

A BIOMEDICAL INNOVATION PROGRAM ORGANIZED BY MEDICAL STUDENTS

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Abstract

The University of Texas Southwestern Medical Center is a basic science-focused research institution that fosters a deep dedication to clinical excellence. However, there has been a lack of formal training in the fields of innovation and entrepreneurship. The Biomedical Innovation program was developed in response to student interest to introduce medical students to the world of medical device innovation. In the program, students cultivate their capacity to innovate, invent, and improve the quality of clinical care through hands-on, project-based learning. The program brings together multiple disciplines, drawing from the collective experience of physicians, design engineers, clinical practitioners, and entrepreneurial experts. The interaction of such a diverse yet compatible group of experts creates a rich environment for clinical innovation and allows students to strengthen communication and critical thinking skills that will benefit them in their future careers. Exposure to the process of innovation and entrepreneurship is critical to prepare students to lead the future of healthcare.

Introduction

The University of Texas Southwestern Medical Center (UTSW) is a leading institution in the fields of healthcare education, biomedical research, and patient care; its mission statement notes a desire to “deliver patient care that brings ... scientific advances to the bedside.” In pursuit of this mission, medical students at UTSW are exposed to a diverse patient population through a combination of private, public, and veterans affairs hospitals. Students are also afforded the opportunity to explore and expand on individual interests through a culminating Scholarly Activity. These elements within the medical education curriculum, combined with the institution’s openness to student initiatives, make UTSW a fertile ground for the continued development of the Biomedical Innovation program. This program aims to empower medical students with the skills needed to identify unmet clinical needs, brainstorm creative solutions, prototype innovative biomedical devices, and ultimately bring these solutions to market.

The Biomedical Innovation program (BI) is a student and faculty joint collaboration consisting of three stages. First is a pre-clinical elective course, wherein skills are taught through didactic lectures and hands-on group projects. Following this course, students embark on a period of clinical need-finding during their clinical rotations. The program culminates in the student’s Scholarly Activity, for which the student works with a team consisting of graduate students in business and engineering, as well as a faculty mentor. The final deliverable is a product prototype and complete business plan. Since its inception in 2008, BI has grown to involve students and faculty from multiple branches of the University of Texas system, as well as local partners dedicated to healthcare innovation.



Motivation for the Program

Early in their education, aspiring doctors are encouraged to think deeply and critically and to use their skills to serve the community. Undergraduates who hope to become doctors are educated in a variety of disciplines, including science, technology, engineering, and math (STEM) fields and the humanities. During these formative years, students cultivate their creativity and often work on volunteer and research projects about which they are deeply passionate. When the time comes to apply to medical school, students profess their passion for science and medicine and their dedication to service in their admissions essays.

Upon matriculation, however, first year medical students often find that they must put these creative passions aside as they begin to dedicate countless hours to memorizing human anatomy, biochemical pathways, and other medical facts. Students are rarely asked to think critically as part of a team until their third year in medical school. The learning curve of medicine is so steep that much of the first two years must be dedicated just to becoming fluent in the language of medicine. Many students begin to feel out of touch with some of the skills and passions that were so integral to their identity as undergraduates. Teamwork, critical thinking, creativity, and leadership are indispensable in the practice of modern medicine, yet these skills are often left by the wayside in the medical school curriculum.

The Biomedical Innovation program was created by medical students to meet their need for a creative outlet that would allow them to work together to solve important problems in healthcare. This project-based program offers a group environment for students to learn problem-solving skills and acquire knowledge about the basic and clinical sciences while tackling real clinical problems. Until recently, UTSW has

followed the traditional didactic lecture format, but the school has slowly been incorporating more team-based learning activities. In fact, with the implementation of a new pre-clinical curriculum this year, UTSW has made team-based learning an integral component of students' education.

Program Timeline and Structure

As UTSW's emphasis on team-based learning and active problem solving has grown, so has its support of the Biomedical Innovation program. The program was started at UTSW in 2008 as a one-semester, student-run elective course called Innovating Healthcare Solutions (IHS). Since then, it has grown into Biomedical Innovation, a program spanning all four years of medical school and intimately woven into the new curriculum being implemented at UTSW (Figure 1).

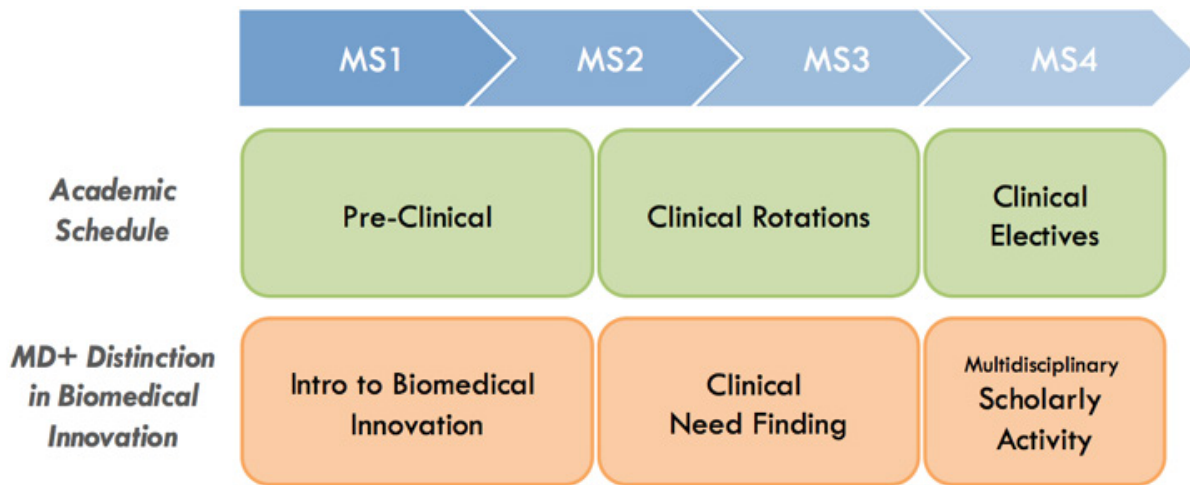


Figure 1. The Biomedical Innovation program spans all four years of the new medical school curriculum, culminating in a Scholarly Activity.

During the 1.5 year pre-clinical period of the curriculum, students take the Intro to Biomedical Innovation elective, which draws inspiration from great programs such as MIT’s D-Lab and Stanford’s Biodesign. It was developed to teach medical students from varied backgrounds a systematic approach to need-finding, solution development, and design. In the Intro to Biomedical Innovation elective, students attend a total of eighteen one-hour sessions covering topics such as team dynamics and project planning, stakeholder analysis, cultural competency, intellectual property, prototyping, business plan writing, and presentation skills (Appendix 1). Each session is led by a guest speaker with substantial experience in that topic.

As they begin to develop a framework for need-finding and solution generation, students are instructed to arrange shadowing experiences in community hospitals and clinics so that they can find a clinical need to work on for the remainder of the course. This early exposure to the clinical setting is key to the identification and development of good need statements, and good need statements are the key to successful and, most importantly, effective projects.

After students have developed several need statements, they form teams according to compatible interests and select a project under the guidance of a student facilitator—a higher level student with prior experience in Biomedical Innovation. Student facilitators help teams apply the principles they have been learning in class, offer additional insight and guidance, and help teams navigate challenges as they progress. One of the key roles of the student facilitator is to help each team network with community partners and physician mentors so that they may build working relationships. The student facilitators have worked to build relationships with members of each medical specialty at UTSW’s affiliated hospitals so that students have ample opportunity to explore the operating rooms, clinics, and wards and identify a clinical problem in the specialty that interests them. Working under the guidance of student facilitators, physician mentors, engineering mentors, and business mentors, teams develop a prototype solution and a pitch for their product, which they present at the Year End Symposium. The teams are judged on their poster, multimedia presentation, and the quality of their prototype.

Following the Intro to Biomedical Innovation course, students begin their clinical years, rotating through the wards at local hospitals and community clinics. During this time, the

students may participate in the Clinical Need Finding course. The clinical students collect ideas for innovation projects, some of which they offer to the Intro course and some of which they keep for their Scholarly Activity. As firsthand observers of the healthcare process and newly minted biomedical innovators, these students are well equipped to identify deficiencies, problems, and opportunities for improvement. The clinical rotations period is a busy time in the life of a medical student, so the Clinical Need Finding course does not meet in person.

During the last 1-1.5 years of the new UTSW curriculum, medical students are required to complete a twelve-week Scholarly Activity. During this time, students select a faculty mentor to guide them as they work on a solution to the clinical need they identified. In addition to the support of a faculty member, students also have access to the guidance of the Texas Manufacturing Assistance Center, Health Wildcatters (a local healthcare startup incubator), and BioCenter (UTSW's biomedical commercialization campus). Prototyping resources are also available on campus, including a 3D printer and a makerspace. The final deliverable at the end of the Scholarly Activity is either a prototype of their product, a full business plan, or both. Those students who perform exceptionally well receive a Distinction in Biomedical Innovation at graduation.

Program Management

The Biomedical Innovation program is unique because it was created by students and continues to be run by students. A team of student facilitators manages all aspects of the program. The student facilitators are usually upper-level medical students who have been through the pre-clinical Intro to Biomedical Innovation course or have experience with similar design projects.

One challenge presented by student-driven course management is the turnover in

leadership and ideas from year to year as students graduate and move on. For this reason, the student facilitators have proposed the creation of a formal Strategic Advisory Board (SAB) to provide consistency in long-term program strategy. This year, key faculty contributors have been invited to serve in this capacity. The Strategic Advisory Board consists of three UTSW faculty members, 2-3 student facilitators, and community partners in the fields of business, law, engineering, product commercialization, and product manufacturing. The SAB will function to provide long-term vision and direction for the Biomedical Innovation program, with a focus on creating and continuously improving an effective learning environment for UTSW students and trainees. With the varied composition of membership (local program leadership and external collaborators), the SAB will be able to provide feedback, suggest new directions or collaborations, and ensure overall that all partners in BI are well coordinated.

Program Hurdles and Progress

The formation of the Strategic Advisory Board resulted in the student facilitators enlisting the guidance and support of the Department of Surgery at UTSW, an engineering professor, and the support of the Office of Technology Development. This addition has helped alleviate two major bottlenecks in the program: prototyping and locating suitable mentors for design teams. Previously, resources and tools for prototyping possible solutions have been limited. Students would produce compelling designs, but did not have the opportunity to build and test a prototype of their device. Dr. Majewicz, Assistant Professor of Mechanical Engineering, was recently awarded a grant to build and outfit a makerspace on campus at UTSW. With her help, UTSW students have also been able to gain access to the engineering machine lab at UT Dallas. Having access to these facilities allows students to bring