GI Tracked: A Wearable Abdominal Sensing System for Monitoring Gut Motility and Circadian Rhythms

Katz, Annabelle (Annie) (School: The Leffell School)

Gut motility disorders affect over 20% of the population, but standard diagnostic tools, including endoscopy and manometry, are invasive, expensive, limited to clinical settings, and don't track patterns longitudinally. Existing noninvasive wearables remain impractical for repeated home sleep use due to discomfort and sensitivity to motion artifacts. GI Tracked is a novel biomedical device: a reusable abdominal wearable with integrated electrical components that monitor gut activity and circadian patterns overnight. The system combined three piezoelectric contact microphones positioned over distinct abdominal regions and a thermistor embedded in an abdominal wrap. A microcontroller sampled acoustic and thermal data across multiple nights. Power spectral density analysis using Welch's method showed that dominant energy fell below 0.2 Hz, consistent with known frequencies of colon contractions, confirming that the signals recorded were real biological activity and not noise. When acoustic data was overlaid with sleep-stage data, gut events increased during lighter sleep. Additionally, abdominal surface temperature showed an inverse relationship with acoustic event rate. Both of these findings were consistent with established biological patterns. These results validated GI Tracked as a low-cost prototype capable of capturing physiologically meaningful gut data at home. Simulated disease-specific profiles suggested that the system could differentiate between conditions like IBS and gastroparesis. Future work will expand participant testing and integrate dietary logging for further habitual data correlation. GI Tracked offers physicians and researchers a tool to monitor gut motility longitudinally and detect abnormalities before they escalate.

Awards Won:

Lehigh University: Four Scholarships ($20,000 per year for four years)