The field of medical technology is vast and encompasses a wide range of innovations that benefit patient care, treatment outcomes and/or healthcare delivery. With a constant influx of new technologies, hospitals and physicians must decide which technologies to incorporate into their care, if any. However, the process of adopting medical technologies is tiring and time-consuming, and many obstacles prevent new medical technologies from being used as a standard of care within hospitals. These obstacles can arise from the field of specialty, location of the hospital, financial state of the hospital, and the specific technology itself. Thus, the works in this portfolio ask a fundamental question: how can medical technologies be used and implemented to improve patient care and efficiency for physicians? This question is explored from a technical and socio-technical perspective in two research projects.

My technical project sought to build a machine learning algorithm to improve predictions of focused ultrasound treatment eligibility from CT scans. Focused ultrasound (FUS) is a new non-invasive technology that can treat many disorders that otherwise require costly and high-risk surgeries. The current method to predict outcomes of FUS treatments is a physical metric called skull-density-ratio (SDR). However, SDR proved to be ineffective in accurately predicting the outcomes of FUS. Our proposed model uses features extracted from patient datasets such as power and duration of sonication, energy absorbed during sonication, and other features in addition to SDR, to predict the temperature reached during FUS treatments. This temperature reached can later be used to predict the outcome of FUS treatments.

My STS project explores the process of adoption of medical technologies by physicians and hospital systems. Three different medical technologies were chosen for a comparative analysis due to their current relevance in healthcare and their drastic differences in usage and implementation. These three technologies are electronic medical records (EMRs), robotic-assisted surgeries (RAS), and emergency contraception pills (ECs). The Diffusion of Innovations Theory (IDT) by E.M. Rogers was used to evaluate the similarities and differences in perception of these innovations by physicians. This theory states that five attributes of an innovation contribute to the perception and eventually influence adoption. These five attributes are relative advantage, compatibility, complexity, observability, and trialability. A literature review was performed, and a numeric score for each attribute was given for each innovation. This study can help us understand how the attributes of an innovation can influence the adoption of that technology.

The technical project was a success. We chose to expand an XGBoost model over other types of machine learning models such as support vector machine or logistical regression. An XGBoost model is a non-linear regression that uses a decision tree framework to find patterns within data. After training on our 75 patient data files and using cross-validation to evaluate its performance, our model predicted the average temperature with an R2 of 0.90 and an RMSE of 1.28. While our model can predict with high precision, our limited data size indicates that we would need more data samples to limit bias in our model. My STS research also introduces important findings in the adoption of medical technologies. While relative advantage and compatibility are seen as the most important attributes for the adoption of technology in literature, the high complexity scores of EMRs and low observability scores of ECs hindered the rapid adoption of those technologies. RAS, on the other hand, were able to continue to be adopted despite their low relative advantage and compatibility scores. These findings can be further explored by further research about the correlation between these attributes and their exact adoption rates worldwide.

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