

Work in Progress: Novel Initiatives for Senior Design Collaborative Projects With Healthcare Workers and Undergraduate Students—a COVID-19 Response Nursing Hackathon

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Dr. Christine King is an Assistant Teaching Professor of Biomedical Engineering at UC Irvine. She received her BS and MS from Manhattan College in Mechanical Engineering and her PhD in Biomedical Engineering from UC Irvine, where she developed brain-computer interface systems for neurorehabilitation. She was a post-doctorate in the Wireless Health Institute at the University of California, Los Angeles, and a research manager in the Center for SMART Health, where she focused on wireless health monitoring for stroke and pediatric asthma. Her current research is on engineering education, specializing in pedagogy strategies to promote learning in design-build-test courses, including senior design, computer programming, and computer-aided-design courses.

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Dr. Tolomiczenko serves as Executive Director of the Merkin Institute for Translational Research at Caltech. His interdisciplinary experience as a clinician, researcher, professor and administrator jointly inform his inclusive approach toward fostering cultures of innovation and entrepreneurship conducive to stakeholders aiming to translate ideas into products that improve health and healthcare delivery. Breakthroughs in science and engineering at Caltech are legendary - and numerous. Translating these research advances to improve healthcare requires breaking through barriers and adaptive tailoring to sustainably address needs and solve problems. At Caltech, Dr. Tolomiczenko works with a diverse set of internal and external stakeholders to foster collaborations that will result in new paths to cures and improved access to affordable, high-quality healthcare.

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Introduction:

Nurses and healthcare staff are uniquely positioned to identify opportunities to improve systems of care delivery but are often underrepresented in medical innovation initiatives [1, 2]. Furthermore, although hackathons have gained traction over the past decade as a successful innovation tool to tackle modern healthcare problems [3], there remains a lack of events that allow undergraduate students in different STEM fields to work with healthcare professionals to develop innovative solutions for healthcare problems. These events can allow interdisciplinary collaboration across engineering and computer science students with healthcare workers, as well as have been found to improve collaboration among interprofessional teams, practical problem-solving skills, ultimately leading to the development of successful startup companies [4, 5]. Traditionally, hackathons are 24 to 48-hour events of the brainstorming and ideation process of innovation that provides an accessible forum to pitch complex, difficult problems and develop initial solutions and prototypes in a quick and iterative manner [6]. Prior to the COVID-19 pandemic, such events typically occurred in person to allow for engineers and scientists to develop hands on prototypes and solutions in an open collaborative environment [7]. In order to transition to online learning during the pandemic, the authors hosted a virtual hackathon in which prototypes and solutions were developed in a simulated environment (e.g. computer-aided design or programming software), and collaborations were developed using virtual means with mentors who were able to provide one-on-one guidance with each of the teams throughout the event.

Methods:

The University of California Irvine (UCI) School of Engineering's and School of Information and Computer Science's senior design programs [8, 9] co-hosted a COVID-19 Response Nurse Hackathon event with the Children's Hospital of Orange County's Medical Innovation Institute on August 3rd, 2020, two months prior to the first day of fall instruction. Our full-day virtual event tackled current pediatric healthcare topics related to the COVID-19 pandemic, such as mentioned below. The 12-hour event began with an introductory lecture regarding the BioDesign process [10], then grouped students and healthcare workers into multidisciplinary teams based on their healthcare topic of interest. The teams then identified the problem, generated a solution, and generated a business and engineering plan to execute their solution. Teams were categorized into five topics related to the COVID-19 pandemic: school reintegration, pediatric mental health, telemedicine/remote care, ensuring families feel safe to seek care, and ensuring healthcare workers feel safe to provide care. Each team had a healthcare worker who worked directly with the undergraduate students as part of the design team. At the end of the event, each team gave a short presentation about their problem and solution and received feedback from a panel of judges. Projects were scored in terms of impact, innovation, marketability, and usability/intuitiveness (Table 1). These criteria were developed through collaboration with the instructors of the UCI senior design program and the Innovation Institute, a healthcare incubator

that provides services to several healthcare systems including the Children’s Hospital of Orange County. In particular, the scoring criteria were developed to assess both the potential commercialization of the teams’ innovations from an entrepreneurial perspective and the technical feasibility of the design from an academic and engineering perspective.

Table 1: Scoring criteria for innovation and potential commercialization of the resulting presentations during the hackathon event.

Criteria	Description
Health Impact / Clinical Need	The proposed concept represents a viable solution to a real problem, the problem the group is trying to solve is clear and the need is well-defined.
Innovative	The solution is unique and reflects a creative and innovative approach, addresses the identified need and the benefits of it are clear.
Usability and Intuitiveness	Provides a solution with ideas for an intuitive user experience, how the product will work has been thought through from the user’s perspective.
Product Demonstration	A prototype (storyboard, sketch, screenshot, process or service diagram) was included, it conveyed a clear picture of the solution
Business Case	The team was able to speak to who would <i>pay</i> for this solution, it was evident the team thought through the reasons why someone would buy it.
Overall Pitch	The presentation is effective and compelling. The elements of the presentation are clearly articulated and presented well.

The top three teams were announced as winners for “bragging rights” at the end of the event by the moderators. In addition, after the event, five of the highest scoring teams were contacted by the Innovation Institute and the UCI senior design programs to continue the projects through their respective senior design programs. Following that, a survey was sent to all participants to determine whether the event stimulated creativity and discussion, and whether they would attend again in the following years. For those projects that decided to continue beyond the hackathon event through the senior design programs, pre- and post- surveys were provided to all team members to assess whether the ideas generated from the hackathon created any viable healthcare solutions. Viability of the solution is currently being assessed by determining the status of intellectual property (IP) filing and fundraising accomplished because of the project.

Results:

Over 50 people attended the event, including 11 healthcare workers and 28 undergraduate students who participated as contestants. A total of 13 teams presented innovative healthcare solutions, and seven of these teams continued the project through the senior design programs. Of these attendees (both healthcare workers and students), 15 individuals responded to the follow up survey. Qualitative findings from the survey highlighted the awareness of interprofessional collaboration to be able to tackle large healthcare issues, such as those faced during the COVID-19 pandemic. Among the responses to “What were your key takeaways from this event?”, survey respondents mentioned that (a) there are many COVID-19 related issues that are still unsolved today; (b) COVID-19 is a multifaceted issue; and (c) by uniting people of different educational backgrounds, productive results can be produced. Student comments highlighted the

need for communication, particularly among healthcare workers and engineers, and how team cohesion and diverse backgrounds can improve problem solving and creativity:

“[I saw there is...] a strong need for greater communication between healthcare workers and the engineers that can develop better tools for them. The medical devices used in hospitals are pretty outdated as it is right now. A complete revamp of the system would be a long and costly process, but it would yield better data collection, automation of processes that could save on resources, and better communication between healthcare workers and the devices they use.”

“Got to get a variety of different perspective on the issue from different majors and health professionals.”

Furthermore, healthcare worker comments also highlighted the need for networking:

“The process of creativity development.”

“Networking with disciplines you normally wouldn’t to create a viable solution.”

Quantitative analysis of the survey results included analyzing the event’s ability to increase creativity and discussion of COVID-19 healthcare problems, ability to lead to an innovative solution relevant to a COVID-19 problem, and the relevancy of the event in regard to their career path. These questions used a Likert scale of 1 to 5, where 1 represents “not at all” and 5 represents “very much”. It was found that 93.3% (14/15) of the respondents agreed that the event increased their creativity and discussion of COVID-19 healthcare problems, and 80.0% (12/15) agreed that it led to an innovative solution to a relevant COVID-19 problem. Lastly, 53.3% (8/15) of the respondents agreed that the event was helpful in their current career path. However, although only approximately half of the participants believed it was helpful in their future career path, all of the participants were interested in attending the event if it was offered in the future.

After following the seven teams that continued the project through the senior design programs, it was found that three teams were invited to complete their project in the Information and Computer Science senior design program, and four teams were invited to complete their project in the Department of Biomedical Engineering’s senior design program. Of these invited teams, three teams pursued further development of their project in the Information and Computer Science program and none pursued further development of their project in the Department of Biomedical Engineering’s senior design program. Since these courses are ongoing, the results of pre- and post- surveys, the project’s resulting patent filings, and their commercialization potential, have yet to be evaluated, as these projects will be completed in the Spring of 2021.

Conclusion:

The present study identified whether a nursing hackathon event with engineering and computer science undergraduate students can identify and develop potential innovations and senior capstone project opportunities during the COVID-19 pandemic. It was found that the hackathon can be a robust opportunity for interprofessional education and collaboration among healthcare workers and students. Although no teams pursued their project in the biomedical engineering senior capstone course, several teams pursued their projects in the information and computer

science capstone course. This is likely due to the outside industry sponsored projects that are also offered by the biomedical engineering capstone course. Furthermore, one limitation of the study is that it does not describe the long-term effects of the hackathon on potential IP filings and start-up company generation. Future work will aim toward establishing methods and results that can investigate the long-term effects nursing and student hackathons produce. If it is found in this future work that the projects followed became viable products, then we will disseminate our findings and methodologies for adopting virtual nursing hackathon events prior to senior design programs across undergraduate institutions to improve innovation in healthcare.

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