
BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Brokamp, Cole

eRA COMMONS USER NAME (credential, e.g., agency login): brokampr

POSITION TITLE: Assistant Professor

EDUCATION/TRAINING (*Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.*)

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
University of Cincinnati	B.S	06/2010	Biomedical Engineering
University of Cincinnati	Ph.D.	04/2016	Biostatistics and Bioinformatics
Cincinnati Children's Hospital Medical Center	Postdoctoral Research Fellow	10/2017	Biostatistics and Epidemiology

A. Personal Statement

I am an environmental and population health scientist trained at the intersection of biostatistics, epidemiology, and geoinformatics in order to advance precision public health. My work has focused on using GIS, machine learning, and causal inference methods with “big spatial data” to estimate the effect of spatiotemporal environmental exposures on neurobehavioral and psychiatric pediatric health outcomes. Specifically, my interest lies in the interaction of these urban exposures with individual- and community-level socioeconomic characteristics in order to identify subpopulations of children who are more susceptible to environmental health problems and inform targeted interventions. I have specialized myself in the areas of machine learning and geoinformatics and their applications to large environmental and clinical datasets. My early career work was dedicated to furthering exposure science methodology in order to bring more precise exposure assessment tools to environmental health studies. Furthermore, I have developed a novel approach and accompanying software package called DeGAUSS which allows for user-friendly attachment of geospatial variables to existing research cohorts and within multi-site studies where sharing of private health information like residential addresses is not feasible. I am also the founding director of the Geospatial Research Accelerator for Precision Population Health (GRAPPH) at Cincinnati Children's Hospital Medical Center, a shared facility that works to develop and democratize geospatial data and methodologies across the institution.

In this project, I will serve as a co-Investigator and will utilize my expertise and experience in biostatistics and epidemiology to help develop regression models to determine the impact of LAA exposures on the presence of respiratory symptoms, pleural abnormalities, and lung function decline. My previous experience with this cohort in modeling the estimated exposures and outcomes as well as my working relationship with the other investigators will allow me to successfully collaborate as a part of this team and contribute to successful completion of the study aims. I also have much experience in biostatistical modeling of respiratory outcomes later in life caused by early life exposures. Furthermore, I believe that the long-term health effects of asbestos are important to continue studying because it is not fully understood and mechanistic insights will provide valuable information for similar prevalent exposures across the country.

1. Patrick Ryan, James E. Lockey, Brad Black, Carol H. Rice, Jeff Burkle, Tim Hilbert, Linda Levin, **Cole Brokamp**, Roy McKay, Ted Larson, Grace K. LeMasters. Childhood exposure to libby amphibole asbestos

and respiratory symptoms in young adulthood. Environmental Research. 158. 470-479. 2017.

2. Jennifer Kannan, **Cole Brokamp**, David I. Bernstein, Grace K. LeMasters, Gurjit K. Khurana Hershey, Manuel Villareal, James E. Lockey, Patrick Ryan. Parental Snoring and Environmental Pollutants, but Not Aeroallergen Sensitization, Are Associated with Childhood Snoring in a Birth Cohort. Pediatric Allergy, Immunology, and Pulmonology. 0. 2016.
3. Kelly J Brunst, Patrick H Ryan, **Cole Brokamp**, David Bernstein, Tiina Reponen, James Lockey, Gurjit K Khurana Hershey, Linda Levin, Sergey A Grinshpun, Grace LeMasters. Timing and duration of traffic-related air pollution exposure and the risk for childhood wheeze and asthma. American Journal of Respiratory and Critical Care Medicine. 192(4). 421-427. 2015.

B. Positions and Honors

Positions and Employment

2012–2016	Research Associate, Department of Environmental Health, University of Cincinnati
2016–2017	Research Fellow, Cincinnati Children's Hospital Medical Center Division of Biostatistics & Epidemiology
2017–	Assistant Professor of Pediatrics, the University of Cincinnati Department of Pediatrics and Cincinnati Children's Hospital Medical Center Division of Biostatistics & Epidemiology

Honors

2010	B.S. awarded with Distinguished Honors, University of Cincinnati
2016	CCHMC Division of Biostatistics & Epidemiology Travel Award
2016	CCHMC Arnold W. Strauss Fellowship Award
2017	CCHMC Epidemiology & Biostatistics Top Publication and Top Research Achievement

C. Contribution to Science

1. My early career has been spent developing exposure assessment models for spatialtemporal pollutants and community characteristics based on machine learning techniques. This work includes the first machine learning or ensemble model used to assess exposure to elemental components of particulate matter. Recent introduction of remote sensing satellite data has allowed for extension of the land use random forest model to produce daily estimates of air pollution back to 2000 at a resolution of 1 x 1 km.
 - a. **Cole Brokamp**, Eric B. Brandt, Patrick H. Ryan. Assessing Exposure to Outdoor Air Pollution for Epidemiological Studies: Model-based and Personal Sampling Strategies. Journal of Allergy and Clinical Immunology. 2019.
 - b. **Cole Brokamp**, Roman Jandarov, Monir Hossain, Patrick Ryan. Predicting Daily Urban Fine Particulate Matter Concentrations Using Random Forest. Environmental Science & Technology. 52 (7). 4173-4179. 2018.
 - c. **Cole Brokamp**, Roman Jandarov, MB Rao, Grace LeMasters, Patrick Ryan. Exposure assessment models for elemental components of particulate matter in an urban environment: A comparison of regression and random forest approaches. Atmospheric Environment. 151. 1-11. 2017.
 - d. **Cole Brokamp**, MB Rao, Patrick Ryan, Roman Jandarov. A comparison of resampling and recursive partitioning methods in random forest for estimating the asymptotic variance using the infinitesimal jackknife. Stat. 6(1). 360-372. 2017.
 - e. **Cole Brokamp**, Grace LeMasters, Patrick Ryan. Residential mobility impacts exposure assessment and community socioeconomic characteristics in longitudinal epidemiology studies. Journal of Exposure Science and Environmental Epidemiology. 26(4). 428-34. 2016.
 - f. **Cole Brokamp**, MB Rao, Tina Zhihua Fan, Patrick H Ryan. Does the elemental composition of indoor and outdoor PM_{2.5} accurately represent the elemental composition of personal PM_{2.5}? Atmospheric Environment. 101. 226-234. 2015.
2. Building on advanced exposure assessment models has allowed me to lead epidemiological studies on the impacts of the built environment (e.g., fine particulate matter, greenspace, combined sewer overflows,

community deprivation) on several different pediatric health outcomes (e.g., psychiatric, neurobehavioral, gastrointestinal, and all-cause hospital utilization).

- a. **Cole Brokamp**, Jeffrey R. Strawn, Andrew F. Beck, Pat Ryan. Pediatric Psychiatric Emergency Department Utilization and Fine Particulate Matter: A Case-Crossover Study. *Environmental Health Perspectives*. 2019.
 - b. Juliana Madzia, Patrick Ryan, Kimberly Yolton, Zana Percy, Nick Newman, Grace LeMasters, **Cole Brokamp**. Residential Greenspace Is Associated with Childhood Behavioral Outcomes. *Journal of Pediatrics*. 30. 37-43. 2019.
 - c. **Cole Brokamp**, Andrew F. Beck, Neera K. Goyal, Patrick Ryan, James M. Greenberg, Eric S. Hall. Material Community Deprivation and Hospital Utilization During the First Year of Life: An Urban Population-Based Cohort Study. *Annals of Epidemiology*. 30. 37-43. 2019.
 - d. **Cole Brokamp**, Andrew F. Beck, Louis Muglia, Patrick Ryan. Combined Sewer Overflow Events and Childhood Emergency Department Visits: A Case-Crossover Study. *Science of the Total Environment*. 607-608. 1180-1187. 2017.
 - e. Kim Hartley, Patrick Ryan, **Cole Brokamp**, Gordon L. Gillespie. Effect of greenness on asthma in children: A systematic review. *Public Health Nursing*. 0. 1-8. 2020.
 - f. Rebecca Gernes, **Cole Brokamp**, Glenn Rice, J. Michael Wright, Michelle Kondo, Yvonne Michael, Geoffrey Donovan, Demetrios Gatzolis, David Bernstein, Grace LeMasters, James Lockey, G. Khurana Hershey, Patrick Ryan. Using high-resolution residential greenspace measures in an urban environment to assess risks of allergy outcomes in a cohort of children. *Science of the Total Environment*. 668. 760-767. 2019.
 - g. Kelly J Brunst, Patrick H Ryan, **Cole Brokamp**, David Bernstein, Tiina Reponen, James Lockey, Gurjit K Khurana Hershey, Linda Levin, Sergey A Grinshpun, Grace LeMasters. Timing and duration of traffic-related air pollution exposure and the risk for childhood wheeze and asthma. *American Journal of Respiratory and Critical Care Medicine*. 192(4). 421-427. 2015.
3. I have developed a novel approach and accompanying software package called DeGAUSS which overcomes the multiple privacy-related challenges in the use of address data in multi-site studies and also serves as a more general reproducible research tool for geocoding and geomarker assessment. This approach is currently being implemented in a wide variety of national environmental health studies. Extending this approach into a scalable and sustainable framework for automated integration of disparate and heterogeneous geomarkers via spatiotemporal location has reduced the need for manual data curation and specialized expertise required to utilize them within biomedical research studies.
- a. **Cole Brokamp**, Chris Wolfe, Todd Lingren, John Harley, Patrick Ryan. Decentralized and Reproducible Geocoding and Characterization of Community and Environmental Exposures for Multi-Site Studies. *Journal of American Medical Informatics Association*. 25(3). 309-314. 2018.
 - b. **Cole Brokamp**. DeGAUSS: Decentralized Geomarker Assessment for Multi-Site Studies. *Journal of Open Source Software*. 2018.
4. I have also contributed to several studies on the disparities of health outcomes within children and the contribution of the place-based and social determinants of health to these disparities in order to identify root causes and meaningful solutions.
- a. Sarah Orkin, **Cole Brokamp**, Toshifumi Yodoshi, Andrew T. Trout, Chunyan Liu, Syeda Meryum, Stuart Taylor, Christopher Wolfe, Rachel Sheridan, Aradhna Seth, Mohammad Alfrad Nobel Bhuiyan, Sanita Ley, Ana Catalina Arce-Clachar, Kristin Bramlage, Robert Kahn, Stavra Xanthakos, Andrew F. Beck, Marialena Mouzaki. Community Socioeconomic Deprivation and Non-Alcoholic Fatty Liver Disease Severity. *Journal of Pediatric Gastroenterology and Nutrition*. 2019.
 - b. Erica Andrist, **Cole Brokamp**, Stuart Taylor, Carley Riley, Andrew Beck. Neighborhood Poverty and Pediatric Intensive Care Use. *Pediatrics*. 2019.
 - c. Andrew F. Beck, Carley L. Riley, Stuart Taylor, **Cole Brokamp**, Robert S. Kahn. Toward a Culture of Health in Hospitals: Pervasive population disparities in inpatient bed-day rates across conditions and

subspecialties. *Health Affairs*. 37(4). 551-559. 2018.

- d. Lauren C. Riney, **Cole Brokamp**, Andrew F. Beck, Wendy Pomerantz, Hamilton Schwartz, Todd A. Florin. Emergency Medical Services Utilization is Associated with Community Deprivation in Children. *Prehospital Emergency Care*. 2018.

5. Lastly, I have contributed to a research team that has recently used functional data analysis combined with joint modeling (FD-JM) to identify and predict rapid decline in lung function among patients with cystic fibrosis (CF) lung disease. My work in translating this predictive model into an interactive application has allowed for patients and clinicians to take advantage of it at the bedside. Focus groups and partnerships with clinicians have allowed us to iteratively develop the application based on end-user feedback. Work with the CF Foundation Patient Registry (CFFPR) to implement these models and visualizations into clinical settings has improved prognostic care.

- a. Rhonda D. Szczesniak, Weiji Su, **Cole Brokamp**, Ruth H. Keogh, John P. Pestian, Michael Seid, Peter J. Diggle, John P. Clancy. Dynamic predictive probabilities to monitor rapid cystic fibrosis disease progression. *Statistics in Medicine*. 2019.
- b. Rhonda D. Szczesniak, **Cole Brokamp**, Weiji Su, Gary L. McPhail, John Pestian, and John P. Clancy. Improving Detection of Rapid Cystic Fibrosis Disease Progression—Early Translation of a Predictive Algorithm into a Point-of-Care Tool. *IEEE Journal of Translational Engineering in Health and Medicine*. 7(1). 1-8. 2019.
- c. Rhonda Szczesniak, **Cole Brokamp**, Weiji Su, Gary L. McPhail, John Pestian, John P. Clancy. Early Detection of Rapid Cystic Fibrosis Disease Progression Tailored to Point of Care: A Proof-of-Principle Study. *Healthcare Innovations and Point of Care Technologies*. (HI-POCT), 2017 IEEE. 204-207. 2017.
- d. Rhonda D. Szczesniak, Dan Li, Weiji Su, **Cole Brokamp**, John Pestian, Michael Seid, John P. Clancy. Phenotypes of Rapid Cystic Fibrosis Lung Disease Progression during Adolescence and Young Adulthood. *American Journal of Respiratory And Critical Care Medicine*. 196(4). 471-478. 2017.
- e. Pending US Patent: “Description of Methodology for Longitudinal FEV1 and Biomarker Augmentation in the Prediction of Rapid Lung Function Decline.” US Provisional Pat. Ser. No. 62/474,739, filed [March 22, 2017], under disclosure D17-0021 and tech id #2017-0211. Co-Inventors: Clancy, Ziady, Szczesniak.
- f. Software Application: Cystic Fibrosis Point of Personalized Detection (CFPOPD) for Forecasting Rapid Decline: <http://predictfev1.com> Co-Developers: Clancy, Szczesniak.

Complete List of Published Work in ORCID:

<https://orcid.org/0000-0002-0289-3151>

D. Additional Information: Research Support and/or Scholastic Performance

Ongoing Research Support

ECHO Opportunities and Infrastructure Fund Award

Decentralized and Reproducible Geomarker Assessment for Multi-Site Studies

Brokamp, PI (09/01/2019 - 08/31/2021)

This award will work towards building geospatial exposure assessment computing tools for utilizing high resolution spatiotemporal gridded datasets within ECHO.

Role: PI

ODH Contract No. CSP907820

Model Identifying Geographic Areas in Ohio for Blood Lead Testing

Brokamp, PI (04/01/2020 - 09/30/2020)

This award will develop a predictive model to determine which children should be tested for potentially high blood lead during physician visits based on their residential location.

Role: PI

NIH 5UG3OD023282-02

Children's Respiratory Research and Environment Workgroup (CREW)

Gern, PI (09/01/2016 - 08/31/2023)

This consortium will leverage a large (nearly 9000 births and long-term follow-up of 6000-7000 children and young adults) and diverse national data set, to harmonize data related to asthma clinical indicators and early life environmental exposures, develop standardized measures for prospective data collection, and conduct targeted enrollment of additional subjects into existing cohorts.

Role: Co-I

NIH/NHLBI R01HL141286-01A1

Mapping Environmental Contributions to Rapid Lung Disease Progression in Cystic Fibrosis

Sczcesniak, PI (01/01/2019 - 12/31/2023)

The overall objective of this research is to leverage a rich CF registry, extant national and local environmental data sources, and prospectively collected study data to accurately forecast the onset of rapid decline progression.

Role: Co-I

NIH/NIEHS R21ES030092

Developing and Evaluating Novel Strategies for Reporting Back Individual Results of Personal Air Monitors

Ryan, PI (09/01/2019 - 08/31/2021)

The objectives of this proposal are to collaborate with study participants, caregivers and community stakeholders to develop effect report-back strategies for personal air pollution monitoring results and evaluate report-back materials and their influence on knowledge, behavior, and personal UFP exposure.

Role: Co-I

Recently Completed Research Support**Internal Processes and Methods Award - Center for Clinical & Translational Science & Training**

Using Machine Learning to Supplement Electronic Health Record databases with Individual Socioeconomic Status

Brokamp, PI (09/1/2017 - 06/30/2019)

Retrospective epidemiological studies are often created using electronic health record databases that lack individual level demographic data. We propose a novel machine learning based approach that uses open city and auditor databases to predict individual level income and family socioeconomic status.

Role: PI

Internal Arnold W. Strauss Fellowship Award - Cincinnati Children's Hospital

Assessing Exposure to Air Pollution Across Time and Space

Brokamp, PI (07/01/16 - 06/30/17)

The primary objective of this award is to combine satellite-based measurements, land use characteristics, and meteorologic data to create a hybrid spatiotemporal model for ground level exposure to particulate matter using exact addresses and dates.

Role: PI

Internal Processes and Methods Award - Center for Clinical & Translational Science & Training

Validating a Geocoding Approach for Multi Site Studies

Brokamp, PI (01/24/17 - 06/30/17)

The primary objective of this award is to compare the geocoding (assigning latitude and longitude coordinates to addresses) accuracy of our software DeGAUSS (DEcentralized Geomarker Assessment for mUlti Site Studies) to with other common geocoding software. Furthermore, each method will be evaluated based on its ability to correctly estimate environmental exposures and community-level characteristics.

Role: PI