

## Cole Brokamp

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CONTACT INFORMATION	Division of Biostatistics and Epidemiology Cincinnati Children's Hospital Medical Center Cincinnati, OH 45229 USA	<i>Voice:</i> (513) 518-5121 <i>E-mail:</i> cole.brokamp@gmail.com <i>Website:</i> www.colebrokamp.com
RESEARCH INTERESTS	Machine learning applied to biomedical data, statistical methods for random forest, statistical computing, environmental health, air pollution, land use modeling	
EDUCATION	<b>Cincinnati Children's Hospital Medical Center</b> , Cincinnati, Ohio USA Postdoctoral Research Fellow, April 2016 – present  <b>University of Cincinnati</b> , Cincinnati, Ohio USA Ph.D., Biostatistics, April 2016  <b>University of Cincinnati</b> , Cincinnati, Ohio USA B.S., Biomedical Engineering, June 2010	
RESEARCH EXPERIENCE	<b>Department of Biostatistics and Epidemiology, Cincinnati Children's Hospital Medical Center</b>  <i>Spatiotemporal Land Use Models</i> <span style="float: right;"><i>April 2016 – present</i></span> Advisor: Patrick Ryan, Roman Jandarov Develop spatiotemporal land use model use for elemental components of particulate matter based on land use and satellite data.  <i>Community Health</i> <span style="float: right;"><i>April 2016 – present</i></span> Advisor: Andrew Beck Contributing GIS and statistical tools to a community-centered action plan to improve the health of children in the local Avondale community.  <i>Offline Geocoding</i> <span style="float: right;"><i>April 2016 – present</i></span> Advisor: Keith Marsolo Create a nationwide geocoding program for use offline with private health information. Incorporate local data surrounding the medical center for more accurate geocoding at the local scale. Implement as intranet application for institution wide use.  <i>Catalyzing Ambulatory Research in Pneumonia Etiology and Diagnostic Innovations in Emergency Medicine (CARPE DIEM)</i> <span style="float: right;"><i>April 2016 – present</i></span> Advisor: Lilliam Abroggio, Todd Florin Use machine learning algorithms to develop a diagnostic test to differentiate viral from bacterial community-acquired pneumonia based on metabolomics data.  <b>Department of Biostatistics and Bioinformatics, University of Cincinnati</b>  <i>Statistical Inference for Random Forest</i> <span style="float: right;"><i>January 2015 – March 2016</i></span> Advisor: Roman Jandarov, MB Rao Development of theory for calculating confidence intervals for random forest predictions using the infinitesimal jackknife. Executed simulations to test the accuracy and precision of novel estimators. Created software package for R to implement novel techniques to help users extract	

more statistical inferences from random forests.

*Land Use Random Forest Model*

*January 2015 – March 2016*

Advisor: Roman Jandarov, MB Rao

Created a novel random forest land use (LURF) model for assessing exposure to elemental components of particulate matter in the urban Cincinnati, OH area. Showed that LURF was a more precise and accurate tool compared to land use regression. Furthermore, used tool to relate air pollution exposures to respiratory and mental health outcomes in the CCAAPS cohort.

*Cincinnati Childhood Allergy and Air Pollution Study (CCAAPS)*

*March 2014 – March 2016*

Advisor: Patrick Ryan

Conducted unsupervised clustering analysis of asthmatic children into clinically-useful subtypes and machine learning based prediction of disease phenotypes. Analyzed and visualized big air pollution data from real-time, GPS equipped sensors using GIS tools. General statistical consulting for epidemiologists and clinicians involved with study.

*Relationship of Indoor Outdoor and Personal Air (RIOPA)*

*January 2014 – November 2014*

Advisor: Patrick Ryan, MB Rao

Characterized and analyzed multivariate data using clustering and principal component techniques. Implemented machine learning algorithm for prediction of personal exposure to individual elements in PM<sub>2.5</sub> based on indoor and outdoor air data, as well as information about potential PM<sub>2.5</sub> sources and personal activities.

*Brief Rating of Aggression by Children and Adolescents (BRACHA)*

*March 2013 – August 2014*

Advisor: Jeff Welge, Doug Mossman, Drew Barzman

Created novel data tool combining machine learning and logistic regression to predict presence, severity, frequency, and timing of aggressive acts committed in Cincinnati Children's College Hill Psychiatric Residential Clinic.

**Department of Pharmacology and Biophysics, University of Cincinnati**

*Ultrasound- and Liposome-Mediated Targeted Gene Therapy*

*July 2010 – January 2012*

Advisor: Keith Jones, Christy Holland

Developed novel methodology for delivering genetic material to myocardium in mouse model of acute myocardial infarction. Ultrasound-mediated delivery of oligonucleotides targeted to suppress inflammation-related gene expression with spatial and temporal control over dosing.

**Department of Biomedical Engineering, University of Cincinnati**

*Ion Channel Engineering and Characterization*

*March 2007 – July 2010*

Advisor: David Wendell, Carlo Montemagno

Implemented a planar artificial lipid bilayer system to study voltage-responsive ion currents through several ion channels. Characterized Connexin-43 and several mutants' responses to voltage differences as well as several compounds. Designed and purified several membrane proteins: genetic design and construction, protein production and purification, reconstitution into liposomes and polysomes.

ACADEMIC  
EXPERIENCE

**University of Cincinnati, Cincinnati, Ohio USA**

*Instructor*

*August - December, 2015*

Co-taught graduate level course for the Department of Biostatistics and Epidemiology. Shared responsibility for lectures, exams, homework assignments, and grades.

PUBLICATIONS

Rebecca Gernes, **Cole Brokamp**, Glenn Rice, J. Michael Wright, Michelle Kondo, Yvonne Michael, Geoffrey Donovan, Demetrios Gatzliolis, David Bernstein, Grace LeMasters, James Lockey, G. Khurana Hershey, Patrick Ryan. Evaluation of Multiple Measures of Residential Greenspace Exposure and Early and Late-onset Allergy Outcomes in a Cincinnati Children's Cohort. *In Preparation*.

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. *Submitted*.

Lusine Yaghjyan, R Aroa, **Cole Brokamp**, E O'Meara, B Sprague, G Ghita, Patrick Ryan. Association of air pollution with mammographic breast density in the Breast Cancer Surveillance Consortium. *In Preparation*.

**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. *Under Review*.

Hong Ji, Jocelyn M Biagini Myers, Eric B Brandt, **Cole Brokamp**, Patrick H Ryan, Gurjit K Khurana Hershey. Air pollution, epigenetics, and asthma. *In press*.

**Cole Brokamp**, Roman Jandarov, MB Rao, Grace LeMasters, Patrick Ryan. Land use models for eleven elemental components of particulate matter in an urban environment: A comparison of linear regression and random forest models. *Under Review*.

Jennifer Kannan, **Cole Brokamp**, David I. Bernstein, James E. Lockey, Manuel Villareal, Gurjit K. Khurana Hershey, Grace K. LeMasters, Patrick Ryan. Clinical and environmental factors associated with habitual snoring in the Cincinnati childhood allergy and air pollution study. *Submitted*.

Kristin A. Schmidlin, **Cole Brokamp**, Grace K. LeMasters, David I. Bernstein, James E. Lockey, Manuel Villareal, Gurjit K. Khurana Hershey, Patrick Ryan. Cluster analysis of childhood asthma phenotypes identifies specific environmental risk factors. *Submitted*.

Jessica S. Tan, **Cole Brokamp**, David I. Bernstein, Grace K. LeMasters, Gurjit K. Khurana Hershey, James E. Lockey, Manuel Villareal, Patrick Ryan. Patterns of longitudinal allergic sensitization identifies phenotypes of children at increased risk for asthma. *Submitted*.

**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*. online:1-7, 2016. [Download](#).

Kanistha C. Coombs, Ginger L. Chew, Christopher Schaffer, Patrick H. Ryan, **Cole Brokamp**, Sergey A. Grinshpun, Gary Adamkiewicz, Steve Chillrude, Curtis Hedman, Meryl Colton, Jamie Ross, Tiina Reponen. Indoor air quality in green-renovated vs. non-green low-income homes of children living in a temperate region of US (Ohio). *Science of The Total Environment*. 554-555:178-185, 2016. [Download](#).

Patrick Ryan, **Cole Brokamp**, Z-H Fan, MB Rao. Analysis of personal and home characteristics associated with the elemental composition of PM<sub>2.5</sub> in indoor, outdoor, and personal air in the RIOPA study. *Health Effects Institute Research Report 185*. :, 2015. [Download](#).

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. [Download](#).

Patrick H Ryan, Sang Young Son, Christopher Wolfe, James Lockey, **Cole Brokamp**, Grace LeMasters. A field application of a personal sensor for ultrafine particle exposure in children. Science of The Total Environment. 508:366-373, 2015. [Download](#).

**Cole Brokamp**, MB Rao, Tina Zhihua Fan, Patrick H Ryan. Does the elemental composition of indoor and outdoor PM2.5 accurately represent the elemental composition of personal PM2.5?. Atmospheric Environment. 101:226-234, 2015. [Download](#).

**Cole Brokamp**, Jacob Todd, Carlo Montemagno David Wendell. Electrophysiology of single and aggregate Cx43 hemichannels. PLoS ONE. 7(10):e47775:, 2012. [Download](#).

Sheryl E Koch, Xiaoqian Gao, Lauren Haar, Min Jiang, Valerie M Lasko, Nathan Robbins, Wenfeng Cai, **Cole Brokamp**, Priyanka Varma, Michael Tranter, Yong Liu, Xiaoping Ren, John N. Lorenz, Hong-Sheng Wang, W Keith Jones, Jack Rubinstein. Probenecid: novel use as a non-injurious positive inotrope acting via cardiac TRPV2 stimulation. Journal of Molecular and Cellular Cardiology. 53(1):134-144, 2012. [Download](#).

Michael Tranter, Robert N Helsley, Waltke R Paulding, Michael McGuinness, **Cole Brokamp**, Lauren Haar, Yong Liu, Xiaoping Ren, W Keith Jones. Coordinated post-transcriptional regulation of HSP70. 3 gene expression by microRNA and alternative polyadenylation. Journal of Biological Chemistry. 286(34):29828-29837, 2011. [Download](#).

#### CONSULTING

##### *Sewer Overflow*

Collaborators: Louis Muglia, Andrew Beck, Patrick Ryan, Todd Trabert

GIS data extraction and statistical modeling for relationship between sewer overflows and admission to CCHMC. A collaboration with the Metropolitan Sewer District of Greater Cincinnati.

##### *Abusive Head Trauma Incidence*

Collaborators: Emily Eismann, Kathi Makoroff

Mapping and statistical models for relationship of abusive head trauma cases at CCHMC and socioeconomic status.

##### *Phenotypic Subtypes of Autism based on Gene Expression*

Collaborators: Ping-I (Daniel) Lin

Semi-supervised principal components analysis on genome wide expression data and association of functional gene pathways with autistic severity scores.

##### *Breast Density and Air Pollution*

Collaborators: Lusine Yaghjian, Patrick Ryan

Air pollution exposure assessment for nationwide cohort of breast cancer patients. Model uses EPA's hierarchical Bayesian model and combines monitoring data with output from the Community Multi-scale Air Quality model.

##### *Infectious Diseases and Trauma Transportation*

Collaborators: Monir Hossain

Calculation of transportation related GIS data for nationwide cohort. Calculation of estimated driving times between accident locations and major trauma centers using Google Maps API.

##### *Traffic Exposures for Rush University Medical Center*

Collaborators: Christopher Codispoti

Geocoding and GIS calculation of traffic related variables for a cohort of subject in the Chicago, IL area.

CONFERENCE  
PRESENTATIONS

**Brokamp C**, Jandarov R, Rao MB, LeMasters G, Ryan PH. Land Use Models for Elemental Components of Particulate Matter in an Urban Environment: A Comparison of Regression and Random Forest Models. A talk given at the International Society of Exposure Science Annual Meeting, October 2016, Utrecht, NL.

**Brokamp C**, LeMasters G, Ryan PH. Childhood Residential Changes are Associated with Decreased Traffic Exposure and Improved Neighborhood Characteristics. A talk given at the International Society of Exposure Science Annual Meeting, October 2015, Las Vegas, NV.

**Brokamp C**, Appel K, Welge J, Mossman D, Barzman D. Brief Rating of Aggression by Children and Adolescents (BRACHA) 1.0. A poster presented at the American Academy of Psychiatry and the Law conference, October 2014, Chicago, IL.

**Brokamp C**, Rao MB, Ryan P. Assessing the Improvement in Predicting Personal Exposure to Elements in PM<sub>2.5</sub> by Including Indoor PM<sub>2.5</sub> Measurements and Home Characteristics to Outdoor PM<sub>2.5</sub> Measurements. A poster presented at the International Society of Exposure Science Conference, October 2014, Cincinnati, OH.

**Brokamp C**, Rao MB, Ryan P. Assessing Personal PM<sub>2.5</sub> Exposure Prediction Improvement After Addition of Indoor PM<sub>2.5</sub> Exposure and Personal Characteristics to Outdoor PM<sub>2.5</sub> Exposure Measurements. A poster and speed oral presentation at the Joint Statistical Meeting, August 2014, Boston, MA.

**Brokamp C**, Rao MB, Ryan P. Assessing the Improvement in Predicting Personal Exposure to Elements in PM<sub>2.5</sub> by Including Indoor PM<sub>2.5</sub> Measurements and Home Characteristics to Outdoor PM<sub>2.5</sub> Measurements. A poster presented at the Health Effects Institute Conference, May 2014, Alexandria, VA.

**Brokamp C**, Wendell D, Montemagno C. Electrophysiology and Plaque Formation of Cx43 Hemichannels. A poster presented at the Biophysical Society Conference, March 2010, San Francisco, CA.

**Brokamp C**, Wendell D, Montemagno C. Exogenous Control of Gene Expression in Insect Cells via Ribozyme Modulation. A poster presented at the Biophysical Society Conference, March 2009, Boston, MA.

**Brokamp C**, Wendell D, Montemagno C. The Engineering and Conductance of a Membrane Bound Nanopore from the Phi29 Portal Protein GP10. A poster presented at the Biophysical Society Conference, March 2009, Boston, MA.

**Brokamp C**, Wendell D, Montemagno C. Exogenous Control of Gene Expression in Insect Cells via Ribozyme Modulation. A poster presented at the University of Cincinnati Undergraduate Poster Symposium, June 2008, Cincinnati, OH.

**Brokamp C**, Wendell D, Montemagno C. Engineering the Calvin Cycle: A Cell Free Photoconversion System for Biofuel Generation. A poster presented at the University of Cincinnati Undergraduate Poster Symposium, June 2008, Cincinnati, OH.

SEMINAR  
PRESENTATIONS

**Brokamp C**. Combined Sewer Overflow and Childhood Hospital Admissions. A presentation for the Division of Biostatistics and Epidemiology seminar series at Cincinnati Children's Hospital Medical Center, June 2016, Cincinnati, OH.

**Brokamp C**. Geospatial Data for Environmental Epidemiology. A seminar presentation for the Environmental Epidemiology Shared Interest Group at Cincinnati Children's Hospital Medical Center, February 2016, Cincinnati, OH.

**Brokamp C**. Confidence Intervals for Random Forest Predictions Using the Infinitesimal Jackknife. A seminar presentation for the University of Cincinnati Division of Biostatistics and Bioinformatics, November 2015, Cincinnati, OH.

**Brokamp C.** R Studio and R Markdown: An integrated IDE and report generator for R. A guest lecture for BE7022 (Intro To Biostatistics), University of Cincinnati, September 2015, Cincinnati, OH.

**Brokamp C.** Does the Elemental Composition of Indoor and Outdoor PM<sub>2.5</sub> Accurately Represent the Elemental Composition of Personal PM<sub>2.5</sub>? A seminar presentation for the University of Cincinnati Division of Biostatistics and Epidemiology, September 2014, Cincinnati, OH.

**Brokamp C.** Exact Sampling and Counting for Fixed-Margin Matrices. A seminar presentation for University of Cincinnati Biostatistics and Epidemiology, September 2013, Cincinnati, OH.

**Brokamp C.** Calculating Correct Standard Errors from Subsets of Complex Sampling Designs in R. A seminar presentation for University of Cincinnati Biostatistics and Epidemiology, August 2013, Cincinnati, OH.

**Brokamp C.** Statistical Analysis of Microarray Data: Controlling the False Discovery Rate. A seminar presentation for BE 7089, University of Cincinnati Biostatistics and Epidemiology, October 2012, Cincinnati, OH.

**Brokamp C.** Small Molecule Disruption of G Beta Gamma Signaling Inhibits the Progression of Heart Failure. A seminar presentation for the University of Cincinnati Department of Pharmacology and Biophysics, November 2011, Cincinnati, OH.

**Brokamp C.** Ultrasound-Targeted Microbubble Destruction to Deliver Nucleic Acid to the Heart. A seminar presentation for the University of Cincinnati Department of Pharmacology and Biophysics, March 2011, Cincinnati, OH.

**Brokamp C.** An academic research cooperative education experience. A seminar presentation for BME 321, University of Cincinnati Biomedical Engineering, February 2011, Cincinnati, OH.

**Brokamp C.** Chronopharmacology: The Role of the Circadian Clock in Pharmacology. A seminar presentation for the University of Cincinnati Department of Pharmacology and Biophysics, January 2011, Cincinnati, OH.

COMPUTER SKILLS    *Statistical Packages:* R (including GIS packages: rgdal, rgeos, sp, raster)  
*Languages:* Python, Unix shell scripting, R Markdown, Max  
*Applications:* RShiny, Knitr, L<sup>A</sup>T<sub>E</sub>X, MS Office, qGIS, ArcGIS, GEOS, LSF  
*Operating Systems:* Unix/Linux, Mac, Windows

SOFTWARE            **RFinfer**  
A package for R that implements novel versions of the random forest from my dissertation research, produces confidence intervals and prediction variances.  
Available at <https://github.com/cole-brokamp/RFinfer>  
DOI: 10.5281/zenodo.50879

**aiRpollution**  
A package for R that assesses exposure to air pollution components in Cincinnati, Ohio. Also includes other convenience functions for extracting Cincinnati GIS variables.  
Available at <https://github.com/cole-brokamp/aiRpollution>  
DOI: 10.5281/zenodo.50878

**geocoder**  
A software package for linux that geocodes using TIGER/Line data. Offline geocoding is useful when dealing with private health information. This software is also implemented on a internal server, available to researchers at CCHMC.  
Available at <https://github.com/cole-brokamp/geocoder>

DOI: 10.5281/zenodo.56484

#### geocodeCAGIS

A package for R that uses exact address files from CAGIS to geocode addresses in Cincinnati, Ohio.

Available at <https://github.com/cole-brokamp/geocodeCAGIS>

DOI: 10.5281/zenodo.50876

#### CB

A package for R that covers my commonly used personal functions. Includes data exploration functions common to epidemiologic studies.

Available at <https://github.com/cole-brokamp/CB>

DOI: 10.5281/zenodo.50877

#### Location-based Pollution Exposure

A portable R Shiny web application that generates predictions of traffic related air pollution exposures based on location. Supports interactive mapping as well as batch submission of addresses.

Available at <http://colebrokamp.com>

#### Other Projects

My contributions to open source projects and more software currently under development.

Available at <https://github.com/cole-brokamp>

#### AWARDS AND MEMBERSHIPS

CCHMC Arnold W. Strauss Fellow Award	<i>2016</i>
CCHMC Division of Biostatistics & Epidemiology Travel Award	<i>2016</i>
Member - International Society of Exposure Science	<i>2014 – present</i>
Member - American Statistical Association	<i>2013 – present</i>
Choose Ohio First Scholarship Recipient	<i>2010 – 2015</i>
University Graduate Scholarship Recipient	<i>2010 – present</i>
Distinguished Honors Scholar, UC Engineering	<i>2010</i>
University of Cincinnati Alumni Scholarship	<i>2008 – 2009</i>
University Cincinnati Scholar Recipient	<i>2005 – 2010</i>

#### LEADERSHIP AND SERVICE

Journal Reviewer, Journal of Exposure Science and Environmental Epidemiology	<i>2015-2016</i>
Chair of the Land Use Regression Modeling Session, International Society of Exposure Science Annual Meeting	<i>2016</i>
Co-founded Biostatistics Student Journal Club, Department of Biostatistics, University of Cincinnati	<i>2013</i>
Student Representative to Graduate Education Committee, Department of Pharmacology, University of Cincinnati	<i>2010 – 2011</i>