Nicolas Barbera, Ph.D.

barbera@virginia.edu
(908) 787-2808

Education

Ph.D. (2020)	**University of Illinois at Chicago** **Chemical Engineering** Thesis: "Uncovering the Functional Effects of Multifaceted Cholesterol-Kir2 Interactions via Molecular Modeling" *Advisors: Dr. Belinda Akpa and Dr. Irena Levitan*
M.S.E. (2014)	**Johns Hopkins University** Chemical and Biomolecular Engineering
B.S. (2013) (Honors)	**Johns Hopkins University** Chemical and Biomolecular Engineering

Research Experience

Postdoctoral Research (2020 – Present)
Advisor: Dr. Mete Civelek

Identification of Causal Variants in Coronary Artery Disease

- Designed a lentivirus-based massively parallel reporter assay to simultaneously test 52,000 candidate DNA sequences for allele-specific expression in both primary vascular smooth muscle and vascular endothelial cells
- Performed extensive chromatin mapping for different epigenetic marks in both primary vascular smooth muscle and vascular endothelial cells using Cleavage-under-targets-and-release-using-nuclease (Cut&Run)
- Performed CRISPR intereference experiments in vascular smooth muscle cells
- Experience with primary cell culturing, cloning, transfection, lentiviral production and transduction, and high-through put sequencing and analysis

Ph.D Research (2015 – 2020)
Advisors: Drs. Belinda Akpa and Irena Levitan

Cholesterol Regulation of Inwardly Rectifying Potassium Channels

- Used coarse-grained molecular dynamics simulations to study the interactions between Kir2.2 and cholesterol molecules in a dynamic lipid membrane environment
- Developed, validated, and utilized analytical software to interrogate molecular dynamics simulations
- Designed an analytical approach utilizing graph theory to better characterize ligand binding dynamics. This approach was later incorporated into publicly available analysis software.
- Utilizing docking analysis software to predict the interactions between Kir and various cholesterol isomers to determine functionally relevant amino acids
- Experience with bash scripting, high-performance supercomputing, GROMACS molecular dynamics simulation software, MATLAB, AutoDock, and VMD protein visualization software

Undergraduate and Master's Research (2011 – 2014)
Advisor: Dr. Konstantinos Konstantopoulos

- Designed microlithographic scaffolds and used cellular microscopy to investigate the extravasion process of metastatic cancer cells and rearrangement of the acto-myosin network and the cell cytoskeleton in response to outside mechanical stimuli.

Teaching and Mentoring

UVA USOAR Program Mentor (2021-Present)
- Taught an undergraduate student the basics of molecular biology, cell culturing, human genetics, and CRISPR editing
- Helped the student design and conduct a long-term project which systematically tested genetic variants using CRISPRi
- *Project Successes:* For work done in this project the student won a UVA Harrison Award, which provided research funding for the summer of 2023

UVA Summer REU Mentor (2021)
- Guided an undergraduate student through a summer research project which integrated publicly available genetics data into a machine learning model.

Undergraduate Mentor (2019-2020)
Senior Honors Project, UIC Bioengineering
- Advised a senior undergraduate student in their Honors Capstone project, teaching them basic techniques in protein homology modeling, MD simulations, and simulation data analysis.
- *Project Successes:* Work from this project contributed to an academic publication in the journal *iScience*

Undergraduate Mentor (2018-2019)
Senior Design, UIC Bioengineering
- Advised a team of undergraduates on the development of an in-browser app for protein visualization

Teaching Assistant (2015)
Chemical Process Control, UIC Chemical Engineering
- Tutored students in the basics of chemical reaction engineering and theory behind process control
- Designed and ran an interactive process control lab project, which gave students hands-on experience to supplement their in class learning
- Created handwritten and video tutorials for the above lab project, as well as tutorials on solution strategies for in-class and homework problems
- Provided administrative aid to professors (such as with grading, scheduling, and student help)

Teaching Assistant (2014)
Chemical Engineering Process and Product Design, JHU Chemical Engineering
- Advising students on the basic principles of efficient process design and product design
- Creating tutorials and comprehensive aid to students utilizing the Aspen design program
- Providing administrative aid to professors (such as with grading, scheduling, and student help)

Service

- **Trainee Career Development Committee, Cardiovascular Research Center** (2021-Present) Helped organize yearly seminar series which brought in speakers from industry and academia to provide advice and networking opportunities for the trainees of the UVA Cardiovascular Research Center.
- **Judge, Piedmont Regional Science Fair** (2022, 2023) Evaluated science projects presented by middle school and highschool students from 14 different counties in Virginia.
- **Abstract Reviewer, UVA Harrison Award and Double Hoo Award** (2023) Reviewed undergraduate abstracts for proposed research projects in biomedical engineering.

Honors, Awards, and Recognition

- Leducq Junior Investigator Award (2023)
- Emerging Scholar in Genomic Sciences, an honor from the University of Virginia to participate in selective symposium (2023)
- Semifinalist, 2023 Trainee Awards for Excellence in Human Genetics Research, American Society of Human Genetics
- Winner of an Excellence in Chemical and Biomolecular Engineering Award, JHU ChemBE Department (2012, 2013)
- Captain of the JHU Varsity Fencing team (2012, 2013)

Research Support

Postdoctoral Fellowship (916402) 07/1/2022 – 06/30/2024
American Heart Association
Role: PI

5 T32 HL007284 – 45 (PI: Gary Owens) 09/01/2020 – 06/30/2022
NIH/NHLBI
Role: Trainee

Publications

1. Beverly, K. M., **Barbera, N.,** and Levitan, I. “Dual Pattern of Cholesterol-Induced Decoupling Pattern of Cholesterol-Induced Decoupling of Residue-Residue Interations of Kir2.2” *Preprint SSRN 4516485*. (2023)
2. **Barbera, N.**, et al. "Cholesterol induced suppression of Kir2 channels is mediated by decoupling at the inter-subunit interfaces." *iScience* (2022): 104329.
3. Srivastava, N., Tauseef, M., Amin, R., Joshi, B., Joshi, J.C., Kini, V., Klomp, J., Li, W., Knezevic, N., **Barbera, N.** and Siddiqui, S. (2020) "Noncanonical function of long myosin light chain kinase in increasing ER-PM junctions and augmentation of SOCE." *The FASEB Journal 34.9: 12805-12819.*
4. Gutorov, R., Peters, M., Katz, B., Brandwine, T., **Barbera, N. A.**, Levitan, I., & Minke, B. (2019). Modulation of Transient Receptor Potential C Channel Activity by Cholesterol. *Frontiers in Pharmacology 10: 1487.*

5. **Barbera, N.,** Minke, B., Levitan, I. (2019) Comparative docking analysis of cholesterol analogs to ion channels to discriminate between stereospecific binding vs. stereospecific response. *Channels 13.1: 136-146.*
6. **Barbera, N.**, Levitan, I. (2019) Chiral Specificity of Cholesterol Orientation within Cholesterol Binding Sites in Inwardly-Rectifying K+ Channels. *Cholesterol Modulation of Protein Function: 77-95.*
7. **Barbera, N.**, Ayee, M.A., Akpa, B.S., Levitan, I. (2018) Molecular Dynamics Simulations of Kir2.2 Interactions with an Ensemble of Cholesterol Molecules*. Biophysical Journal 115.7: 1264-1280.*
8. Ayee, M.A., LeMaster, E., Shentu, T.P., Singh, D.K., **Barbera, N.**, Soni, D., … & Cho, M. (2017) Molecular-scale biophysical modulation of an endothelial membrane by oxidized phospholipids. *Biophysical Journal 112.2: 325-338.*
9. **Barbera, N.**, Ayee, M.A., Akpa, B.S., Levitan, I. (2017) Differential effects of sterols on ion channels: binding vs. stereospecific response. *Current Topics in Membranes 80: 25-50.*

Presentations

Commented [BN(1]: Add CVRC, CPHG, ASHG, to this in coming months

1. **Barbera, N** (2023) Comprehensive identification of coronary artery disease-associated variants regulating expression in human vascular smooth muscle cells. ASHG 2023, Washington, DC
2. **Barbera, N** (2023) Comprehensive Characterization of Coronary Artery Disease-Associated Variants Regulating Expression in Vascular Smooth Muscle Cells. CPHG Emerging Scholars in Genome Sciences Symposium, Charlottesville, Virginia
3. **Barbera, N.**, Akpa, B.S., Levitan, I. (2020) Molecular Simulations of Kir-Cholesterol Interactions Uncover Cholesterol Mediated Decoupling of Functional Domains Important for Gating. Biophysical Society Meeting 2020, San Diego, California
4. **Barbera, N.**, Akpa, B.S., Levitan, I. (2019) Kir-Cholesterol Interactions: Molecular Simulations Reveal Cholesterol-Mediated De-Coupling between Functionally Important Domains Essential for Gating. AIChE 2019 Annual Meeting, Orlando, FL, USA
5. **Barbera, N.**, Akpa, B.S., Levitan, I. (2019) Uncovering Mechanisms of Cholesterol Regulation of K+ Channels through MD Simulations Network Theory. Chicago Center for Cardiovascular Research (CCVR) Research Day 2019
6. **Barbera, N.**, Akpa, B.S., Levitan, I. (2019) Molecular Dynamics Simulations of Kir2.2 and Cholesterol Reveal State- and Concentration-Dependent Binding Sites. Biophysical Society Meeting 2019, Baltimore, MD, USA.
7. **Barbera, N.**, Akpa, B.S., Levitan, I. (2019) Computational Methods to Investigate the Interactions Between Cholesterol and Ion Channels, UIC Pulmonary, Critical Care, Sleep & Allergy Research Conference Series, Chicago, IL, USA
8. **Barbera, N.**, Akpa, B.S., Levitan, I. (2018) Kir-Cholesterol Interactions: Molecular Simulations Reveal a Dynamic Ensemble of Lipid Ligands and a Composite Binding Domain of Asymmetric Concentration Dependence. AIChE 2018 Annual Meeting, Pittsburgh, PA, USA.
9. Akpa, B.S.*, **Barbera, N.**, Levitan, I. (2018) Elucidating the action of a regulatory lipid ligand via molecular simulation: Cholesterol swarms and the inwardly rectifying potassium channel. Biology and Medicine Through Mathematics, Richmond, VA, USA.

10. **Barbera, N.**, Akpa, B.S., Levitan, I. (2017) Molecular Dynamics Simulations of Cholesterol Regulation of Kir2.2. UIC College of Medicine Scholarly Activities Day, Chicago, IL, USA.
11. **Barbera, N.**, Akpa, B.S., Levitan, I. (2017) Coarse-Grained Molecular Dynamics Simulations of Kir2.2 Interactions with an Ensemble of Cholesterol Molecules. South East Lipid Conference, Lexington, KY, USA.
12. **Barbera, N.**, Ayee, M.A.A. Akpa, B.S., Levitan, I. (2016) Molecular Dynamics Simulations of Cholesterol-Kir2.2 Interactions. Biophysical Society Meeting 2016, Los Angeles, CA, USA