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Global Health Commentary

Impacting Global Health Through Equipment Repurposing: Measurable Progress Through the Accumulation of Many Tiny Victories

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ABSTRACT

There is an active and growing effort occurring in laboratories throughout Africa to research the underpinnings of endemic communicable diseases, many of which are considered “neglected tropical diseases” as defined by the World Health Organization. Across the continent, scientists, doctors, health care workers, and students investigate the *in vitro* activity of pharmacologically active extracts against known pathogens in hope of discovering new treatments for the diseases that affect the local population. During the summer of 2014, I had the opportunity to visit laboratories in 3 different countries engaged in this area of research through participation in the Merck Fellowship for Global Health (Merck is known as Merck, Sharp & Dohme outside of the United States and Canada.), in which Merck sponsors employees on a short-term sabbatical to work with a global health-focused nonprofit organization. This commentary describes the objectives of the fellowship program, the specific project to which my co-fellow and I contributed, and the story of a subsequent equipment donation effort that was inspired by my individual fellowship experience. It also captures a few of the more notable challenges and opportunities for the scientists in the laboratories we visited. Finally, for the reader who may be curious as to how she or he can contribute, I hope to move you to action by highlighting some of the opportunities for researchers to positively and creatively impact global health from their “home” lab benches and hoods.

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Introduction

The subject of “global health” is a hugely diverse and broadly encompassing one, and thus it is important to specify how we define it in the context of this commentary. In a 2010 editorial, notable epidemiologists Robert Beaglehole and Ruth Bonita defined global health as “collaborative trans-national research and action for promoting health for all.”¹ The authors noted that this definition was derived from a 2009 definition proposed by the Executive Board of the Consortium of Universities for Global Health that specifies: “Global health is an area for study, research, and practice that places a priority on improving health and achieving equity in health for all people worldwide.”² “Global health is derived from public health and international health, which in turn, evolved from hygiene and tropical medicine,” the authors continue. Notably, both

definitions cite the importance of research and make “health for all” a fundamental requirement. Through the lens of this definition, this commentary focuses specifically on understanding and enabling current research efforts in Africa to address the unmet medical needs associated with neglected tropical diseases.

Neglected tropical diseases,³ or NTDs, encompass more than a dozen distinct viral, parasitic, and bacterial diseases that are endemic in tropical and subtropical climates and overwhelmingly affect people living in the absence of clean water sources and proper sanitation controls. In total, it is estimated that more than 1 billion people suffer from one or more NTDs, and the collective toll caused by these diseases in the form of suffering, debilitation, productivity and educational losses, stigma, and death is too big to quantify.^{4,5}

In the summer of 2014, I had the opportunity to learn intimately about the burden of NTDs on global health as a participant in the Merck Fellowship for Global Health.⁶ This recognized⁷ initiative, now in its fifth year, affords Merck employees an opportunity to take a 12-week sabbatical from their current roles to partner with a nonprofit organization with a global health-oriented mission. In

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doing so, Merck employees aim to share their technical, strategic, and operational talents to expand the capacity and reach of the nonprofit with whom they are paired. Over 33 nonprofits have participated in the program to date, with new selections made each year based on detailed proposals from the nonprofits for incoming fellows. A common trait among the projects is the emphasis on field-based research. Depending on the need of the nonprofit organization, this fieldwork may occur within the United States and across the globe in developing countries. To date, fellows have assumed projects based out of more than 22 countries.

Employee selection for the program within Merck is quite competitive, and those wishing to participate in the program undergo a rigorous application and interview process. Fellows are selected for the program and matched with a specific nonprofit based on their passion for global health, their performance history, and the close alignment of their skills and talents with the demands of the proposed project. Those selected to represent the company are given the title of "RTC Fellow," in honor of former Merck CEO, Richard T. Clark.

On completion of the candidate selection process, I was delighted to learn that I had been selected for participation and partnered with Katherine Young, a veteran Merck microbiologist with expertise in infectious disease drug discovery. I am formally trained as a synthetic chemist and have several years of experience in Merck's Discovery Pharmaceutical Sciences group. For me, the fellowship would serve as a crash course in NTDs, as I had never worked in this area before, but as a pair, Katherine and I could offer insight to the pharmaceutical research and development experience from both the biological and chemical perspective. At the same time, we learned that our RTC Fellowship duo would be partnered with BIO Ventures for Global Health (BVGH), a Seattle-based nonprofit founded in 2004 with the goal of effectively engaging biotechnology and biopharmaceutical companies in initiatives to improve global health and accelerate the discovery of novel medicines, vaccines, and diagnostics.⁸ This organization manages a variety of multifaceted programs including: (1) developing and maintaining the FundFinder, a user-friendly database detailing funding opportunities for infectious disease researchers, (2) the Nigerian Capacity Building Initiative, which pairs Nigerian researchers with international biopharmaceutical companies as hosts for hands-on training and professional development, and (3) the Africa e-Learning Initiative, through which BVGH is enabling scientific associations to share their electronic learning content freely to select research institutions in sub-Saharan Africa. Our fellowship assignment was designed to align with one of BVGH's flagship programs, WIPO Re:Search, a joint venture with the World Intellectual Property Organization (WIPO) and several leading pharmaceutical companies to share resources to accelerate the discovery and development of novel therapeutics, vaccines, and diagnostics for NTDs, malaria, and tuberculosis. Consortium membership includes academic and nonprofit research institutions, governmental and non-governmental organizations, and budding biotechnology companies committed to addressing the unmet medical needs of the developing world.

In alignment with the objectives of the WIPO Re:Search Consortium program, Katherine and I were asked to visit the research facilities of 3 Consortium members within Africa for 3 weeks each. The goal of each visit was to gain a detailed understanding of the active research projects on site and assess the most urgent needs of faculty, staff, and students in accelerating that research toward global health impact. Our travels would take us first to the University of Buea, Cameroon, then the Noguchi Memorial Institute of Medical Research in Ghana, and finally to the Kenya Medical Research Institute (KEMRI) in Nairobi, Kenya. Each institution had multiple laboratories invested in researching NTDs, and we had the

opportunity to meet with faculty, students, and staff scientists from each of these. At each stop on our journey, we toured the labs, gave hands-on technical demonstrations when appropriate, and presented scientific lectures on drug development in the U.S. pharmaceutical industry. To enhance personal connectivity with the students and staff, we held "office hours" for open-ended question and answer sessions, and we were the engaged audience to presentations of their research. Most of the research in the labs we visited was prioritized to address the most urgent needs in the local communities. For example, onchocerciasis (commonly known as "river blindness") is a parasitic disease endemic to sub-Saharan Africa, and University of Buea researchers have developed a specialized pharmacological model to study the effectiveness of extracts from local plants against the parasite.⁹ More specifically, it is common in Cameroon for individuals to be co-infected with *Onchocerca volvulus* and *Loa loa*, and administration of typical onchocerciasis treatments to these co-infected individuals can have severe adverse effects.¹⁰ Stemming from this local unmet medical need, researchers at the University of Buea have prioritized the study the pharmacological activity of crude medicinal extracts in both *Onchocerca ochengi* and *Loa loa* microfilariae using specialized *in vitro* models.¹¹ In the end, our 9 weeks of travel abroad constituted an extraordinary, eye-opening experience, and we came back energized and inspired to have an impact in global health.

Challenges Impacting Research in Africa

On reflection of the experience, I realized that our time spent in Buea, Cameroon provided a glimpse into some of the challenges and successes of conducting NTD research in developing nations. Certainly, Buea is only a single city and not necessarily representative of the entire country of Cameroon or continent of Africa, but we were able to glean valuable insight and understanding from our brief time here. After traveling a day and half by air and road, we arrived in Buea in the dark of the night. On waking the next morning, we began to take stock of our surroundings and, over the course of several days of exploration, came to the realization that the infrastructure in the region is not what we were accustomed to in the United States. For instance, electrical power failures are extremely common in the area. Often there were 3 to 4 hour blocks of time, sometimes several days a week, during which the university and hotel lost power. These blackouts interrupted critical scientific experiments and happened with a frequency such that they slowed overall research progress. Inconsistent power supply also puts unnecessary stress on the equipment in the labs, as many pieces of equipment contain electronics sensitive to fluctuations in power. Furthermore, donated equipment from the United States is designed with different electrical specifications (voltage, amperage, etc.) in mind, so interventions must be made sometimes to make them suitable for use in other countries. Other infrastructure challenges that impact experimental progress include the lack of temperature and humidity control in the research buildings, causing additional stress on sensitive equipment leading to compromised valves, pumps, seals, and electronics. A slow supply and delivery chain for common lab reagents and supplies meant that weeks to months frequently elapsed between when reagents were purchased from American or European vendors and when they were available for use in the laboratory.

We observed that purchasing and maintaining laboratory equipment was a significant challenge under these circumstances. First, the cost to purchase new equipment is often prohibitive, even for a well-funded laboratory. Many of the chemistry laboratories we visited were working in the area of natural product isolation and characterization. Researchers extract natural products from the

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