RESEARCH STATEMENT

1 Overview

I am an applied mathematician working at the intersection of computational science, systems biology, and translational medicine. My research trajectory began at Jackson State University (B.S., Mathematics), continued through a Ph.D. in Systems Modeling and Analysis at Virginia Commonwealth University, and has now evolved into a postdoctoral appointment at the University of Florida's Laboratory for Systems Medicine.

My work focuses on mathematically modeling disease mechanisms, particularly those affecting underserved and underfunded communities. Through differential equations, computational simulations, and interdisciplinary collaboration, I seek to understand and predict immune responses, pain dynamics, and the impact of treatment interventions. I bring a dual commitment to technical rigor and health equity, guided by a deep personal motivation to improve care for communities disproportionately affected by chronic illness.

2 Systems Biology

In my Ph.D. research, I developed two mathematical models to study pain episodes in patients with sickle cell disease (SCD). The models, validated with patient survey data and de-identified clinical datasets, offered insights into pain dynamics and personalized treatment pathways. This work culminated in my dissertation, *Dynamic Mathematical Approaches to Studying Pain in Sickle Cell Disease*, and laid the foundation for my entry into systems biology.

As a postdoc, I am studying the host immune response to Invasive Pulmonary Aspergillosis (IPA), a serious fungal infection, through computational modeling. Computational tools like Python allow me to capture complex biological interactions and simulate experimental conditions, providing scalable frameworks for both hypothesis generation and therapeutic targeting. This training marks my evolution from a mathematical biologist to a systems medicine researcher.

My systems biology research integrates biological data with mathematical structure, allowing simulation of biochemical networks, immune interactions, and disease progression. This approach makes it possible to explore mechanisms across scales — from molecules to tissues — and to develop models that support both scientific discovery and clinical application.

Beyond model construction, I am actively engaged in mastering experimental data interpretation and model validation. Exposure to immunology research, pathology seminars, and interdisciplinary lab collaborations has deepened my capacity to interface theoretical models with empirically driven science.

3 Interdisciplinary Research and Translational Medicine

With expertise rooted firmly in the space between disciplines, I bridge mathematics, biology, computer science, and medicine to create dynamic, systems-level representations of disease. My research thrives on interdisciplinary practice, thereby exposing me to the utility of mathematics to multiple research areas in medicine. This mathematical approach is particularly valuable in studying pathologies where mechanistic understanding is limited or funding gaps exist. I am interested in studying a range of diseases including lupus, diabetes, cardiovascular disease, and fungal infections, aiming to connect mathematical abstraction with clinical relevance for more translational results. My technical toolbox includes MATLAB, RStudio, and Python, while my modeling methods draw on dynamical systems, differential equations, and statistical analysis.

I've also engaged in grant writing workshops through NIH and GWSW, strengthening my grantsmanship skills as I prepare to lead independent research. I view translational medicine as a space where modeling, experimentation, and community needs meet — and where equitable healthcare solutions can be born.

My motivation is rooted in community. Personal experiences with family members and classmates affected by lupus, diabetes, and sickle cell disease deeply influence my research goals. I aim to investigate and elevate our understanding of underfunded diseases that primarily affect minority populations—not only for academic advancement but also for the societal impact of health equity. My goal is to elevate these conditions as central topics in systems biology, using mathematical modeling to unlock understanding and guide intervention.

4 Future Work

As I approach the end of my postdoctoral fellowship in Fall 2026, I am preparing to apply for tenure-track assistant professorships beginning Fall 2025. My long-term goals are threefold: to establish a systems biology lab focused on minority health, to create a portfolio of funded, collaborative projects, and to contribute original research to the field of biomathematics. I intend to leverage my expertise to develop models that illuminate disease mechanisms, test novel therapies, and guide equitable treatment strategies.

Future research directions include:
- Mathematical modeling of immune responses in chronic illness (e.g., lupus, diabetes, cardiovascular disease)
- Application of digital twin technology in rare disease research
- Integration of experimental and clinical data into model design
- Building a mentoring ecosystem that fosters interdisciplinary collaboration and supports underrepresented scholars

These aims are grounded in rigorous mathematics and fueled by a personal commitment to research equity. I envision a lab that serves both scholarly and public health missions, leveraging systems-level modeling to uncover affordable, actionable insights into chronic illness.
My ideal lab will serve as both a technical hub and a mission-driven space for academic leadership, public impact, and inclusive research practice.

References

Please see my professional website for a full list of publications, project descriptions, and conference presentations (updated December 2024). I am happy to provide selected manuscripts or modeling samples upon request.