Purdue Undergraduate Research Conference: Spring 2020

(hosted by the Office of Undergraduate Research)

Abstracts submitted by DURI students

Oral Presentation Abstract Number: 65

Mathematical/Computation Sciences Krannert School of Management
Predicting Postoperative Delirium Post-Intracranial Surgery

Author:
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Abstract: OBJECTIVES/RELEVANCE: Delirium has a high morbidity rate and is common in the hospital; around 10% of older, hospitalized patients have delirium, and 15-50% of patients experience delirium during hospitalization. If delirium could be predicted, many patients would experience a shorter hospital stay, less complications, and greater life expectancy, making finding an accurate predictive model prominent. Upon reading literature on postoperative delirium (POD), most focus on POD in the Intensive Care Unit (ICU), however none are specialized towards post-intracranial surgery. Our research specifically examines POD in the ICU after brain surgery, making our work unique. Our purpose is to employ machine learning methods to predict whether a post-intracranial surgery patient will get delirium in the ICU, and determine the variables that heavily influence POD. METHODS: We used a Chinese dataset with 800 patients and 80 variables with information about brain surgery patients. We conducted variable data analysis to see how each relates to delirium. Then, based on a dendrogram, performed factor analysis to decrease variable count. This created our cleaned dataset. We then employed net elastic classification to select important variables and employed decision tree and neural networking methods. To evaluate model accuracy, we implemented confusion matrices and significance tests. This provided us with a model that accurately predicts POD in the ICU following intracranial surgery, and indicated variables that correlate to the onset of delirium. CONCLUSIONS: By the accurate models employed, we conclude the main factors correlated with postoperative delirium following intracranial surgery are delirium at ICU admission, inadequate emergency, catheter presence, lesions, and length of stay in the hospital.

Research Mentor:
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Oral Presentation Abstract Number: 66

Mathematical/Computation Sciences Krannert School of Management
Data Analytics to Improve Hospital Patient Flow Management

Author:
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Abstract: At the intersection of public health and engineering technology lies the potential for innovative smart health solutions. As healthcare spending increases in the United States, it has become paramount to improve the efficiency of healthcare delivery while reducing costs. Opportunities to create impactful change in hospital operation administration include making improvements to patient flow management and mitigating patient readmission risks. This project seeks to design data-driven personalized decision support frameworks to predict a patient's risk of hospital readmission and use this decision to proactively propose optimal solutions for methods of treatment and care. It also aims to use similar analytical approaches to optimize hospital resource allocation and improve patient flow management, such that patients are routed within hospitals in a timely and efficient manner. By designing and practically applying statistical tools and machine learning predictive models on hospital datasets and patient readmittance histories on both a system level and an individual scale, the goal of this project is to decrease patient readmittance rates and ensure that patient flow within hospitals is made increasingly efficient. From this analysis, cost estimation models are designed to infer optimized resource allocation to ultimately create an integrated system that will reduce hospital congestion and improve patient care.

Research Mentor:
Pengyi Shi, Management

Poster Number: 143

Social Sciences/Humanities College of Health and Human Sciences
Service Dogs and their Effect on Interpersonal Relationships of Veterans with PTSD

Author:
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Abstract: Veterans with Post Traumatic Stress Disorder (PTSD) face many struggles in their day to day life. With these daily struggles researchers have focused on new interventions. PTSD service dogs have become a more popular form of aid for veterans, yet there are gaps in the scientific literature. One major gap is the impact that service dogs have on the veteran and spouse relationship, which is the focus of the current study. A total of 104 participants (n=70 veterans, n=34 spouses) were recruited from K9s For Warriors, a national service dog provider. Veterans and spouses completed a two-week study period in which they filled out surveys, collected saliva, and participated in ecological momentary assessments and actigraphy. Qualitative survey data was analyzed through content analysis and several themes emerged. Preliminary findings showed that themes emerged in reference to interactions with family, self, service dog and environment. Findings will give us understanding to the benefits or drawbacks veterans face within multiple relationships in their lives. These findings inform the impacts of service dogs on veterans with PTSD giving us insight into the influences a service dog may have on the veteran spouse relationship. Future studies should continue to examine this relationship in an effort to aid in clinicians' responses to veteran relationships.

Research Mentor:
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Poster Number: 145

Life Sciences College of Health and Human Sciences
Exploring language use within a parent-mediated intervention for children exhibiting social communication difficulties

Author:
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Abstract: For infants/toddlers experiencing social communication difficulties, parent-mediated interventions (PMI) are the current field standard to promote development within a natural context. Previous research highlights the importance for parents to scaffold language learning opportunities beyond clinical settings to maximize children's potential. However, for infants/toddlers exhibiting social communication-based difficulties currently enrolled in a family routines-based PMI, less is known about the individual contributions of communication between child and parent in order to promote optimal language development. The present study expands our understanding of children's communication by examining whether (1)children exhibit language impairments at enrollment; (2)whether observed mother-child communication during play increases following an eight-session intervention; and (3)associations between children's language impairments and observed communication. As part of an ongoing PMI, 16 children were assessed with the Mullen Scales of Early Learning (MSEL) at enrollment to index their receptive (RL) and expressive language (EL) skills. Home visit recordings of play-based interactions were rated for child EL use (e.g., single words; two-word phrases) and mothers' language-learning opportunities (i.e., symbol highlighting). Overall, children on average received MSEL-RL and MSEL-EL scores within the concerns range for their age. A series of repeated measures ANCOVAs to assess communication during play were conducted and revealed a significant increase in child EL use, $F(1,15)=5.87, p=.03$. To examine associations between children's MSEL scores and play-based observations, a series of partial correlations were conducted. No significant associations were observed. In sum, these findings highlight the importance of monitoring language development and the modest impact of an 8-week PMI on children's language use.

Research Mentor:
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Poster Number: 264

Mathematical/Computation Sciences College of Science
Exploration and Scientific Applications of IBM's Quantum Processors

Author:
Berkley Weyer, Science

Abstract: Our group focuses on gaining proficiency in IBM's quantum processor to apply it in other fields of physics. We are creating quantum gates and understanding the theory behind them to apply them on systems of qubits. Now we are beginning to branch out into more complex tools and algorithms for quantum circuits. Our group utilizes IBM's Quantum Experience to create quantum circuits to then run on their quantum processors. Due to the probabilistic nature of quantum mechanics, we run these circuits numerous times recording each output in a histogram. Interpreting the output histogram is done by taking many trails in order to approach the theoretical probability of each output. However, a drawback of more trails is a longer runtime of the circuit. As time increases, heat begins to excite the qubits to different states manifesting as differences between the theoretical histogram and the histogram from the quantum processor. Our group has replicated Grover's algorithm which specializes in database searching. This has widespread applications for potentially faster searches especially in particle tracing done at the CMS Detector. We have formulated a general proof for quantum teleportation and verified it with a quantum processor as an alternative form of sending information. Finally, we have explored the concept of Fourier transforms on a system of qubits that allow for a larger variety of operations to be done by the quantum processor.

Research Mentor:
Andreas Jung, Physics and Astronomy
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