University of Rochester
Department of Biomedical Engineering

M.S. Defense Seminar

"Development and Optimization of an Assay for Rapid and Sensitive Procalcitonin Detection Using Optical Ring Resonators"

by

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Supervised by: Dr. Benjamin Miller

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Medical Center K-207 (2-6408)

https://rochester.zoom.us/j/96783161219

Abstract: Sepsis is a life-threatening condition caused by a dysregulated immune response to infection, leading to widespread inflammation, tissue damage, organ failure, and potentially death. In the United States, sepsis affects at least 1.7 million people annually. Sepsis has a rapid progression rate and requires immediate intervention since each hour of delay in treatment significantly reduces survival rates. While blood cultures remain the gold standard for diagnosis, they are time-consuming and often lack sensitivity. Procalcitonin (PCT) is a key sepsis biomarker that distinguishes between bacterial and viral infections and offers a favorable kinetic profile for early sepsis diagnosis.

The goal of my thesis research was to develop a real-time, sensitive, and quantitative assay for PCT using ring resonator-based biosensing platforms. I tested three device configurations: one employing a pressure-driven pump and two enabling passive sample flow, to identify the factors influencing assay performance. I characterized PCT-antibody binding interactions and applied computational modeling to investigate the effects of inconsistent flow rates on data reproducibility. This work provided a deeper understanding of the kinetics involved and offered insights for future optimization strategies to further refine the assay design. Finally, I successfully quantified PCT concentrations in human serum samples, demonstrating the platform's potential for clinical applications.