Continuous Detection of Sepsis Risk Using Biomarkers in Patient Sweat

The Problem
Sepsis results from an overwhelming immune response to infection, and it causes 1 in 5 deaths worldwide, mostly due to organ failure [1]. Sepsis can be treated with antibiotics if caught in time, but current diagnosis methods involve drawing blood and do not allow for continuous real-time sepsis detection. Our team spoke with local physicians and sepsis advocacy groups to gain more insight into this issue.

Research
Our 12-student team developed a wearable device that uses DNA aptamers to bind to proteins in sweat that are linked to sepsis. Attached electrodes provide physicians with a continuous readout of sepsis risk. We worked on the device as part of the University of Rochester’s 2021 iGEM team. iGEM is an international competition in which student teams present their novel projects to a panel of judges. Our team, Team Bio-Spire, earned a gold medal and our project was nominated for best hardware, best diagnostic device, and best education component. I read scientific literature to help determine our protocols in the lab, and learned molecular biology techniques to synthesize and amplify the aptamers.

The Grand Challenges Scholars Program
Hajim School Grand Challenges Scholars take on a project that explores a Grand Challenge through a variety of different perspectives: research, interdisciplinary, entrepreneurship, global, and service learning. These projects are inspired by societal challenges in fields of sustainability, health, security, and knowledge. Through participating in iGEM, I have gained valuable research experience and the ability to critically view an issue from a variety of angles. I chose to pursue the mission “Advance Health Informatics” through work on our diagnostic device.

Entrepreneurship
When developing this device, our team narrowed down our target market to facilities providing post-surgical patient care. We also estimated the total cost of the product to be around $375, making it more affordable than current alternatives. I am also currently working with some of our team members to enter a business plan for our device in several business competitions through the Ain Center for Entrepreneurship at U of R.

Global
iGEM highly encourages collaboration between teams around the world. We met with teams from Taiwan, the Netherlands, and Brazil to discuss ideas and collaborate on aspects of our projects. We also worked to make our device accessible to low-resource regions around the world where sepsis is more difficult to diagnose and treat.

Interdisciplinary
iGEM involves the intersection of many different fields of study. I served as our team’s Public Relations manager, coordinating interactions with the press and posting regular updates on social media. In collaboration with the Ohio State iGEM team, we also wrote, illustrated, and published an e-book educating children on sepsis. Additionally, a sub-team of us developed and presented science lessons to children attending Rochester summer camps.

In the image above, I am performing a serial dilution on lactoferrin, a sepsis-related biomarker. I spent much of my time running experiments as part of our wet lab sub-team.

The above image shows our prototype of ‘Bio-Spire,” a wearable device designed to diagnose sepsis risk based on biomarkers present in patient sweat.

Future Directions
I really enjoyed the hands-on, student-led nature of our project, and I gained a newfound appreciation for science communication as the team’s PR Manager. The experience I gained in the lab also helped to solidify my decision to obtain a master’s degree in biomedical engineering in the future. Our work is open source, so we hope that it can be expanded upon and implemented in a clinical setting.

https://2021.igem.org/Team:Rochester

References:

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