Bailer AJ. 2006. Comparing median lethal concentration values using confidence interval overlap or ratio tests. Environ Toxicol Chem 25(5):1441-4; doi: 10.1897/05-320r.1. PMID: 16704080.

Bailer AJ, Noble RB, **Wheeler MW**. 2005. Model uncertainty and risk estimation for experimental studies of quantal responses. Risk Anal 25(2):291-9; doi: 10.1111/j.1539-6924.2005.00590.x. PMID: 15876205.

Bailer AJ, **Wheeler MW**, Dankovic D, Noble R, Bena J. 2005. Incorporating uncertainty and variability in the assessment of occupational hazards. Int J Risk Assess Manage 5(2-4):344-57; doi: 10.1504/IJRAM.2005.007176.

Schuler LJ, **Wheeler MW**, Bailer AJ, Lydy MJ. 2003. Toxicokinetics of sediment-sorbed benzo[a]pyrene and hexachlorobiphenyl using the freshwater invertebrates *Hyalella azteca, Chironomus tentans*, and *Lumbriculus variegatus*. Environ Toxicol Chem 22(2):439-49; doi: 10.1002/etc.5620220227. PMID: 12558178.

Wheeler MW, Bailer AJ. 2003. A simulation study of methods for constructing confidence intervals for bioaccumulation factors. Environ Toxicol Chem 22(4):921-7; doi: 10.1002/etc.5620220433. PMID: 12685730.

PRESENTATIONS

East A, **Wheeler M**, Kennedy S. Artificial intelligence application to critical appraisal of published literature: A case example using the Criteria for Reporting and Evaluating Ecotoxicity Data (CRED) evaluation method. Poster presentation, Health and Environmental Sciences Institute (HESI) Biannual Meeting, Washington, DC, June 2025.