BIOGRAPHICAL SKETCH

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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

As a biostatistician, I have specialized myself in the areas of machine learning and its application to large environmental and clinical datasets. Recent democratization of "big spatial data" and advances in geoinformatics have allowed unprecedented access to environmental characteristics that can be used to estimate exposures to pollutants that vary highly with respect to both time and space. More precise environmental features require more complex models and I have dedicated my early career to furthering exposure science methodology in order to bring more precise exposure assessments to environmental health studies. I have created different spatiotemporal land use models based on the machine learning technique called random forest. Development of the land use random forest (LURF) model has also lead to methodological contributions to the random forest model itself.

The proposed work to examine the relation between early life ambient air pollution exposure and cardiometabolic outcomes later in life will benefit from my recently developed spatiotemporal $PM_{2.5}$ exposure assessment model. My expertise will be useful in both extending the current model to a higher spatiotemporal resolution and in estimating early life exposure to children in the cohorts.

1. **Cole Brokamp**, Roman Jandarov, Monir Hossain, Patrick Ryan. Predicting Daily Exposure to Urban Fine Particulate Matter at a High Spatial Resolution. Under Review.

2. **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. In Press.

3. **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.

B. Positions and Honors

Positions and Employment

2010–2016	Graduate Research Assistant, University of Cincinnati
2016–2017	Research Fellow, Cincinnati Children's Hospital Medical Center
2017–	Assistant Professor, Cincinnati Children's Hospital Medical Center

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
2017	CCHMC Epidemiology & Biostatistics Top Research Achievement

C. Contribution to Science

1. The main aim of my early career work has been to develop exposure assessment models for airborne pollutants based on machine learning techniques. Specifically, applying random forest to land use models results in higher accuracy and precision of air pollution exposure assessment by elucidating complex interactions and nonlinear relationships between land use predictors and pollutant concentrations. 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 from 2000 - 2015 at a resolution of 1 x 1 km across the Greater Cincinnati area.

    a. **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.

    b. **Cole Brokamp**, Roman Jandarov, Monir Hossain, Patrick Ryan. Predicting Daily Exposure to Urban Fine Particulate Matter at a High Spatial Resolution. Under Review.

2. The work in developing LURF methods has helped me gain expertise in geospatial computing. Along with other collaborators, I have applied these geospatial techniques to analyze the effect on health of other environmental exposures such as combined sewer overflows, elemental components of particulate matter, greenspace, and ozone.

    a. **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.

    b. 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. Breast Cancer Research. 19:36. 1-10. 2017.

    c. **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.

    d. Rebecca Gernes, **Cole Brokamp**, Glenn Rice, J. Michael Wright, Michelle Kondo, Yvonne Michael, Geoffrey Donovan, Demetrios Gatziolis, David Bernstein, Grace LeMasters, James Lockey, G. Khurana Hershey, Patrick Ryan. Using medium- and high-resolution residential greenspace measures to assess risks of allergy outcomes in a cohort of children residing near Cincinnati, Ohio. Under Review.

3. Collaborating with other researchers wishing to use geospatial characteristics of research participants within existing cohorts and multisite studies has highlighted the significant need for a reproducible and distributed method for extracting place-based information from a residential address while maintaining the privacy of protected health information. I recently developed a novel approach and accompanying software package called DeGAUSS which overcomes the multiple 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.

    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. Under Review.

    b. 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. In Press.

    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. Under Review.

4. As a trained biostatistician, I also have a general interest in collaborating with others and often use my expertise in spatial statistics to study the effect of place-based characteristics on health outcomes.

    a. 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. 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.

    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. Under Review.

Complete List of Published Work in MyBibliography:

https://www.ncbi.nlm.nih.gov/myncbi/browse/collection/49821426

D. Research Support

Ongoing 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 (9/1/17 - 12/31/17)
Retrospective epidemiological studies are often created using electronic health record databases. Although these records are "wide", they are not "deep" with respect to 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. This will solve the urgent problem of unconfounding for individual SES in the execution of EHR based research.
Role: PI

NIH/NIEHS 1R01ES019890-01
Neurobehavioral and Neuroimaging Effects of Traffic Exposure in Children
Ryan, PI (7/1/12 - 3/31/18)
The association between exposure to traffic-related air pollutants (TRAP) during early childhood and neurobehavioral and neuroimaging outcomes has not been thoroughly examined. The objective of the proposed study is to determine if children exposed to increased levels of TRAP during critical time periods of brain development have altered neurobehavior in childhood as measured by a battery of valid and reliable tests and to assess the physiologic impact of TRAP exposure on brain structure, organization, and function using quantitative magnetic

resonance imaging (MRI). These results will fill important gaps in current scientific knowledge related to the relationship between TRAP exposure and neurobehavior and central nervous system effects.
Role: Biostatistician

NIH 5K23AI121325
Biomarkers and Risk Stratification in Pediatric Community
Florin, PI (01/01/16 - 12/31/19)
The extensive variation in care, in addition to the lack of evidence-based decision aids, highlights the critical need for an improved understanding of disease severity and tools to guide management for pediatric CAP. The proposed research will address this important knowledge and practice gap.
Role: Biostatistician

U01HG008666
EMERGE: Better Outcomes for Children: Promoting Excellence in Healthcare Genomics to Inform Policy
Harley, PI (09/01/15 - 05/31/19)
We have developed algorithms for the electronic health record (EHR), led the Pediatric Workgroup, developed pharmacogenomics, evaluated the preferences of parents and caregivers to advance genomic medicine and assimilated technical advances into our EHR. The eMERGE effort has become the basic fabric of the institutional initiative to incorporate the extraordinary advances of genetics, genomics and the electronic medical record into healthcare.
Role: Biostatistician

Internal ARC - Cincinnati Children's Hospital
Mother Infant Data Hub
Marsolo, PI (7/1/15 - 7/1/18)
The goals of this award are to create a research database of comprehensive clinical coverage for neonates born throughout the greater Cincinnati area including linkage of medical records to external data sets at the individual- and area-level during the first year of life.
Role: Biostatistician

Internal ARC - Cincinnati Children's Hospital
CARPE DIEM
Ambroggio, PI (7/1/15 - 7/1/18)
The goals of this award are to develop a diagnostic tool based on the urinary metabolome that can differentiate between viral and bacterial community-acquired pneunomia in children.
Role: Biostatistician

Internal - University of Cincinnati
Epidemiology of Rural/Urban Disparities in Stroke
Jasne, PI (1/1/17 - 12/31/17)
The goal of this project is to identify stroke incidence disparities among rural and urban geographic areas.
Role: Biostatistician

Recently Completed Research Support

Internal Arnold W. Strauss Fellowship Award - Cincinnati Children's Hospital
Assessing Exposure to Air Pollution Across Time and Space
Brokamp, PI (7/1/16 - 6/30/17)
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 (1/24/17 - 6/30/17)

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 it ability to correctly estimate environmental exposures and community-level characteristics.
Role: PI

Academy Health

Community Health Peer Learning Program: Participant Community

Beck, PI (2/1/16 - 6/30/17)

The goals of this project are to reduce by 10% the inpatient bed-day rate for one high risk neighborhood in Cincinnati through interventions promoted by shared data and improved data visualization.
Role: Biostatistician

HEI 4784-RFA08-1/09-5

Analysis of Personal and Home Characteristics Associated with the Elemental Composition of PM2.5 in Indoor, Outdoor, and Personal Air in the RIOPA Study

Ryan, PI (12/1/12 - 11/30/13)

The purpose of this study is to assess the relationship between concurrent measurements of the elemental composition of PM2.5 in indoor, outdoor, and ambient air and the elemental composition of indoor, outdoor and personal air across individuals and cities. The study will also identify personal, home, and environmental factors significantly associated with specific elements or clusters of elements in PM2.5.
Role: Biostatistician

Gerber Pediatric Research Grant, Gerber Foundation

Clinical Prediction Model for Community-Acquired Pneumonia

Florin, PI (1/1/14 - 12/31/16)

This project will use clinical data and the biomarker procalcitonin to develop a severity score used to predict the development of severe disease and complications in children with community-acquired pneumonia, the most common serious bacterial infection children and leading killer of children worldwide.
Role: Biostatistician