Chapter 8
Health Hackathons Drive Affordable Medical Technology Innovation Through Community Engagement

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8.1 Introduction

Successful medical innovation requires a process of co-creation among key healthcare stakeholders including healthcare professionals, end users, scientists, engineers, and entrepreneurs (IDEO 2015; Lee et al. 2012; Prahalad and Ramaswamy 2004). This can be challenging especially in resource-limited settings where interdisciplinary collaboration may be hampered by more pronounced professional, socioeconomic, and age barriers (Sachs 2003).

MIT Hacking Medicine, a group founded in 2011 at MIT, aims to energize the healthcare community and accelerate medical innovation by carrying out co-creation through health hackathons. These 1- to 3-day events bring together diverse stakeholders to solve pressing healthcare needs. The group has organized to date more than 40 health hackathons across 9 countries and 5 continents.

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MIT Hacking Medicine first partnered with the Consortium for Affordable Medical Technologies (CAMTech) of the Center for Global Health at the Massachusetts General Hospital (MGH) in the fall of 2012 to organize a hackathon focused on affordable medical technology for low- and middle-income countries (LMICs). Since then, MIT Hacking Medicine's annual flagship event has featured a global health track in collaboration with CAMTech whose participants include students and healthcare professionals from India and Uganda. The Hacking Medicine team has in turn joined CAMTech-led hackathons in India and Uganda. Engagement of the local community in the process of healthcare disruption has led to multiple award-winning projects for better monitoring, diagnosis, treatment, and prevention of disease. Many of these solutions are translated from bench to bedside at remarkable rates aided by the CAMTech Innovation Platform and follow-up strategies that promote and track project development and progress. Sustainable business strategies for product commercialization and reverse innovation to bring cost-effective technologies to resource-rich settings are highly encouraged. The hacking philosophy applied to affordable healthcare, engagement of the local community engagement, and support of novel ideas toward long-term sustainability hold great promise for creating low-cost medical solutions that can improve healthcare outcomes globally.

8.2 Objectives and Methodology

8.2.1 The Need for Co-creation

Both developed and developing economies are under pressure to provide more cost-effective healthcare to address the demands of their populations (Chilukuri et al. 2010; Witty 2011). Medical technology companies are rethinking their approach to medical product design to increase product efficiency and accessibility (Prahalad and Ramaswamy 2004; Witty 2011). This is particularly true in resource-limited areas, where political, financial, and cultural constraints often hamper innovation and stakeholder collaboration necessary for collective healthcare transformation (Chilukuri et al. 2010; Sachs 2003; Mauser et al. 2013).

8.2.2 The Need for Health Hackathons: MIT Hacking Medicine and the Hackathon Model

Locally driven medical transformation in LMICs requires crosstalk between the main players of the healthcare ecosystem. These players need to overcome communication and collaboration barriers, see beyond their discipline and approach a problem using a nontraditional way. This allows them to generate effective and efficient healthcare solutions. Health hackathons promise to offer precisely the opportunity to do so.

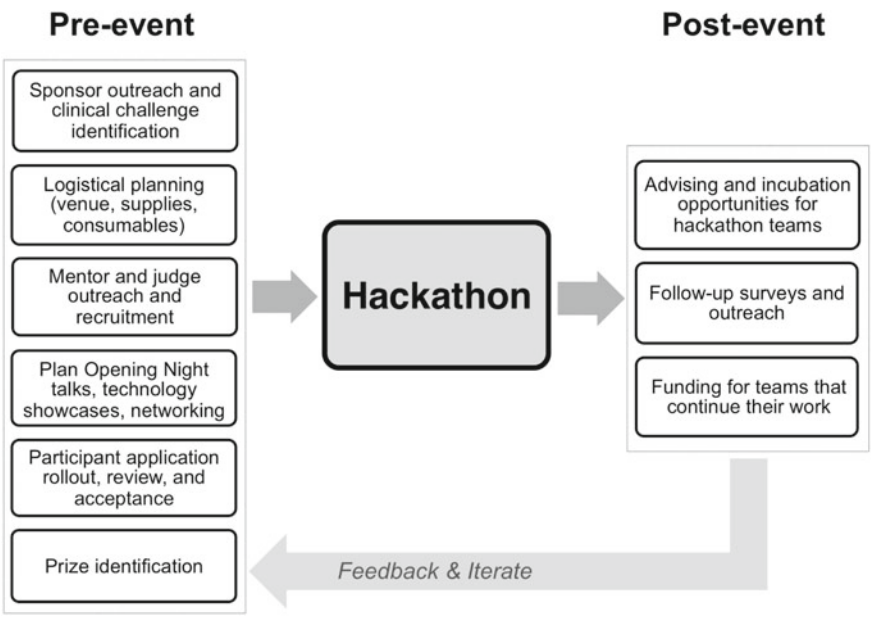

Fig. 8.1 The MIT hacking medicine health hackathon process

MIT Hacking Medicine organizes health hackathons with specific themes attended by participants with diverse backgrounds, who will address pain points in healthcare delivery and assess business viability as a key component of their hacks (Caputo 2014) (Fig. 8.1). The group has organized more than 40 hackathons across 9 countries and 5 continents. Themes have included reproductive, maternal, newborn, and child health; diabetes; telehealth; Ebola; and road safety. Sponsorships or collaborations with different entities are established for each hackathon. The hackathon scope and intended outcomes are refined closer to the event date, and expert mentors are recruited to support the participants during the hackathon. Judges are enlisted among the sponsors and healthcare innovator community to determine the hackathon winners. Participants are selected through a rigorous application that ensures diversity and interest in healthcare innovation.

MIT Hacking Medicine has focused much of its attention on creating a health hackathon experience that does not start and end at the hackathon weekend; rather, the vision is to generate a network of individuals compelled to make healthcare better by exchanging ideas, knowledge, and skills in the long term. For that reason, the group has piloted pre- and post-hackathon opportunities for networking, ideation, securing funds, and progress follow-up.

The actual hackathon begins with healthcare experts presenting theme-specific umbrella challenges. Participants then pitch project challenges to their peers focusing on a specific "pain point." These 60-second pitches energize the audience and serve as starting points for team formation and problem identification. A mingling

session ensues to allow team formation. Teams spend the subsequent event duration "hacking" their projects, receiving guidance from mentors with expertise related to health care, engineering, business development, and other key areas.

At the conclusion of the event, the hackathon teams present their work to the judging panel and the rest of the participants. Presentations are limited to a 3-minute pitch capturing the clinical need, ideas for a solution, any prototypes created during the hackathon, and a business model. Prizes may include monetary awards, sponsored internships, support from startup incubators, and funds for pilot studies.

8.2.3 The MIT Hacking Medicine Model Applied to Hackathons in LMICs by CAMTech

CAMTech first partnered with MIT Hacking Medicine in 2012 to organize a hackathon in Boston focused on affordable medical technology for LMICs. The collaboration extended to a global health track sponsored by CAMTech in the 2014 and 2015 Grand Hacks, held in Cambridge MA. CAMTech further adapted the MIT Hacking Medicine health hackathon model to the LMIC health needs and innovation potential by bringing health hackathons to India and Uganda. In collaboration with MIT Hacking Medicine, CAMTech has organized eight international events in these two countries over the past 3 years. Participants and mentors from the India and Uganda ecosystems created through these local events have then joined their US-based counterparts in the 2014 and 2015 Grand Hacks, giving a voice to the LMIC setting in the Cambridge-based events. CAMTech has also organized Boston hackathons with a focus on pressing global health challenges in partnership with MIT Hacking Medicine, including a Stop Ebola hackathon held in 2015 at MGH and a Global Cancer Innovation hackathon held in 2016 at MGH.

Through this relationship, the authors have found that the hackathon model can be adapted to an LMIC setting in a straightforward manner, and presents a unique opportunity to involve local stakeholders to work toward the betterment of their community. More so than in the resource-rich parts of the world, in LMICs, physicians may never brush shoulders with software engineers, and business people may never cross paths with technology designers. A local health hackathon puts these unlikely players together at the same drawing board, encouraging different perspectives, experiences, and expertises to play off each other and so championing locally driven, sustainable healthcare improvements in a groundbreaking way.

8.3 Potential for Development Impact

Solutions coming from healthcare stakeholders in LMICs inspire entrepreneurship and confidence in the community (Morel et al. 2005a, b). By involving key figures

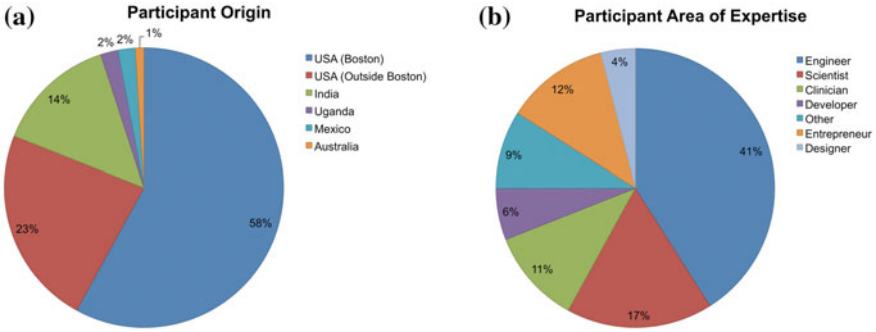

Fig. 8.2 MIT hacking medicine's grand hack 2015 statistics for global health track participants: **a** Origin of the participants; **b** Area of expertise or background

of the local healthcare delivery and technology development chains in the medical innovation process, a health hackathon in LMICs can harness local talent and knowledge to result in solutions championed by their local creators that can more easily be adapted by the community. At the same time, power holders in LMICs such as investors, entrepreneurs, educational institutions, or even governments take notice of the innovation coming out of these local hackathons, oftentimes opting to support this work financially or otherwise (Bailey 2014).

8.3.1 Direct Impact of Global Health Hackathons

Over the past 4 years, CAMTech and MIT Hacking Medicine have collaborated to run 11 global health-focused hackathons with a total of 2077 participants and over 470 pitches. The events have turned into annual initiatives in both India and Uganda, attracting several hundred participants from all over the host country and even neighboring countries. The applicant pool has grown making participant admission highly competitive. Figure 8.2 provides a profile of global health track participants at MIT Hacking Medicine's Grand Hack in 2015.

8.3.2 CAMTech Extension of the Hackathon Model

Though hackathons are continually growing in popularity on a global scale, they should not be viewed as a single event but rather a launching pad to spur sustainable innovations. CAMTech has worked to extend the hackathon model to engage stakeholders after the event, provide resources, and educate on best practices for cost-effective medical innovation. To incentivize teams to continue working on their ideas beyond the event, a post-hackathon prize is awarded to the team that has demonstrated

the most progress. CAMTech organizes innovation workshops and entrepreneur boot camps that are run by professionals from industry, investment, clinical, and technical fields—event goals may include product engineering and realization, clinical validation and testing, business strategy, IP and regulatory strategy, financing and investment, and commercialization strategies. CAMTech is also continuously working to assess the value of hackathons. One means of accomplishing this is through follow-up surveys whose results will be presented in future publications.

8.3.3 Case Studies

Co-creation Labs

The staffing and initiatives of the CAMTech Co-creation Lab in Mbarara illustrate the influence that health hackathons in LMICs have had on the local innovator community. The Co-creation Lab manager is a computer engineer and alumnus of the Mbarara University of Science and Technology (MUST) who is a former participant in CAMTech health hackathons. Many of the staff at the Co-creation Lab have been introduced to the principles of co-creation by participating in workshops and hackathons held by CAMTech locally and abroad. This has increased their confidence in their capacity to create novel medical technologies applicable to their setting and potentially appropriate for reverse innovation. Examples include a locally made hand sanitizer to aid with infection control called *Sanidrop*, a modular continuous airway pressure device (*mCPAP*) currently under development in the Co-creation Lab, as well as a digital infusion monitor and control device, a wireless physiological monitor, and an automatic surgical suction pump controller ("CAMTech Uganda,"). The Co-creation Lab has recently launched the MUST Innovation Cafes and the Students Innovation Internship Program, both intended to foster interdisciplinary creativity and innovative thinking in healthcare by MUST students ("CAMTech Uganda,").

Startup Ventures

O2-Matic, one of the winning teams of the 2015 Jugaadathon held in Bangalore, comprised engineers, clinicians, entrepreneurs, and industrial designers. This team developed the concept for a low-cost method for oxygen production to address unpredictable availability of medical gases in limited resource settings. *O2-Matic* won a Post-Hackathon Award, sponsored by the Federation of Indian Chambers of Commerce & Industry (FICCI) and Terumo, to continue working on their project. They used this funding to iterate on their proof-of-concept prototype and are currently filing for intellectual property and pitching their idea to potential investors with the hopes of starting a company in the future.

Startup companies are not just an aspiration for health hackathon winners; several successful ventures in fact got their inception at hackathons. The *Augmented Infant Resuscitator* (*AIR*) was a project started at a health hackathon in Boston jointly organized between CAMTech and MIT Hacking Medicine by a team including an

engineer from Canada and physicians from the US and Uganda. The group has raised hundreds of thousands of dollars in grant money and has started to conduct tests at clinics in the field. *AIR*, though designed for a local problem in Uganda, also has a large potential market in the US and Europe. Multiple successful startups coming out of MIT Hacking Medicine's health hackathons can be found in resource-rich settings; they include *Smart Scheduling*, *Podimetrics*, *PillPack*, *Cake,* and *Twiage*.

8.4 Conclusions and Future Directions

Involving all stakeholders in a local context can catalyze innovation for and by the bottom of the pyramid. This provides an opportunity to rethink how we approach global health, shifting the focus to co-creating accessible and affordable solutions, harnessing the potential of emerging markets, and seeking applications of innovative ideas to better health outcomes elsewhere (Mauser et al. 2013; Witty 2011).

Although one of the most exciting outcomes of a hackathon could be the start of a successful company, we acknowledge that this is a rare occurrence. It is not our intent to imply that the primary goal of a hackathon is to start a company. Rather, at the core of these events is exposure to innovation and the establishment of new networks. We aim to inspire local stakeholders to attempt solving problems that intimately affect their lives and to form a network of like-minded individuals.

Hackathons can be criticized for generating short-lived project ideation but no sustainable solutions. We are working on strategies to maintain innovator stamina as teams go through all stages of the solution development process (De Passe et al. 2014; Gardner et al. 2007). Resources that allow teams to work on their projects after the hackathon are key. CAMTech is providing this support to hackathon-spurred global health innovations via awards for teams that make the most progress after the hackathon, Innovation Awards, and the Online Innovation Platform. While Research and Development for LMICs has frequently lacked significant investment by large multinational corporations, the hackathon movement's promise of open-source innovation has encouraged forward-thinking life sciences companies to engage in health hackathons around the globe (e.g., the GE Research and Development Center and the Biocon Foundation in Bangalore, India) (Morel et al. 2005a, b; Witty 2011).

Health hackathons can serve as a launching point that engages the community and demonstrates the existence of passion and ability to solve local problems in culturally appropriate and sustainable ways with promise to improve health outcomes globally.

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