How do we make the best decisions to improve public health? Numerous books have been written about how humans make decisions and how to improve our individual decision-making capabilities. Yet, when balancing the intricacies, priorities, and lives involved in decisions within public health policy, we cannot just rely on gut feeling, nor can we boil down every problem to a mathematical function that yields an expected value. Rather, we need tools that allow us to evaluate multiple perspectives to understand the range of impacts that various decisions may produce. My research is focused on how we utilize industrial engineering and operations research tools to guide administrative and policy decisions, particularly in healthcare.

A critical public health issue I have focused on throughout my dissertation is access to healthcare, primarily among veterans. Veterans are older on average than the general U.S. population and are thus at higher risk for chronic disease. Further, veterans report more delays when seeking healthcare. The Veterans Affairs (VA) Healthcare System continuously works to develop policies and technologies that aim to improve veteran access to care. My dissertation demonstrates how industrial engineering tools can guide policy decisions to improve healthcare access by connecting veterans with the most appropriate healthcare resources, while highlighting the trade-offs inherent in such decisions.

My dissertation comprises three stages: (1) using facility location and other optimization methods to design a healthcare network when introducing new provider options for chronic disease screening, (2) developing simulation tools to model how access to care is impacted when scheduling policies accommodate patient preferences, and (3) evaluating how treatment decisions impact patient access when guided by risk-based prediction models compared to current practice. Through these stages, we illustrate how industrial engineering can be used to understand impact on veteran healthcare access when new policies or operations are considered.

In the first stage, we consider veteran access to chronic eye disease screening. Ophthalmologists in the VA have developed a platform in which ophthalmic technicians screen patients for major chronic eye diseases during primary care visits. We use mixed-integer programming-based facility location models to understand how the VA can determine which clinics should offer eye screenings, which provider type(s) should staff those clinics, and how to distribute patients among clinics. The results of this work shows how the VA can achieve various objectives including minimizing the cost of treating a given population or maximizing the number of patients receiving care given a fixed budget. These models also are helpful in two policy-based contexts: first, considering the impact of how adjusting care responsibilities under various provider licenses can impact access, and second, how the VA can identify opportunities to keep more patients receiving care within the VA versus from community providers.

In the second stage, we simulate patients seeking care for gastroesophageal reflux disease as they interact with primary care and gastrointestinal providers. This simulation incorporates policies about how to schedule patients for provider visits in various modalities, including face-to-face and telehealth visits, and also considers uncertainty in key factors like patient arrivals and demographics.

Results of these models can help us understand how scheduling based on these preferences impacts access, including time to first appointment and number of patients seen. Such metrics can guide healthcare administrators as new technologies are introduced that offer options for how patients interact with their providers.

In the third stage, we integrate multiple industrial engineering methods to examine how access is impacted among veterans with chronic liver disease when new clinical decision tools, guided by predictive modeling, are introduced into treatment planning. We developed a simulation model that helps clinical decision-makers better understand how implementing a predictive model may not only change the care pathway for a specific patient, but also impacts system decisions, such as required staffing levels, clinical data acquired at specific patient visits, and how patients are scheduled for various appointments. The simulation model also helps clinicians understand the utility of specific clinical data by demonstrating how input values to the predictive models have larger system impacts to patient access.

As my research career progresses, I look forward to continuing to collaborate with the VA on other important access-related work. I also intend to expand the models developed within the VA to other care providers, primarily civilian health systems. While the VA faces specific access challenges, non-VA systems have additional challenges because their patient populations often interact with other out-of-system providers, patients are more heterogeneous, and the systems interact with more payers. These differences make modeling decisions more difficult, but also provide more opportunities to consider novel ways of creating models and considering outcomes.

Throughout my education, I have explored several areas of study outside of public health and engineering, including law and urban planning. While I am most engaged in healthcare applications, I see great opportunity to extend my research to adjacent issues to improve public good. Access to the legal resources is a timely issue in the judicial system. Similar racial and socioeconomic populations face disproportionately unequal access to both healthcare and legal services. Moreover, several legal issues like housing rights and policing intersect with public health. Also similar to healthcare, the judicial system is expanding use of technology to interact differently with users, including using more tele-law services. Industrial engineering can help decision-makers within this system meet needed objectives while minimizing negative impact to currently underserved populations. Engineering tools can also be used to improve decision-making around access to other public services including education, transportation, and civic amenities like libraries and parks.

I have participated in writing two successful internal grants during my doctoral program and will use these experiences as I apply to funding opportunities in a faculty position. My work aligns well with the priorities of the Health Resources and Services Administration, the Agency for Healthcare Research and Quality, The Robert Wood Johnson Foundation, as well as state and local public health offices. Additionally, continued work within the VA is well-suited for funding from the VA's Center for Health Services and Research Development.