Youth innovation showcase: achieving high-impact success with novel technologies

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ABSTRACT
Universities provide a dynamic environment that enables innovation in healthcare. Challenges to the delivery of healthcare are best overcome by fostering relationships that lead to solutions developed by young innovators. The Youth Innovation Showcase highlights the creative solutions of 5 young entrepreneurs as part of the Simnovate International Summit. Challenges in the process of innovation, finding balance as a young innovator, government support for student entrepreneurs, innovation and global health and how to adapt to the process of innovation are all topics covered in this summary.

Summary points

- Medical innovation in the academic setting requires a dedicated infrastructure that brings together healthcare, engineering and business experts.
- Identifying the needs and concerns of youth innovators is essential to fostering entrepreneurial growth.
- Young innovators are often in need of mentors. Promoting interaction of students and faculty outside of the classroom helps form connections.

Progress in healthcare is rooted in innovation. Access, quality and affordability are challenges to the delivery of healthcare. These challenges are best overcome by solutions created in environments that foster innovation.[1] Innovation can be stepwise, proceeding in a linear fashion with small steps like the commercial airline industry, or transformative, causing rapid disruption and change in practice, like the treatment of peptic ulcer disease.[1] Regardless of the nature of the innovation, fostering the right creative environment is essential.

In 1953, Miller[2] described the conditions needed to synthesise amino acids in primitive earth conditions. Similarly, successful innovations also require an ideal setting to thrive. Miller described elements, temperature, light, electrical charge and timing as variables that needed to be perfectly tuned for primitive life. So too, innovation requires fine-tuning of variables such as: teaching, creating collaborative workspace, allocating physical resources, funding, time, infrastructure and mentorship.[1] Academic Health Centers (AHC) are a vibrant breeding ground for ideas. Eight of the last 10 Nobel Prizes in Medicine and Physiology were awarded for research conducted in AHCs.[1] Ultimately, the AHC should play a role in the discovery of important health solutions, as well as in the clinical research that will lead to adoption by the scientific community, and finally on a global health scale to implement the solution and improve the community health status.[3]

The demands to reduce costs and improve service delivery are increasing in healthcare. As a result, governments and educational institutions are collaborating to provide proven methods for fostering innovations and producing healthcare solutions.[4] Dzau[5] describes the vision of the National Academy of Medicine to build stronger, institutionalised support structures for innovation through creation of incubator programmes that eliminate silos and bring together expertise in medicine, business and engineering.

Youth innovation is of particular interest and has been discussed for centuries. Young innovators are generally under 30 years of age and develop an idea while in pursuit of an academic degree or early in their career. August Comte, a 17th-century philosopher, observed that there is a "…perpetual conflict which goes on between the conservative instinct that belongs to age and the innovating instinct which distinguishes youth…."[6] Several hundred years later, Thomas Kuhn, an American physicist and historian, noted, "the men who achieve [the] fundamental inventions of a new paradigm have been either very young or very new to the field whose paradigm they changed."[7] Although it may be a commonly held belief that with age, scientists become more set in their ways of thinking and less receptive to ideas, the struggle between emerging theories and established scientific views fuels progress and in turn sparks innovation.

Interest in promoting youth innovation has grown in the past decade and has led to thousands of students across the globe to participate in science fairs sponsored by government and industry. From the elementary grade through the university, students learn about scientific enterprise in the course of carrying through projects under guided mentorship. Google, Intel and the White House have sponsored science fairs that encourage youth innovation.[8]

The Youth Innovation Showcase was a featured event of the inaugural Simnovate International Summit of McGill University. The summit was a 2-day event that brought together world leaders in medical education, innovation and simulation-based learning. Simnovate fostered an environment that stimulated discussion around medical innovation. In doing so, the Youth Innovation Showcase featured five young innovators. They participated in a

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panel to describe the trials and triumphs they faced in their path to creating successful innovations. The following summary describes the innovations and topics discussed during the Youth Innovation Showcase of the Simnovate International Summit held in Montreal in May 2016.

Blossom, Matthieu Crepy

It has been shown that an increasing choice of condoms to users and access to female condom (FC) increases the total number of protected sex acts, which in turn reduces the public sector financial burden of HIV and other STIs-associated problems.[9] Yet for the past years, donor agencies have been focused on male condoms because of their low price, an average 0.03$ per male condom versus 0.56$ per FC. Blossom is currently attempting to challenge this issue by designing the world's first reusable FC intended for low-income women in developing countries, with the goal of expanding women's options in how they can protect themselves against STIs and unwanted pregnancies. It is to have the benefit of being cost-effective, constantly accessible, more pleasurable, with the powerful effects of giving women more sexual agency. Blossom's introduction in the contraceptive market will increase choice for consumers while reducing the cost of female-centred dual-barrier contraceptives and empowering women.

Lifebox, Ed Fitzgerald

The delivery of accessible, safe, timely and affordable surgery in resource-poor countries is now an increasingly recognised public health issue.[10] A shortage of essential surgical equipment is common in resource-poor hospital settings, and may contribute to the higher risk of death and complications seen with surgery performed in these settings. Even when present, inadequate numbers of surgical instruments for the activity required compromises in surgical capacity and reduced the time available for adequate instrument sterilisation between cases.

Lifebox is a high-quality, safe and affordable pack of essential surgical instruments sufficient to perform the three key 'bellwether' surgical procedures identified by the Lancet Commission on Global Surgery: abdominal laparotomy, caesarean section and treatment of open fracture.[11]

Exploratory work around this is being undertaken with the Lifebox Foundation (http://www.lifebox.org) and funding from the British Medical Association. Lifebox is a Non-Governmental Organisation and registered charity working to address the growing global crisis of unsafe surgery through the distribution of equipment and training, and introduction of life-saving basic safety checks in LMICs. Lifebox has particular expertise around medical equipment donation, having developed an affordable environment-appropriate oximeter that uses rechargeable batteries. Over 13 000 of these have now been distributed to hospitals in low and middle-income countries.

Imagia, Jonathan Kanevsky

Machine learning is a branch of computer science that uses large data sets to train algorithms to classify and predict information. These algorithms are regularly used in the field of finance but are now becoming increasingly useful in medicine.[12] Visual data, like radiology images, are rich in information that can be used to train algorithms to identify anatomical structures and pathologies. Imagia focuses on developing tools incorporated into the radiology workflow that enhance images to improve cancer diagnosis and treatment. Imaging modalities such as CT, X-ray and MRI are currently interpreted by radiologists. Imagia offers products and solutions that act as adjuncts to radiologists to improve the efficiency of helping identify and treating various tumours.

Dialysave, Anya Pogharian

There is a tremendous need for accessible dialysis for patients with kidney disease. In countries such as India and Pakistan, 90% of patients with kidney disease do not have access to

life-saving treatment. Dialysave is a simple and highly affordable dialysis machine designed for use in developing countries. Such a device has the potential to make dialysis accessible in impoverished countries. The main barrier to the widespread use of a dialysis machine is high cost. The price tag on a home-haemodialysis machine is typically $25 000, whereas the Dialysave prototype costs less than $500 to produce. This prototype is designed following the steps of the haemodialysis process, a standard method of filtering blood. It can be easily disassembled to enable quick repair. Also, its small size makes it easily transportable to sites where a natural disaster has taken place. Dialysave is a haemodialysis machine for low-income settings.

RevoLOOtion, Swathi Sadagopan

Nearly half of India's population lacks access to toilets and must defecate in the open.[13] RevoLOOtion aims to end this practice in India with waterless toilets. Similar to how cell phones revolutionised telecommunication, new toilets aim to 'revolootionize' sanitation, bypassing the need for expensive and inefficient sewage networks. By using a novel approach to generate revenue in urban areas and to generate demand in rural areas, revoLOOtion will sanitise India beginning with chawls (residential apartment blocks) around Mumbai and rural villages around Chennai. The urban model involves selling inhome commodes to residents of chawls who currently use unhygienic community toilets with inadequate drainage systems. Residents keep up general maintenance of the toilet. A monthly service contractor empties decomposed waste and transports it to our central facility where it will be processed into fertiliser. The rural model entails village gram panchayats (local governing bodies) subsidising toilets for a 'micro-community' of families. In return, the waste of this micro-community helps power street lighting in the village through the installation and operation of biogas digesters. Families pay for the maintenance of bio-digesters and street lights.

CHALLENGES IN THE PROCESS OF INNOVATION

The process of innovation is one riddled with challenges. Young innovators learn through a process of trial and error. Although the participants in Simnovate all had different innovations, they agreed that access to the right information, as opposed to information itself, is key to the success of any endeavour. Gaining traction without a solid network of mentors and industry contacts is a significant obstacle. Young age, in combination with lack of experience, can create a barrier that is difficult to overcome when attempting to create a technology that is disruptive to an established industry with veteran entrepreneurs. This is especially relevant when the innovation is not within the innovator's field of study or expertise. In addition, the competitive mindset encountered in university, where success is measured by academic excellence, constructs a barrier to youth innovation because of fear of failure. Ultimately, the greatest strength of a young innovator is his or her passion and belief in the invention.

In the process of developing a new idea, simulation may play a role in training young entrepreneurs how to foresee the challenges of innovation. For example, an innovation simulator would allow a student to input an idea and then apply different variables that exist along the path of innovation development such as recruiting funding, product testing and marketing. Similar systems have been described in many Asian countries with regard to the importance of building institutions for health and health systems in the context of rapid change.[14] Allowing young entrepreneurs to interact with ideas in a simulated environment creates a safe space to try new ideas and minimise the consequences of failure.

FINDING BALANCE AS A YOUNG INNOVATOR

Being an entrepreneur is unpredictable and at times overwhelming. It is a commitment that takes time, patience and perseverance. Many students are able to generate exciting ideas; however, executing them is challenging. A major obstacle to execution is gathering the right resources and expertise with a limited budget and little time. Learning to identify and balance priorities is essential. By reverse engineering a product or idea, it is possible to establish steps and milestones that in turn will help in triaging the most important tasks. There are constant time constraints, so when overwhelmed, it is important to have a proper sounding board of mentors to provide objective feedback and to effectively delegate tasks as much as possible. Building a network of knowledgeable advisors and motivated, focused team members is essential. A team expands the capacity of a young innovator to push ahead a project more easily than one person can do on their own.

GOVERNMENT SUPPORT FOR STUDENT ENTREPRENEURS

Higher education in North America often requires students to take on debt to complete a degree. Although Canadian student debt is significantly smaller than that of US students, financial burden is a significant concern for most graduating students.[15] As a result, many students seek employment after university that will provide security and a guaranteed path to pay off their debt. The need for secure income outweighs the desire to innovate and disrupt an industry. Therefore, student debt and financial insecurity limits many intelligent innovative students from pursuing a path as an entrepreneur because it involves risk and lack of financial security. Governments could promote innovation while simultaneously helping students with a financial burden. University students who create a product or business that generates sustainable jobs or profits should have their debt-burden reduced. This type of arrangement allows students to take risks in a financially secure environment.

INNOVATION AND GLOBAL HEALTH

Global health problems are often solved by innovation; however, the solutions must be accessible and scalable. Implementation of innovative solutions in developing countries requires entrepreneurs to be sensitive to cultural issues and employ corporate social responsibility.[16] In general, the challenge is to develop a cost-effective and sustainable solution that can align communities and local governments so they may adopt new technology. For example, RevoLootion provides a cost-effective means to provide toilets as well as a possible energy source for communities in need. Typically, innovation in

Table 1 Goals and action plan to drive youth innovation

Goal	Details	Action
Finding funding	Securing seed funding to generate a prototype or to perform field testing to generate a business plan	▶ Startup incubators ▶ Government innovation grants ▶ University research prizes ▶ Angel investors
Making time for innovation	There is limited time between academic and career pursuits for innovation	▶ Book daily time for projects ▶ Set small weekly goals for each project
Mentorship	Finding and choosing a suitable mentor is essential	▶ Meet with professors who teach/research topics of interest ▶ Visit local startup events and network with leaders
Building a team	Building a leadership team is essential to allow delegation of tasks and to reach milestones	▶ Choose people with similar values and different skill sets ▶ If working with friends, set work boundaries to avoid damaging relationships
Overcoming failure	Failure is an inevitable part of the process. Being prepared to deal with failure is essential	▶ Create back-up plans for each milestone ▶ Meet regularly with mentors to seek advice on new situations

low-resource settings is challenging because of dynamic socioeconomic factors. Innovating on a global health scale requires technology that is cheap, accessible and sustainable to the target consumer. Improving the collective health of a community is feasible when the effort in delivering new technology is equal to the energy expended to create it in the first place.

ADAPTING TO THE PROCESS OF INNOVATION

Despite the structure that comes with the innovative process, unexpected events arise that require adaptability and patience. Setting reasonable and attainable goals, such as those in table 1, provides a sample action plan. First, even if an idea is great, it may be difficult to obtain funding to start exploratory work. Initial funding applications get rejected, and it can take months, even years, for initial proposals to transform into action.

Second, underestimation of the impact of a specific innovation can hinder progress. For example, Lifebox highlighted a profound need for improved surgical instruments. Poor quality, broken instruments were found at all four hospitals visited. Local medical staff reported frequently delayed or cancelled operations. Considerable patient morbidity and mortality was directly attributable to poor instruments. Surgical instrument quality and supply chains are an underinvestigated component of delivering essential surgery in low-resource settings. Visiting these hospitals highlighted the urgent need for a short-term solution, much greater than initially envisaged. In the longer term, support and education for improved instrument procurement and supply chains is required.

CONCLUSION

The Simnovate International Summit is a major global initiative that brought together world leaders in simulation, education and innovation in the healthcare arena. With a focus on four domain areas: patient safety, pervasive learning, medical technologies and global health, the summit featured a review of current strengths and areas of focus, determination of future directions and zones of importance to improve healthcare. Fostering an environment that stimulates innovation is challenging but not impossible. The congregation of key opinion leaders, business leaders and experienced entrepreneurs provides a valuable network of resources that can provide mentorship to budding innovators. The Youth Innovation Showcase highlights the success of young entrepreneurs who created technologies through their own path of discovery and innovation. Together, these young innovators show a diversity of solutions and the current topics relevant to entrepreneurs in healthcare. The potential of young entrepreneurs has never been greater. Creating an infrastructure that allows young entrepreneurs to realise and reach their potential will lead to unprecedented progress and innovation in healthcare.

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