

# Zachary Ryan McCaw

## Curriculum Vitae

December 1st, 2020

## Education

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### Harvard University

08/2014 – 05/2019

PHD IN BIOSTATISTICS, AM IN BIOSTATISTICS

- DISSERTATION: Transformation and multivariate methods for improving power in genome-wide association studies.
- ADVISOR: Xihong Lin, Ph.D.
- COMMITTEE: Martin Aryee, Ph.D. and Jeffrey Miller, Ph.D.

### UNC Chapel Hill

08/2009 – 05/2013

BSPH IN BIOSTATISTICS, BS IN QUANTITATIVE BIOLOGY

- Graduate with highest distinction.
- GPA: 4.00 of 4.00; Dean's List: 8 of 8 Semesters.

## Experience

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### Google

09/2019 – Present

DATA SCIENTIST

- DEPARTMENT: Core Developer.
- PROJECT: Causal inference to understand factors affecting developer productivity.

### Broad Institute

06/2019 – 09/2019

VISITING SCIENTIST

- DEPARTMENT: Medical and Population Genetics.
- PRINCIPAL INVESTIGATOR: Hilary Finucane, Ph.D.
- PROJECT: Cross-population fine-mapping to identify shared and population-specific causal effects.

### Harvard School of Public Health

02/2016 – 05/2019

GRADUATE STUDENT

- DEPARTMENT: Biostatistics.
- PRINCIPAL INVESTIGATOR: Xihong Lin, Ph.D.
- PROJECT 1: Operating characteristics of the rank-based inverse normal transformation for genome-wide association studies of quantitative traits.
- PROJECT 2: Cross-tissue eQTL calling via surrogate expression analysis.

- PROJECT 3: Synthetic surrogate analysis for genetic association testing with a partially missing target outcome.

## **Broad Institute**

07/2016 – 07/2017

GRADUATE STUDENT

- DEPARTMENT: Computational Methods for Genomics and Epigenomics Lab.
- PRINCIPAL INVESTIGATOR: Martin Aryee, Ph.D.
- PROJECT: Identifying differential chromatin boundaries across cell lines.

## **Dana Farber Cancer Institute**

06/2015 – 08/2015

RESEARCH STUDENT

- DEPARTMENT: Biostatistics and Computational Biology.
- PRINCIPAL INVESTIGATOR: John Quackenbush, Ph.D.
- PROJECT: Network analysis of eQTL.

## **National Institute of Environmental Health Sciences**

05/2012 – 08/2014

RESEARCH STUDENT

- DEPARTMENT: Environmental Genetics Group.
- PRINCIPAL INVESTIGATOR: Steven Kleeberger, Ph.D.
- PROJECT 1: Identifying genetic signatures of respiratory syncytial virus (RSV) disease susceptibility in mice.
- PROJECT 2: Role of Notch receptors in ozone-induced lung injury.
- PROJECT 3: Mitochondrial determinants of susceptibility to oxidative stress in mice.

## **UNC Chapel Hill**

08/2012 – 12/2012

UNDERGRADUATE RESEARCH STUDENT

- DEPARTMENT: RNA Folding Bioinformatics Group.
- PRINCIPAL INVESTIGATOR: Alain Laederach, Ph.D.
- PROJECT: Quantifying eQTL enrichment of mRNA protein binding sites.

## **UNC Chapel Hill**

08/2010 – 12/2012

UNDERGRADUATE RESEARCH STUDENT

- DEPARTMENT: Nanoscale Science Research Group.
- PRINCIPAL INVESTIGATOR: Michael Falvo, Ph.D.
- PROJECT: Analysis of fibrin clot structure *in vitro*.

## Teaching Experience

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### Harvard University

- CLASS: Inference II (BST 241) 02/2019 – 05/2019  
INSTRUCTOR: Rui Wang, Ph.D.
- CLASS: Introduction to Biostatistics 02/2019  
INSTRUCTOR: Lori Chibnik, Ph.D.  
LOCATION: University of KwaZulu-Natal, Durban, SA
- CLASS: Multivariate and Longitudinal Analysis (BST 245) 02/2018 – 05/2018  
INSTRUCTOR: Sebastien Haneuse, Ph.D.
- CLASS: Inference I (BST 231) 02/2017 – 05/2017  
INSTRUCTOR: Judith Lok, Ph.D.
- CLASS: Statistical Genetics (BST 227) 10/2016 – 12/2016  
INSTRUCTOR: Martin Aryee, Ph.D.
- CLASS: Computational Biology (STAT 215) 02/2016 – 05/2016  
INSTRUCTOR: X. Shirley Liu, Ph.D.

### UNC Chapel Hill

- CLASS: General Chemistry I (CHEM 101) 08/2012 – 12/2012  
INSTRUCTOR: Jennifer Krumper, Ph.D.
- CLASS: Organic Chemistry II (CHEM 262) 08/2011 – 12/2011  
INSTRUCTOR: Jennifer Krumper, Ph.D.

## Awards and Distinctions

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- **Distinguished Student Paper Award** 07/2019  
Joint Statistical Meeting, Section in Genetics and Genomics.
- **Stellar Abstract Award** 11/2018  
Program in Quantitative Genomics
- **Ruth L. Kirschstein National Research Service Award (F31)** 03/2018  
TITLE: Innovations in Genome Wide Association Testing Inspired by Obstructive Sleep Apnea Phenotypes.
- **Teaching Fellow** 11/2017  
Global Initiative for Neuropsychiatric Genetic Education in Research
- **NIH Pre-Doctoral Training Grant** 08/2016  
Statistical and Quantitative Training in Big Data Health Science
- **NIH Pre-Doctoral Training Grant** 08/2014  
Interdisciplinary Training Grant in Biostatistics and Computational Biology

• <b>NIH Post-Baccalaureate Research Fellow</b>	09/2013
National Institute of Environmental Health Sciences	
• <b>Undergraduate Academic Achievement Award</b>	04/2013
• <b>Phi Beta Kappa National Honors Society</b>	11/2011
• <b>NIH Summer Internship</b>	05/2011
National Institute of Environmental Health Sciences	05/2010

## Articles

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- [1] B Alipanahi et al. “Large-scale machine learning-based phenotyping significantly improves genomic discovery for optic nerve head morphology”. In: *arXiv* (Nov. 2020). DOI: [arXiv:2011.13012](https://doi.org/10.1101/2020.11.29.403063).
- [2] ZR McCaw et al. “Cross-tissue eQTL mapping in the presence of missing data via surrogate outcome analysis”. In: *bioRxiv* (Nov. 2020). DOI: [10.1101/2020.11.29.403063](https://doi.org/10.1101/2020.11.29.403063).
- [3] C Perego et al. “Utility of Restricted Mean Survival Time Analysis for Heart Failure Clinical Trial Evaluation and Interpretation”. In: *JACC Heart Failure* (Oct. 2020). DOI: [10.1016/j.jchf.2020.07.005](https://doi.org/10.1016/j.jchf.2020.07.005).
- [4] ZR McCaw et al. “Survival analysis of treatment efficacy in comparative COVID-19 studies.” In: *Clinical Infectious Diseases* (Oct. 2020). DOI: [10.1093/cid/ciaa1563](https://doi.org/10.1093/cid/ciaa1563).
- [5] ZR McCaw et al. “Selecting Appropriate Endpoints for Assessing Treatment Effects in Comparative Clinical Studies for COVID-19”. In: *Contemporary Clinical Trials* (Sept. 2020). DOI: [10.1016/j.cct.2020.106145](https://doi.org/10.1016/j.cct.2020.106145).
- [6] B Huang et al. “Analysis of Response Data for Assessing Treatment Effects in Comparative Clinical Studies”. In: *Annals of Internal Medicine* (July 2020). DOI: [10.7326/M20-0104](https://doi.org/10.7326/M20-0104).
- [7] ZR McCaw et al. “How to Quantify and Interpret Treatment Effects in Comparative Clinical Studies of COVID-19”. In: *Annals of Internal Medicine* (July 2020). DOI: [10.7326/M20-4044](https://doi.org/10.7326/M20-4044).
- [8] H Julienne et al. “Multitrait genetic-phenotype associations to connect disease variants and biological mechanisms”. In: *bioRxiv* (June 2020). DOI: [10.1101/2020.06.26.172999](https://doi.org/10.1101/2020.06.26.172999).
- [9] ZR McCaw et al. “Operating Characteristics of the Rank-Based Inverse Normal Transformation for Quantitative Trait Analysis in Genome-Wide Association Studies”. In: *Biometrics* (Dec. 2019). DOI: [10.1111/biom.13214](https://doi.org/10.1111/biom.13214).
- [10] ZR McCaw, H Julienne, and H Aschard. “MGMM: an R package for fitting Gaussian Mixture Models on Incomplete Data”. In: *bioRxiv* (Dec. 2019). DOI: [10.1101/2019.12.20.884551](https://doi.org/10.1101/2019.12.20.884551).
- [11] J Marzec et al. “Toll-like receptor 4-mediated respiratory syncytial virus disease and lung transcriptomics in differentially susceptible inbred mouse strains”. In: *Physiological Genomics* (Nov. 2019). DOI: [10.1152/physiolgenomics.00101.2019](https://doi.org/10.1152/physiolgenomics.00101.2019).

- [12] ZR McCaw, G Yin, and LJ Wei. “Using the Restricted Mean Survival Time Difference as an Alternative to the Hazard Ratio for Analyzing Clinical Cardiovascular Studies”. In: *Circulation* 140.17 (Oct. 2019), pp. 1366–1368. DOI: 10.1161/CIRCULATIONAHA.119.040680.
- [13] ZR McCaw et al. “Applying Evidence-Based Medicine to Shared Decision Making: Value of Restricted Mean Survival Time”. In: *The American Journal of Medicine* 132.1 (Jan. 2019), pp. 13–15. DOI: 10.1016/j.amjmed.2018.07.026.
- [14] M High et al. “Determinants of host susceptibility to murine respiratory syncytial virus (RSV) disease identify a role for the innate immunity scavenger receptor MARCO gene in human infants”. In: *EBioMedicine* S2352-3964.16 (2016), pp. 30360–7. DOI: 10.1016/j.ebiom.2016.08.011.
- [15] JM Ciencewicz et al. “Effects of mannose-binding lectin on pulmonary gene expression and innate immune inflammatory response to ozone”. In: *American Journal of Physiology-Lung Cellular and Molecular Physiology* 311.2 (2016), pp. 280–91. DOI: 10.1152/ajplung.00205.2015.
- [16] BP Kleinstiver et al. “Genome-wide specificities of CRISPR-Cas Cpf1 nucleases in human cells”. In: *Nature Biotechnology* 34.8 (2016), pp. 869–74. DOI: 10.1038/nbt.3620.
- [17] KC Verhein et al. “Novel Roles for Notch3 and Notch4 Receptors in Gene Expression and Susceptibility to Ozone Induced Lung Inflammation in Mice”. In: *Environmental Health Perspectives* 123.8 (2015), pp. 799–805. DOI: 10.1289/ehp.1408852.
- [18] J Krishnaswamy et al. “Coincidental loss of DOCK8 function in NLRP10-deficient and C3H/HeJ mice results in defective dendritic cell migration”. In: *PNAS* 112.10 (2015), pp. 3056–61. DOI: 10.1073/pnas.1501554112.
- [19] H Cho et al. “Association of Nrf2 polymorphism haplotypes with acute lung injury phenotypes in inbred strains of mice”. In: *Antioxidants and Redox Signaling* 22.4 (2015), pp. 325–38. DOI: 10.1089/ars.2014.5942.
- [20] KC Verhein et al. “Genetic Factors Involved in Susceptibility to Lung Disease”. In: *The Lung Second Edition: Development, Aging and the Environment*. Ed. by Plopper CG, Harding R, Pinkerton KE. London: Academic Press, 2014.

## Correspondence

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- [1] ZR McCaw, L Tian, and LJ Wei. “Appropriate Analysis of Duration of Response Data in Cancer Trials”. In: *JAMA Oncology* (Oct. 2020). DOI: 10.1001/jamaoncol.2020.4657.
- [2] EB Ludmir, ZR McCaw, and LJ Wei. “Interpreting the Effect of Ipilimumab Following Radiotherapy for Patients with Postdocetaxel Metastatic Castration-resistant Prostate Cancer”. In: *European Urology* (Oct. 2020). DOI: 10.1016/j.eururo.2020.09.049.

- [3] ZR McCaw, L Tian, and LJ Wei. “What We Learned from Recent COVID-19 Clinical Studies Regarding Statistical Methodology”. In: *Biopharmaceutical Report* 27.3 (Oct. 2020).
- [4] EB Ludmir et al. “Progression-free survival in the ICON8 trial”. In: *Lancet* 396.10253 (Sept. 2020), p. 756. DOI: 10.1016/S0140-6736(20)31175-2.
- [5] ZR McCaw et al. “Further clinical interpretation and implications of KEYNOTE-048 findings”. In: *Lancet* 396.10248 (Aug. 2020), pp. 378–379. DOI: 10.1016/S0140-6736(20)30904-1.
- [6] ZR McCaw, DH Kim, and LJ Wei. “Remdesivir for the Treatment of Covid-19 - Preliminary Report”. In: *New England Journal of Medicine* (July 2020). DOI: 10.1056/NEJMc2022236.
- [7] ZR McCaw, DH Kim, and LJ Wei. “Risk-Benefit Comparisons Between Shorter and Longer Durations of Adjuvant Chemotherapy in High-Risk Stage II Colorectal Cancer”. In: *JAMA Oncology* (June 2020). DOI: 10.1001/jamaoncol.2020.2256.
- [8] EB Ludmir et al. “Fulvestrant plus capivasertib for metastatic breast cancer”. In: *Lancet Oncology* 21.5 (May 2020), e233. DOI: 10.1016/S1470-2045(20)30228-X.
- [9] ZR McCaw, LJ Wei, and EB Ludmir. “Interpreting the impact of apalutamide on overall survival among patients with non-metastatic castration-resistant prostate cancer”. In: *Annals of Oncology* 31.3 (Mar. 2020), pp. 438–440. DOI: 10.1016/j.annonc.2019.11.020.
- [10] D Li, ZR McCaw, and LJ Wei. “Interpreting the Benefit of Simvastatin-Ezetimibe in Patients 75 Years or Older”. In: *JAMA Cardiology* (Jan. 2020). DOI: 10.1001/jamacardio.2019.5200.
- [11] EB Ludmir et al. “Quantifying the Benefit of Non-small-cell lung Cancer Immunotherapy”. In: *Lancet* 394.10212 (Nov. 2019), p. 1904. DOI: 10.1016/S0140-6736(19)32503-6.
- [12] ZR McCaw and LJ Wei. “P2Y12 Inhibitor Monotherapy vs Dual Antiplatelet Therapy After Percutaneous Coronary Intervention”. In: *JAMA* 322.16 (Oct. 2019), p. 1607. DOI: 10.1001/jama.2019.13159.
- [13] ZR McCaw, Z Meng, and LJ Wei. “A Shorter Regimen for Rifampin-Resistant Tuberculosis”. In: *New England Journal of Medicine* 381.11 (Sept. 2019), e22. DOI: 10.1056/NEJMc1905782.
- [14] G Yin and ZR McCaw. “Design of Noninferiority Trials for Hypofractionated vs Conventional Radiotherapy Among Patients With Cancer”. In: *JAMA Oncology* (Aug. 2019). DOI: 10.1001/jamaoncol.2019.2391.
- [15] ZR McCaw, DH Kim, and LJ Wei. “Analysis of Long-term Benefits of Intensive Blood Pressure Control”. In: *JAMA* 322.2 (July 2019), pp. 169–170. DOI: 10.1001/jama.2019.5840.
- [16] ZR McCaw, LJ Wei, and DH Kim. “Effects of Aspirin in the Healthy Elderly”. In: *New England Journal of Medicine* 380.18 (May 2019), pp. 1775–1776. DOI: 10.1056/NEJMc1901774.

- [17] Z Yang, ZR McCaw, and G Yin. “Caplacizumab for Acquired Thrombotic Thrombocytopenic Purpura”. In: *New England Journal of Medicine* 380.18 (May 2019), e32. DOI: 10.1056/NEJMc1902336.
- [18] ZR McCaw, LJ Wei, and DH Kim. “Interpreting the Prognostic Value of Unrecognized Myocardial Infarction Among Older Adults”. In: *JAMA Cardiology* (Mar. 2019). DOI: 10.1001/jamacardio.2019.0184.
- [19] ZR McCaw and LJ Wei. “Interpreting the Survival Benefit From Neoadjuvant Chemoradiotherapy Before Surgery for Locally Advanced Squamous Cell Carcinoma of the Esophagus”. In: *Journal of Clinical Oncology* (Mar. 2019). DOI: 10.1200/JCO.18.01164.
- [20] Z Yang, ZR McCaw, and G Yin. “Radical Surgery or Watchful Waiting in Prostate Cancer”. In: *New England Journal of Medicine* 380.11 (Mar. 2019), pp. 1083–1084. DOI: 10.1056/NEJMc1900410.
- [21] ZR McCaw, DH Kim, and LJ Wei. “Evaluating Treatment Effect of Transcatheter Interatrial Shunt Device Using Heart Failure Event Rates”. In: *JAMA Cardiology* (Feb. 2019). DOI: 10.1001/jamacardio.2019.0001.
- [22] ZR McCaw, JL Vassy, and LJ Wei. “Palbociclib and Fulvestrant in Breast Cancer”. In: *New England Journal of Medicine* 380.8 (Feb. 2019), p. 796. DOI: 10.1056/NEJMc1816595.
- [23] ZR McCaw et al. “Trifluridine/tipiracil in metastatic gastric cancer”. In: *Lancet Oncology* 20.1 (Jan. 2019), e8. DOI: 10.1016/S1470-2045(18)30908-2.
- [24] ZR McCaw, F Jiang, and LJ Wei. “Trastuzumab Therapy for 9 Weeks vs 1 Year for Human Epidermal Growth Factor Receptor 2-Positive Breast Cancer”. In: *JAMA Oncology* (Dec. 2018). DOI: 10.1001/jamaoncol.2018.5730.
- [25] ZR McCaw, D Liu, and LJ Wei. “Body Composition and Overall Survival in Patients With Nonmetastatic Breast Cancer”. In: *JAMA Oncology* (Nov. 2018). DOI: 10.1001/jamaoncol.2018.5290.
- [26] ZR McCaw, S Piantadosi, and LJ Wei. “Quantifying the Added Value of Low-Molecular-Weight Heparin to Intermittent Pneumatic Compression for Preventing Venous Thromboembolic Events Under the Risk-Benefit Perspective”. In: *JAMA Surgery* (Nov. 2018). DOI: 10.1001/jamasurg.2018.4294.
- [27] ZR McCaw et al. “Interpreting Clinical Benefits of Neoadjuvant Chemoradiation With Gemcitabine Versus Upfront Surgery in Patients With Borderline Resectable Pancreatic Cancer (BRPC)”. In: *Annals of Surgery* (Nov. 2018). DOI: 10.1097/SLA.0000000000003115.
- [28] ZR McCaw, LJ Wei, and DH Kim. “Gene Expression-Guided Adjuvant Chemotherapy in Breast Cancer”. In: *New England Journal of Medicine* 379.17 (Oct. 2018), p. 1681. DOI: 10.1056/NEJMc1810515.
- [29] BL Claggett et al. “Sex as a predictor of response to cancer immunotherapy”. In: *Lancet Oncology* 19.8 (Aug. 2018), e377. DOI: 10.1016/S1470-2045(18)30517-5.

## Presentations

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- **American Society of Human Genetics** 10/2019  
Cross-population Fine-mapping to Identify Shared and Population-specific Causal Effects.
- **Joint Statistical Meeting** 07/2019  
Cross-tissue eQTL Calling via Surrogate Expression Analysis.
- **Program in Quantitative Genomics** 11/2018  
Leveraging the UKB to Empower Association Testing on Scarce Phenotypes.
- **Joint Statistical Meeting** 07/2018  
Leveraging Surrogate Phenotypes to Improve Inference on a Partially Missing Target Phenotype.
- **Joint Statistical Meeting** 07/2017  
Inverse Normal Transformation for Genome Wide Association Testing of Quantitative Traits.
- **American Thoracic Society** 05/2014  
Gene Expression Profiling Predicts Response to Respiratory Syncytial Virus (RSV) in Mice.
- **NIEHS** 07/2011  
Identifying Candidate Susceptibility Genes for Respiratory Syncytial Virus (RSV) Disease Severity.
- **NIEHS** 07/2010  
Characterization of Transcriptional Networks Underlying Tlr4-Mediated Respiratory Syncytial Virus (RSV) Disease in

## Professional Activities

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- **JSM Section Chair** 07/2019  
Regression Methods for Longitudinal Data
- **JSM Section Chair** 07/2018  
Gene-Gene and Gene-Environment Interactions