

Research Summary

My research interests include the use of physiological modeling to generate hypotheses and to understand integrative physiological mechanisms that are not observable in either whole animal or human experiments. For almost 50 years, our department has been developing computer simulations of integrative physiology for research and educational purposes. The current model, HumMod, is comprised of 14 organ systems, and includes neural, endocrine, circulatory, and renal physiology. We have created techniques that generate and analyze >1000 unique models (a population of virtual patients) by randomly varying underlying physiological parameters and relationships.

Published data from our laboratory show that our model is robust and can realistically simulate salt sensitivity, multiple types of hypertension, and renal denervation in a virtual population. Our current research shows similar virtual population responses to an ACE inhibitor and renal denervation as compared to clinical data.

Approximately 10% of U.S. patients with hypertension have uncontrolled blood pressure even with full adherence to 3 or more drugs (resistant hypertension). As compared to whites, African Americans develop hypertension at an earlier age, have a greater frequency and severity of hypertension, have poorer control of blood pressure, as well as a greater prevalence of comorbid conditions. Even after adjusting for clinical and socioeconomic factors, relatively high rates of resistant hypertension persist in African Americans. Despite these known disparities, there has been little attention or advancement in the blood pressure management in African Americans. My current research focuses on using clinical data, HumMod, and predictive analytic techniques to develop a realistic virtual African American population for studying antihypertensive treatments that have well-known (diuretic or salt reduction), variable (ACE inhibition), or unconfirmed (renal denervation and baroreceptor activation) therapeutic efficacies in hypertensive African Americans.