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Abstract

Artificial intelligent point-of-care tools for rapid diagnostics of trauma

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Abstract:

Today's healthcare delivery system focuses on late-stage disease diagnosis and, as a consequence, results in exceptionally high costs with poor outcomes in far too many cases. Recent developments in the -omics disciplines are starting to provide promising signatures of early disease detection. Likewise, advances in microfluidics, nanoscience, engineering, and artificial intelligence have the potential to drastically improve diagnostic systems. The need for rapid identification of organ failure after an accident is vital for immediate diagnosis, followed by the most relevant medical treatments.

In the quest for fast identification of organ failure, the key is rapid and accurate detection of pertinent biomarkers that are facilitated by the diagnosis of organ injury, the severity of trauma, and the potential for complications of hemorrhage. A comprehensive specialized treatment of the victim at a trauma care service is crucial within an hour of the incident for enhanced survival. At the same time, the rapid diagnostics followed by the appropriate therapies are a significant driver of healthcare costs. In fact, in the United States, approximately 35 million people are treated every year for trauma injuries which translates into one hospitalization every 15 minutes. At an annual cost of $67.3B, trauma is the 3rd most costly medical condition, behind heart disease ($90.9B) and cancer ($71.4B). Despite these facts, a highly effective point-of-care diagnostic device with analysis capabilities that facilitate the treatments is still profoundly absent. Our goal is to address this need by designing and implementing a highly affective chip-based detection system by integrating a wide variety of biomarkers. Using the selected biomarkers: CRP, Myoglobin, Complement 5, HMGB-1, Cystatin-C, N-GAL, L-FABP, Protein C, Properdin, D-Dimer, we developed a novel application of a universal chip-based sensor platform thereby enabling real-time, multiplexed, quantitative screening of trauma related biomarker panels with polymer based micron size sponge biosensors. Furthermore, the quantitative results generated is utilized to train machine learning algorithms to facilitate an intuitive and versatile Trauma ScoreCard that could effectively be used by the healthcare practitioners. The diagnostic tool includes a sensor module involving a single use, credit card-sized plastic cartridge employing a sample input port, microfluidics module, reagent blisters, biomarker array, waste reservoir, and high specificity antibody reagents.

Recent Publications:

Deniz Vurmaz is a doctoral candidate in the Department of Chemical and Biomolecular Engineering Department at NYU-Tandon,

studying under Prof. John T. McDevitt. Her research is developing and integrating innovative diagnostic approaches to advance human health, focusing on programmable bio-nano-chip systems for multi-organ failure. Beyond basic science, she is a veteran of entrepreneurial competitions, having already won a NYU Green Grant and an award from the AABE for her team idea. Her goal is to be a bridge between academia and industry and, therefore, she has been preparing herself in this capacity. Before even joining NYU, Deniz was a project manager at an international renewable energy company. Using her leadership and entrepreneurship skills, she and her team established a start-up called "Lost-Bytes," a data-driven food-waste management and renewable energy company that designs and employs Artificial Intelligence solutions to old school machines. She lectures in high profile renewable energy gatherings, such as the recently held Exxon-Mobil's Energy Day. As the team leader, she has also been selected to NSF's I-Corps Program and recently has funded by this program. She takes Launchpad Business classes upon becoming a member of GreenFeen Cooperative, which collects food-waste and composts in Bronx. Deniz grew up in Turkey and now lives in NYC.

Publication of speakers:

1. N. Zhu , D. Zhang , W. Wang , X. Li , B. Yang , J. Song , X. Zhao , B. Huang , W. Shi , R. Lu , P. Niu , F. Zhan , X. Ma , D. Wang , W. Xu , G. Wu , G. F. Gao and W. Tan , N. Engl. J. Med., 2020, 382 , 727 –733
2. N. Chen , M. Zhou , X. Dong , J. Qu , F. Gong , Y. Han , Y. Qiu , J. Wang , Y. Liu , Y. Wei , J. A. Xia , T. Yu , X. Zhang and L. Zhang , Lancet, 2020, 395 , 507 –513
3. World Health Organization
4. Coronavirus Disease 2019 (COVID-19) Situation Report - 75, World Health Organization
5. D. Wang , B. Hu , C. Hu , F. Zhu , X. Liu , J. Zhang , B. Wang , H. Xiang , Z. Cheng , Y. Xiong , Y. Zhao , Y. Li , X. Wang and Z. Peng , JAMA, 2020, 323 , 1061 –1069

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