NICOLE SARNA

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EDUCATION

Doctor of Philosophy (PhD), Bioengineering *Expected: Spring 2026*
Rice University, *Houston, TX* Jul. 2024-Present
Vanderbilt University*, Nashville TN* Aug. 2021-Jun. 2024
Dissertation: Leveraging T Cell Mechanotransduction and Membrane Dynamics to Enhance Activation, Function, and Transduction Efficiency
Selected Honors/Awards: NSF Graduate Student Research Fellowship

Master of Science (MS), Biomedical Engineering Aug. 2021-May 2024
Vanderbilt University, *Nashville, TN*
Thesis*:* Quantitative Analysis of Circulating Tumor Cell Dynamics in Patients Undergoing Pluvicto Therapy for Metastatic Prostate Cancer

Bachelor of Science (BS), Biomedical Engineering Aug. 2017-May 2021
University of Florida, *Gainesville, FL*
Selected Honors/Awards: *Magna Cum Laude*, Outstanding Undergraduate Research Award, Bright Futures Scholarship

PROFESSIONAL EXPERIENCES

Graduate Research Fellow Aug. 2021-Present
Rice and Vanderbilt University *Nashville, TN | Houston, TX*
Advisor: Michael R. King, PhD, Department of Bioengineering
- Developing a novel approach that utilizes fluid shear stress in ex vivo cell manufacturing protocols to optimize CAR T cell activation and ultimately improving patient outcomes for adoptive cell transfer (ACT) therapies targeting solid tumors

Undergraduate Research Fellow Jul. 2019-Aug. 2021
University of Florida *Gainesville, FL*
Advisor: Carlos M. Rinaldi-Ramos, PhD, Department of Chemical and Biomedical Engineering
- Characterized super-paramagnetic iron oxide nanoparticles (SPIONs) for *in vivo* imaging applications in cancer immunotherapy
- Evaluated the sensitivity and resolution of in-house synthesized SPIONs using Magnetic Particle Imaging (MPI) system
- Performed *in vivo* experiments to monitor and track the biodistribution of T cells following Adoptive Cell Transfer (ACT) in breast cancer and glioblastoma murine models

R&D Project Lead Sept. 2020-Mar. 2021
Lucere Laboratories LLC *Gainesville, FL*
Supervisor: Atticus Steinmetz, Founder & CEO
- Led the development of a luminometer prototype to optimize detection and reduce manufacturing costs of D-Luciferin
- Established critical partnerships, including with the UF Brain Tumor Immunotherapy Dept, enabling product testing and optimization
- Developed and executed a marketing and sales strategy leveraging CRM tools to identify target markets, tailor products to client needs, and drive collaboration between academic and industrial sectors

Undergraduate Research Fellow Jan. 2020-May 2020
University of Florida *Gainesville, FL*
Advisor: Todd E. Golde, MD, PhD, Department of Neuroscience
- Developed MATLAB program to analyze fluorescent images of 3D ex vivo brain slice cultures that exhibit aggregation of tau protein, a primary marker of Alzheimer's and other neurodegenerative diseases

Undergraduate Research Fellow Sept. 2017-Dec. 2018
University of Florida *Gainesville, FL*
Advisor: Norman Fitz-Coy, PhD, Department of Neuroscience
- Collected data for a collaborative research project, DebriSat, led by NASA, The Aerospace Corporation, and the US Air Force Space and Missile Systems Center to improve and update NASA's Standard Breakup Model through orbital debris modeling
- Analyzed space debris from hypervelocity satellite collisions to inform spacecraft design and improve debris mitigation strategies

PATENTS

Fluid Shear Stress for Ex Vivo Activation Of Immune Effector Cells Issued: Oct. 3, 2024
Patent Application No: US 2024/0327792 A1**;**
Inventors: King, MR, Hope, JM, Dombroski, JA, **Sarna, NS**.

PUBLICATIONS

** Asterisk = Co-First Author*

- **Sarna, N.S.,** Curry, N.M., Aalei, E., Kaufman, B.G., King, M.R. "**Immunomechanobiology: Engineering the Activation and Function of Immune Cells with the Mechanical Signal of Fluid Shear Stress**" *IEEE Reviews in Biomedical Engineering,* 2023. doi: 10.1109/RBME.2024.3505073
- King S.M.*, **Sarna N.S.***, Ortiz I.*, Wang W., Lopez-Cavestany M., Zhang Z. "**Retention of E-Selectin Functionalized Liposome Fanny Packs on Jurkat Cells Following Invasion through Collagen**" Journal of Immunological Methods, 2024. doi: 10.1016/j.jim.2024.113700

- **Sarna, N.S.,** Desai, S.H., Kaufman, B.G., Hanna, A.M., King, M.R. "**From Stress to Strength: A Kinetic Study of Enhanced and Sustained T Cell Activation and Function in Response to Fluid Shear Stress**" *iScience*, 2023. doi: 10.1016/j.isci.2024.109999
- Knoblauch, S.V., Desai, S.H., Dombroski, J.A., **Sarna, N.S.**, Hope, J.M., King, M.R. "**Chemical and Mechanical Activation of Piezo1 Enhance TRAIL-Mediated Apoptosis in Glioblastoma Cells**" *ACS Omega*, 2023. doi: 10.1021/acsomega.3c00705
- **Sarna, N.S.***, Marrero-Morales, L*, DeGroff, R*, Rivera-Rodriguez, A, Lui, S, Chiu-Lam, A, Good, H, Rinaldi-Ramos, CM. "**An anatomically correct 3D printed mouse phantom for magnetic particle imaging studies**" *Bioengineering & Translational Medicine*, 2022. doi: 10.1002/btm2.10299
- Dombroski, J.A.*, Hope, J.M.*, **Sarna, N.S.**, King, M.R. "**Channeling the Force: Piezo1 mechanotransduction in cancer metastasis**" *Cells*, 2021. doi: 10.3390/cells10112815
- Rivera-Rodriguez, A, Hoang-Minh, L, Chiu-Lam, A, **Sarna, N.S.**, Marrero-Morales, L, Mitchell, D, Rinaldi-Ramos, C.M. "**Tracking Adoptive T Cell Immunotherapy Using Magnetic Particle Imaging**" *Nanotheranostics*, 2021. doi: 10.7150/ntno.55165
- Lui, S*, Rivera-Rodriguez, A*, Chiu-Lam, A*, DeGroff, R, Savliwala, S, **Sarna, N.S.**, Rinaldi-Ramos, C.M. "**Long Circulating Tracer Tailored for Magnetic Particle Imaging**" *Nanotheranostics*, 2021. doi: 10.7150/ntno.58548

SKILLS

- **Research Techniques:** Phlebotomy, Cell culture, animal handling/in vivo work, flow cytometry, light/fluorescence/confocal microscopy, liquid biopsy/blood sample processing, magnetic cell separation (T cells/circulating tumor cells), histological staining, rotary microtome, western blot, IVIS SpectrumCT, Magnetic Particle Imaging (MPI), Dynamic Light Scattering (DLS), Dynamic Magnetic Susceptibility (DMS), lentiviral transduction/transfection
- **Data Analysis:** ImageJ, GraphPad Prism, JMP, FlowJo, Excel
- **Programming:** MATLAB, HTML, CSS, Git, Python
- **Computer Aided Design:** Solidworks, OnShape, Autodesk Inventor, Autodesk Fusion

CONFERENCES & PRESENTATIONS

- **[Oral] Sarna, NS,** Hanna, AH, Desai, SH, Antunovic, M, Schaffer, KR, Hurley, PJ & King, MR. "Circulating Tumor Cell Dynamics in Patients Undergoing Pluvicto Therapy for Metastatic Prostate Cancer", **Biomedical Engineering Society (BMES) Annual Meeting,** *Baltimore, MD* (Oct. 2024)
- **[Oral] Sarna, NS** & King, MR. "Modeling T Cell Calcium Dynamics and Downstream Activation Signaling in Response to Fluid Shear Stress", **Biomedical Engineering Society (BMES) Annual Meeting,** *Baltimore, MD* (Oct. 2024)
- **[Oral] Sarna, NS,** Desai, SH, Kaufman, BK, Curry, NM, Hanna, AM & King, MR. "Enhanced and Sustained T Cell Activation, Proliferation, and Cytotoxicity in Response to Fluid Shear Stress", **Biomedical Engineering Society (BMES) Annual Meeting,** *Baltimore, MD* (Oct. 2024)
- **[Oral] Sarna, NS,** Desai, SH, & King, MR. "Leveraging T Cell Mechanotransduction for Enhanced and Sustained Ex Vivo Activation", **Biomedical Engineering Society (BMES) Annual Meeting,** *Seattle, WA* (Oct. 2023)
- **[Poster] Sarna, NS**, Desai, S, & King, MR. "Leveraging T cell mechanotransduction for enhanced and sustained ex vivo activation**", NIH National Cancer Institute (NCI) Tissue Engineering Collaborative (TEC) Annual Meeting,** *Portland, OR* (Aug. 2023)
- **[Poster] Sarna, NS**, Desai, S, & King, MR. "Leveraging T cell mechanotransduction for enhanced and sustained ex vivo activation**", The Southeastern Immunology Symposium,** *Nashville, TN* (Jun. 2023)
- **[Poster] Sarna, NS**, Hope, JM, Desai, S, & King, MR. "Enhanced T Cell Activation via Fluid Shear Stress**", The Vanderbilt Institute of Nanoscale Science and Engineering (VINSE) Annual Meeting,** *Nashville, TN* (Nov. 2022)
- **[Oral] Sarna, NS,** Hope, JM, Desai, SH, & King, MR. "Enhanced and Sustained T Cell Activation Over Time via Fluid Shear Stress Exposure", **Biomedical Engineering Society (BMES) Annual Meeting,** *San Antonio, TX* (Oct. 2022)
- **[Poster] Sarna, NS**, Marrero-Morales, L, DeGroff, R, Rivera-Rodriguez, A, Lui, S, Chiu-Lam, A, Good, H, Rinaldi-Ramos, CM. "An Anatomically Correct 3D-Printed Mouse Phantom for Magnetic Particle Imaging Studies", **World Molecular Imaging Congress (WMIC) Annual Meeting**, *Miami, FL* (Sept. 2022)
- **[Poster] Sarna, NS**, Hope, JM, Desai, S, & King, MR. "Enhanced T Cell Activation via Fluid Shear Stress", **The Vanderbilt Center on Mechanobiology Inaugural Retreat**, *Nashville, TN* (Aug. 2022)
    - 2nd place Poster Presentation
- **[Poster] Sarna, NS**, Hope, JM, Desai, S, & King, MR. "Enhanced T Cell Activation via Fluid Shear Stress", **NIH National Cancer Institute (NCI) Tissue Engineering Collaborative (TEC) Annual Meeting,** *Madison WI* (July 2022)
    - 1st place Poster Presentation
- **[Oral] Sarna, NS,** Marrero-Morales, L, DeGroff, R, Rivera-Rodriguez, A, Lui, S, Good, H, Rinaldi-Ramos, CM. "Advancing the Principles of Replacement, Reduction, and Refinement by Evaluating an Anatomically Correct Mouse Phantom for a Brain Tumor Model in Magnetic Particle Imaging", **University of Florida Undergraduate Research Symposium,** *Gainesville, FL* (Apr. 2021)
    - Outstanding Undergraduate Research Award
- **[Poster] Sarna, NS,** Marrero-Morales, L, R, Rivera-Rodriguez, Rinaldi-Ramos, CM. "Evaluating the Sensitivity of the Momentum™ Magnetic Particle Imaging System for Ferucarbotran Iron Oxide Nanoparticles" **American Institute of Chemical Engineers (AIChE) Annual Meeting,** *Orlando, FL* (Nov. 2019)

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TEACHING EXPERIENCE

Graduate Student Research Mentor Jan. 2022-Present
Rice and Vanderbilt University *Houston, TX | Nashville, TN*

- Mentor and train undergraduate student on research techniques in Dr. Michael King's lab
- Conceptualize undergraduate student research project which aims to treat chemotherapy resistant glioblastoma brain cancer cells through combined treatment regimens
- Design, plan, and oversee experiments performed by undergraduate student

SyBBURE Searle Undergraduate Research Program Jan. 2022-Present
Vanderbilt University *Nashville, TN*

- SyBBURE Searle Graduate Fellow
  - Lead weekly subgroup meetings with undergraduate students to provide guidance and direction in their research topics
  - Advise and mentor a group of undergraduate students through a semester long, team-based STEM project
  - Organize and teach personal and professional skill workshops for undergraduate students, including Computer Aided Design (CAD), computer programming, circuit board design, CV/resume building, and time and stress management

Biomedical Engineering Lab (BME2900/3900/4901) Teaching Assistant Jan. 2022-May 2022
Vanderbilt University *Nashville, TN*

- Aided sophomore (3 sections), junior (1 section), and senior (1 section) undergraduate BME students with experimental design, data collection in lab, and scientific writing
- Provided detailed feedback, edits, and grades to student drafts and final lab reports

Introduction to Engineering (ES1041) Teaching Assistant Aug. 2021-Dec. 2021
Vanderbilt University *Nashville, TN*

- Assisted freshman undergraduate students with their coursework and final projects that involve BME wearable device design conceptualization and prototyping
- Planned and led lectures on microcontroller programming and Computer Aided Design (CAD) for project prototyping

UNIVERSITY INVOLVEMENT

Vanderbilt University *Nashville, TN*

- BME Graduate Student Association (GSA)
  - Member (Aug. 2021-Present)
  - Co-chair, Elementary Education Outreach (Aug. 2021-Dec. 2021)
  - Chair, Elementary Education Outreach (Jan. 2022-Aug. 2023)

University of Florida *Gainesville, FL*

- Biomedical Engineering Society, Member (Aug. 2017-May 2021)
- Society of Women in Engineering (SWE), Member (Aug. 2017-May 2021)
- University of Florida Philharmonic Orchestra, Violinist (Aug. 2017-Dec. 2017)

PROFESSIONAL DEVELOPMENT CONFERENCES

- **[Attendee] NextProf Pathfinder Workshop,** *San Diego, CA* (Oct. 2022)
- **[Attendee] IEEE Engineering in Medicine and Biology Conference (EMBC),** *Orlando, FL* (Aug. 2016)