Preface

In taking a step back and looking at our world through a macroscopic lens, we soon realize that we are all functional constituents within the realm of global health and its sphere of influence. Global health affects everyone, in which threats to our health and well-being are prominent all around us, yet we as human beings have the innate capacity to challenge these threats and derive solutions through technological innovation and scientific breakthroughs. But what if these innovations and breakthroughs were only available and adapted to one segment of the population, while millions of others who desperately need these innovations have no access? Imagine if millions of people still die each year due to conditions that could be easily adverted and remedied by basic medical care…quite a shocking paradigm isn't it? We characterize this paradigm as the "global burden of surgical disease", a complex and multi-faceted global health threat that is not only characterized by the medical conditions and maladies it comprises, but also of the lesser-noted social and economic conditions upon which it afflicts. This is a unique "disease pathology," in which it is not defined by a microscopic entity such as a viral or bacterial agent, but rather by a host of surgically-treatable conditions clouted by social and economic components that influence the delivery of palliative surgical care.

While specifically these surgically treatable diseases are not classified as disease-pathologies, the manner and scope in which they impact human health is indeed quite similar. Specifically, the dissonance between healthcare access and delivery between different economic tiers of countries is staggering and allows for global health threats, such as the surgical burden of disease, to perpetually prey on low- and middle-income countries. A question that both my co-author and I have always pondered as researchers is, "how can we live in a modern era which is graced by continual advancements in science, engineering, and medicine, but still have millions of individuals that do not have access to these innovations, and in turn, suffer perpetually or succumb to conditions that could be easily remedied?" This question has no doubt crossed the minds of many researchers, and serves as a pillar of reflection and an impetus for future research initiatives.

In this book, we take a unique and integrative approach to examining the global burden of disease and in particular, the surgical burden of disease. We examine the

interventional capacity for modern technologies and innovations to be applied, adapted, and directly sourced in low- and middle-income countries. We specifically examine the interventional capacities of 3D printing technologies to fabricate surgical instruments and tools to be utilized to enhance surgical care and delivery in resource poor settings. In further following the true tenets of intellectual curiosity and innovation, we take a unique focus on the use of natural and sustainable bio-based materials in fabrication of these medical devices. In this book, we derive a multifaceted approach that examines everything from the social and economic elements related to the burden of surgical conditions on human health, to examining the tenets of applied frugal engineering of 3D printing technologies and the global medical device supply chain, to that of the materials science behind bio-based materials.

We first begin by setting the stage for the global burden of disease, in which we describe the economic tiers that countries are organized into and their respective capacities to deliver palliative care. We specifically define what types of surgical conditions are classified as "essential" and explore the premise of "surgically avertable deaths" and the social and economic impacts of surgical care. We further define the disparities in the access to surgical supplies amongst countries, and then explore a potential remedy for this supply shortage via the use of 3D printing technologies. Specifically, we discuss the use of RepRap 3D printing devices and break these technologies down to their fundamental components and processes, and examine the use integration of frugal engineering to adapt these technologies for resource poor settings. We then further explore the complementary use of 3D printing devices with bio-based materials, further expanding upon the chemical and physical materials profile of various printing filaments such as polylactic acid. We then transition to the feasible application and process analysis of utilizing these devices and their modified bio-based material components to fabricate a cohort of surgical instruments and tools to efficiently and effectively create a surgical toolkit for deployment in the surgical field. Lastly, we delve into the interventional capacities of 3D printing technologies coupled with bio-based materials in the global health field and their respective applications in low- and middle-income countries. The book examines the associated barriers to entry and adoption of these technologies as well as their impact on global medical device supply chains and the future realm of applications to improve global health.

While we indeed focus on only a subset of conditions and elements that contribute to the overall global burden of disease, we hope to foster intellectual inquiry and reflection by our readers and provide a platform that can effectively inform future policy decisions related to how we tackle the most pertinent health threats in our world today. It is through knowledge and inquiry, that we can effectively transform the theories of today into the interventions of tomorrow.

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