INNOVATIONS JOURNALS

Conference Proceedings

Abstracts to be Presented at the 2023 Advancing Healthcare Innovation Summit

Nov 11, 2023 (Virtual)

DOI: 10.36401/IDDB-23-X1

A Game-Theoretical Approach to Clinical Decision Making with Immersive Visualization

Daniel R Catchpoole[1,2], Chng Wei Lau[3], Jolin Qu[3], Dongmo Zhang[3], Paul Kennedy[2], Simeon Simoff[3], Quang Vinh Nguyen[3]

[1]Tumour Bank, Children's Cancer Research Unit, Kids Research, The Children's Hospital at Westmead, Westmead, NSW, Australia; [2]School of Computer Science, Faculty of Engineering and IT, The University of Technology Sydney, Ultimo, NSW, Australia; [3]School of Computer, Data, and Mathematical Sciences, Western Sydney University, Parramatta, NSW, Australia

Introduction*:* Cancer is a significant contributor to diseases and fatality, and it has one of the highest-burden rates in Australia. Next-Generation Sequencing (NGS) has helped advance the genomics analysis study of cancer diseases. When building a framework for personalized treatment of disease, the complexity of the genome must be negotiated in meaningful and actionable ways. Clinical decisions that assist the individual patient require understanding the biological features that are both common to the disease type as well as unique to the individual. Machine learning analysis of complex genomic data embed the high dimensional features into low dimensional (3D) space as a way of visualizing the interrelationships between patients (e.g., PCA, tSNE, UMAP). Whilst such visualizations allow investigators to view the entire cohort, narrowing down the view to understand each individual patient is not normally feasible. The fast growth of virtual reality (VR) and augmented reality (AR) head-mounted displays provides a new medium for interactive visualizations and visual analytics of complex multidimensional data models. VROOM (Virtual Reality to Observe Oncology Models) is a novel VR prototype that has been developed to enable the complete immersion of the user within the data of an individual patient within the context of a 3D model for a cohort of patients allowing for integrated data analysis, visualization, and clinical interpretation. However, without artificial intelligence (AI) technologies, it could be overwhelming for analysts to initiate the analysis process. This abstract describes a novel development applying 'Game Theory' within VROOM as the decision support engine to mimic real-world interaction between doctors, oncologists, and lab scientists in the decision-making process on their patient's treatment options. **Methods:** Game theory offers mathematical techniques for analyzing the dynamics of interactions among rational, intelligent decision-making agents to maximize their gains, specifically competition, cooperation, negotiation, and coordination. We investigate a hypothetical "two doctors" scenario for how two clinicians with different opinions can be modelled into the VROOM visualization system as a decision support system which assumes the decision-making process for our scenario is a strategic game. The model helps to determine which patients of comparison to be selected in the similarity space to look for the gene combination and yields the list of neighbors with the highest survival rate. The data used in this study was from publicly available Acute Myeloid Leukemia (AML) datasets, including TCGA Research Network, HOVON, and National Cancer Institute Office of Cancer Genomic TARGET datasets. **Results***:* The Nash Equilibrium and Social Optimality strategy profiles were used to facilitate complex analysis within the immersive visualization by inspecting which gene and dimensional reduction combination yields the best survival rate and by investigating the treatment protocol to form a new hypothesis. Our game theory model utility value is the survival rate for the ten-nearest neighbors for the patient of interest. Hence, the system provides the best combination pf patients from within the cohort for the analyst to look at, the gene expression of those suggested patients being compared along with their medical history. We present here a case simulation to demonstrate the effectiveness of game theory in guiding the analyst within the AML patient cohort data interrogation system as compared to an analyst without a decision support system. **Conclusion***:* We demonstrate the effectiveness of game theory in guiding the analyst with a case study in the patient cohort data interrogation compared to one without a decision

support system.

Communicate Discreetly by Translating Thoughts to Commands for Medical Emergencies

Nakshatra Piduri, Advaita Piduri, Anushka Sharma, Aroush Fatima, Aarifa Fatima

DiscoverSTEM Research and Innovation Lab, Plano, TX, USA

Introduction: Patients who are communicationally impaired with limited physical movement due to disrupted communication between brain and other parts of the body, often struggle with their day-to-day communications. This problem becomes even more evident when patients face medical emergencies where they don't have an emergency alert system readily available. Existing wearable safety alert systems, such as invisawear bracelets, often rely on physical or voice-based human intervention. These devices exclude all people who cannot communicate via voice or touch. Hence, it is evident that there is a need to create a non-invasive brain communicating system that can convert thoughts to commands and help patients who cannot communicate via voice or touch. **Methods:** This innovation aims to create a customizable, portable, and relatively inexpensive way to send messages using electroen-cephalography (EEG) and the Brain Computer Interface. This electroencephalography (EEG) headset comfortably sits on the user's head and captures the user's brain waves. After calibration of the user's brain waves, the device detects peak brain signals, processes the same and converts them to trigger a text message or command to the configured recipient via Bluetooth using the internet connection in the vicinity. **Results:** This proof of concept has been thoroughly evaluated with 100 participants (ages 11-75 y/o). Each user went through 50 trials and these trials were recorded and averaged for results. SMS messages were sent to multiple cell phone carriers through both Android and iOS devices. Detailed test data with the experimental results vs. actual results were recorded afterwards. Negative test scenarios such as when user is not concentrating or is moving have also been recorded. In the end, the test results showed an overall success rate of 96.5%. **Conclusion:** With the evidence from our experiment, thoughts in the user's mind were captured accurately and successfully processed and sent as an SMS text message to the pre-configured phone number. By leveraging brain waves, our system offered a discreet, portable, and customizable communication solution, addressing the limitations of current methods and enhancing communication and safety for individuals in distress.

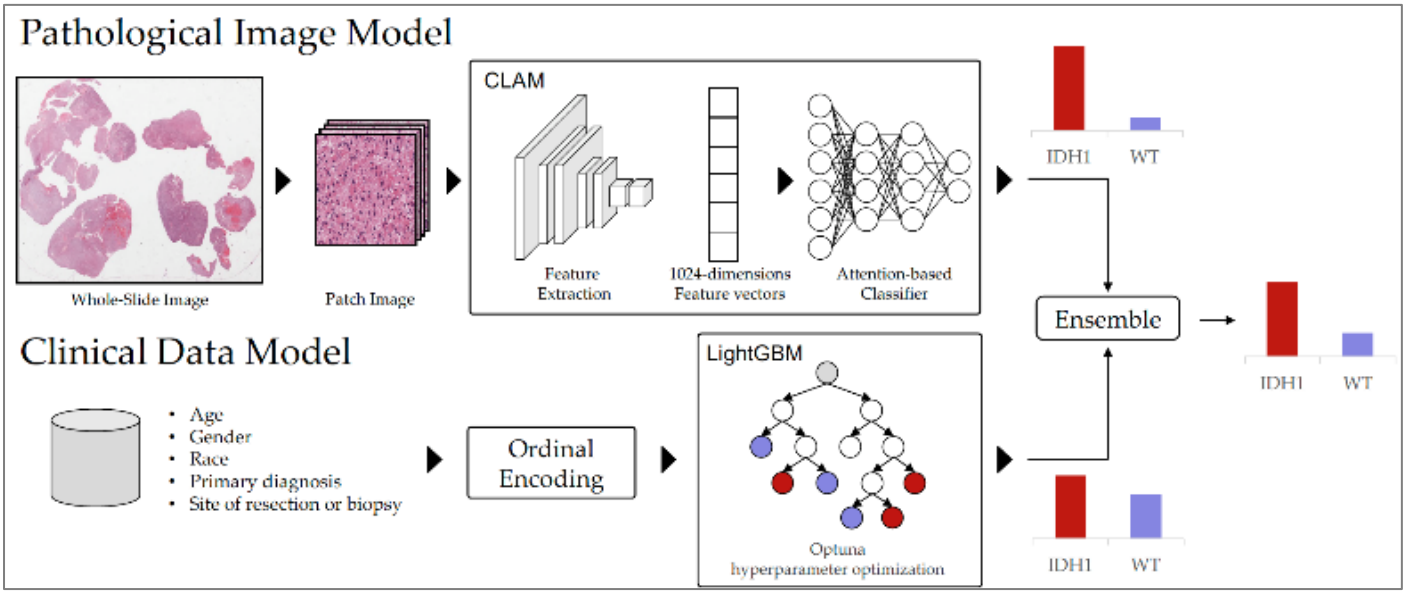
Command Category	Number of Trials	SMS Text Message	Success Rate
Education	50	Feeling bored, can you give me some education material or a book to read?	96%
Emergency	50	Need your help. Please come over ASAP, it is an EMERGANCY	98%
Walking	50	Need some fresh air. Can we go out for a walk?	96%
Restroom	50	Nature call. Need assistance	97%

Multimodal Deep Learning-Based IDH1 Mutation Prediction Using Histopathology and Clinical Data

Shyam Sundar Debsarkar[1], Riku Nakagaki[2], Hiroharu Kawanaka[2], Bruce Aronow[3], V. B. Surya Prasath[3]

[1]University of Cincinnati, Cincinnati, OH, USA; [2]Mie University, Tsu, Japan; [3]Cincinnati Children's Hospital Medical Center, Cincinnati, OH, USA

Introduction: Isocitrate dehydrogenase 1 (IDH1) mutation is implicated in gliomas as the most frequent somatic mutation and can influence the treatment outcomes. Traditionally IDH1 status prediction is undertaken in MRI, immunohistochemistry, and gene sequencing techniques and not on clinical hematoxylin and eosin (H & E) slides. The H & E-staining is an important tool in precision oncology since it guides histopathology-based diagnosis and proceeding patient's treatment. In terms of IDH1 mutation prediction H & E staining alone does not determine the status of a tumor. **Methods:** In this work, we study the application of a deep learning-based multimodal approach for IDH1 mutation prediction H & E-stained pathology and clinical metadata. By combining an attention-based weakly supervised deep learning classification on whole slide images (WSIs) with light gradient-boosting machine (GBM) on clinical parameters, we obtained an ensemble model that can predict IDH1 mutations. **Results:** Experimental results show that our ensemble deep learning-based multimodal model achieves 0.85 receiver operating characteristic (ROC)-area under the curve (AUC) on a set of 546 patients consists of 321 IDH1 mutations, 225 wildtype (WT), whereas the ROC-AUC is 0.806 for WSIs-imaging data only, and 0.790 for clinical data only, respectively. **Conclusion:** Our artificial intelligence model shows that utilizing both imaging and clinical metadata can help predict gene mutations and is also explainable due to the attention-based mechanism, which can support physicians in gliomas' IDH1 status prediction.



Deep Learning-Based Segmentation of Human Epithelial Type-2 (HEp-2) Cells Using Indirect Immunofluorescence Images

Balaji Iyer[1], Smruti Deoghare[1], Krish Ranjan[2], Bruce Aronow[3], V. B. Surya Prasath[3]
[1]University of Cincinnati, Cincinnati, OH, USA; [2]Indian Hill High School, Cincinnati, OH, USA; [3]Cincinnati Children's Hospital Medical Center, Cincinnati, OH, USA

Introduction: Indirect immunofluorescence (IIF)-stained human epithelial (HEp-2) cells used to detect autoimmune diseases are a domain gold standard. Cell segmentation, though usually considered as an intermediary step leading to cell classification, when performed with high accuracy, improves the performance of consequent tasks. **Methods:** In this work, we perform extensive benchmarking of various state-of-the-art convolutional neural network (CNN) and generative adversarial network (GAN) models. We use 17 CNN models without pretraining and 8 CNN models with ImageNet dataset pretraining on the I3A, publicly available HEp-2 dataset, comprising of 1008 HEp-2 grayscale images. **Results:** Cumulatively, three top-performing CNN models - HRNet (Dice score 90.1%) and ResNet50-UNet (Dice score 89.4%) from no pretraining group of experiments, and MobileNet-UNet (Dice score 89.8%) from pretrained CNN encoder group of experiments are chosen to be implemented on an augmented dataset. Furthermore, these chosen CNN models are independently paired with a patchGAN discriminator to measure the performance of GAN models. All experimental outcomes are reported for the entire dataset (1008 images), the test set (subset comprising of 302 images), and the corresponding classwise model performances. Unlike most studies in this domain, we report results using eight different evaluation metrics, namely, Dice/F-score, accuracy, precision, sensitivity, specificity, area under ROC curve (AUROC), area under precision-recall curve (AUPR), and intersection over union (IoU)/Jaccard index. **Conclusion:** Our results indicate that CNN models perform much better than GAN models, primarily because of the limited number of classwise images in the dataset. We expect this detailed systematic review and extensive benchmarking in HEp-2 cell segmentation can pave the way for other sophisticated DL models that are capable of handling challenging staining patterns successfully. A similar benchmarking of CNN and GAN models for HEp-2 cell staining pattern classification is an interesting research direction, either independently or along with augmenting the segmentation outcomes from the top performing DL models.

Artificial Intelligence/Machine Learning in GI Endoscopy

Abdul Monem Swied
Department of Gastroenterology, Southern Illinois University School of Medicine, Springfield, IL, USA

AI is the development and application of computer algorithms that can perform tasks that usually require human intelligence. Machine learning (ML) refers to AI in which the algorithm, based on the input raw data, analyzes features in a separate data set without specifically being programmed and delivers a specified classification output. ML has been applied in image discrimination and classification, which has many applications within medicine, especially when imaging is utilized. In our presentation we will review AI applications in

gastrointestinal endoscopy and endoscopic image analysis, such as GI endoscopy, including colorectal polyp detection and classification, analysis of upper endoscopic images for diagnosis of Helicobacter pylori infection, detection and depth assessment of early gastric cancer, dysplasia in Barrett's esophagus, and detection of various abnormalities in wireless capsule endoscopy images, biliary and pancreatic diseases, and endoscopic ultrasound (EUS). The widespread application of AI technologies across multiple aspects of GI endoscopy has the potential to positively transform clinical endoscopic practice.

Procedure	Application
Colonoscopy	• Detection of polyps (real time and on still images and video) • Classification of polyps (neoplastic vs hyperplastic) • Detection of malignancy within polyps (depth of invasion on endocytoscopic images) • Presence of inflammation on endocytoscopic images
Wireless capsule endoscopy (WCE)	• Lesion detection and classification (bleeding, ulcers, polyps) • Assessment of intestinal motility • Celiac disease (assessment of villous atrophy, intestinal motility) • Improve efficiency of image review • Deletion of duplicate images and uninformative image frames (e.g., images with debris)
Upper endoscopy	• Identify anatomical location • Diagnosis of Helicobacter pylori infection status • Gastric cancer detection and assessing depth of invasion • Esophageal squamous dysplasia • Detection and delineation of early dysplasia in Barrett's esophagus • Real-time image segmentation in volumetric laser endomicroscopy (VLE) in Barrett's esophagus
Endoscopic ultrasound (EUS)	• Differentiation of pancreatic cancer from chronic pancreatitis and normal pancreas • Differentiation of autoimmune pancreatitis from chronic pancreatitis • EUS elastography

AI-Driven Gait Parameters Estimation from Videos for Patients with Cerebral Palsy

Balaji Iyer[1], Bruce Aronow[2], V. B. Surya Prasath[2]
[1]University of Cincinnati, Cincinnati, OH, USA; [2]Cincinnati Children's Hospital Medical Center, Cincinnati, OH, USA

Introduction: Cerebral palsy (CP) is a motor dysfunction caused by brain injury or brain malformation in utero or before or after birth. It is clinically important to objectively evaluate gait function in patients with this kind of motor dysfunction. Typically, optical motion capture is performed, and markers are attached to various positions on the patient's body, with the patient is made to perform specific movements in a well-equipped environment for the capture. This method of evaluating a patient's gait is expensive, time consuming and can only be performed in a well-equipped motion lab under expert supervision. **Methods:** The goal of this study is to leverage the advances in artificial intelligence (AI) to estimate spatiotemporal parameters like gait deviation index, walking speed, cadence etc. from low-resolution commodity camera videos. AI models are capable of reliably estimating these parameters and can be deployed to consumer camera-based videos. Patients with CP potentially leverage this AI-driven gait analysis from the comfort of their homes; drastically reducing cost, time, and effort for obtaining such measurements. **Results:** We prospectively recruited 86 patients and created a dataset consisting of 323 videos. In this work, we present our research efforts on evaluating various AI driven video-based gait analysis for patients with CP along with the problems in real-world video data that is not present in public data-based AI video gait analysis models. **Conclusion:** Our results indicate the potential of AI-driven gait analysis can help increase access to quantitative motion analysis that helps clinicians to improve care.

How to Predict and Prevent Parkinson's Patients from Falling Using Artificial Intelligence and Machine Learning

Isha Agrawal
DiscoverSTEM Research & Innovation Lab, Plano, TX, USA

Introduction: There are more than a million patients diagnosed with Parkinson's disease in the US. These patients usually suffer from freezing of gait, which occurs when they suffer a brief incident where they are unable to move their feet forward although they want to move, resulting in falls. These incidents can lead to severe accidents and injuries. These incidents

can be avoided by using some cues like playing loud sounds, focusing a beam laser light on the path, etc. The focus of this research is to create an app that can monitor and analyze using artificial intelligence / machine learning (AI/ML) in patients while they walk and avoid gait freezing by automatically playing a metronome sound and flashing laser light just before a gait freezing incident is about to happen. **Methods:** This project (Live Intelligent Smart Advisor or LISA) focused on building a smart, automated personal assistant app that runs algorithms (using AI/ML) on user generated data confidentially on their device, analyzes behavior patterns, predicts and aid users in preventing gait freezing incidents proactively. This app can be applied to manage Parkinson's disease by proactively identifying triggers to assist patients by recognizing and preventing falls. The device uses pressure sensors in the patient's shoes and accelerometer to communicate the patient's location coordinates and foot pressure data to the app on the user's phone. The app would run an algorithm (using AI/ML) to process the pressure sensor reading and users x-y-z coordinate data to predict that gait freezing is about to happen. The app then starts playing a loud metronome sound and flash laser beam to alert the patient and bring their attention back to walking and hence prevent them from falling. **Results:** Fifty test runs were conducted with data collected from pressure sensors and accelerometers and sent the data to the algorithm. The algorithm was able to successfully detect 41 of these as gait freezing incidents, and the app played the metronome sound and flashed the laser beam to alert the patients and prevent the fall. **Conclusion:** This project successfully leveraged edge computing to generate the data from the patient using devices like pressure sensors and accelerometer and transmit to the user's phone to prevent falling accidents due to gait freezing. The LISA app, developed as a part of the project, can be extended to continuously monitor and analyze health data (for diabetes, hypertension, COPD, vital statistics) against clinical standards to identify trends and concerns (using AI/ML). This can also be extended for an automated emergency contact or provider call when a fall is detected in Parkinson's case.

Increasing the Value of Crowdsourcing Data by Novel Patient-Centric IT Infrastructure for Longitudinal Real Word Data Collection

Desislava Ivanova, Panagiotis Katsaounis, Konstantinos Votis
Metabio PC, Thessaloniki, Greece

Introduction: Digital health and evolutionary medicine create new insights of mediation and health management, introducing crowdsourcing and patients' real world data records, so as to promote the development of high-quality healthcare accessible to everyone. Within the scope of its activities, Metabio's team has developed an interoperable unified method and technology for crowd-generated databases, creating a user-friendly platform for data collection, processing, and distribution among stakeholders within the global healthcare system in real-time. Through a Dynamic Real-Time Tiered (DRT) e-consent module and Digital Rights Management protocols, the overall platform enables patients to monitor and manage their disease-related conditions, as well as for healthcare providers and / or research entities to have access to valuable biomedical patients' data, not recorded so far. **Methods**: The progress of the IT Architecture design and deployment was separated into six different stages, including: i) initial research of the current IT infrastructures and potential friction points, ii) establishment of the general framework of activities and operational mode, iii) evaluation of main strategies and modality requirements for the type of the disease-specific data records that will be collected iv) establishment and implementation of international standards for interoperability, harmonization and standardization, v) evaluation of potential ethical and legal issues, in accordance with security compliance and vi) creation of effective and secure channels for data dissemination, including data management policies and access rights. **Results**: An interoperable platform for patients was developed, providing an electronic system for recording RWD, associated with the onset and progression of a patient's disorder, that collects the data in real-time from patients' entries and places them in data collections from healthcare providers and other entities, in a longitudinal way. The platform is enabled with DRT e-consent module, allowing the patients to be the only and main custodians of their data, establishing the rights for the entire usage chain. Patient UI/UX is user-friendly and easily-accessible, enabled to record environmental, lifestyle, health-status, genealogical, bodily, socio-data, psychological, clinical and treatment data. **Conclusion**: Crowdsourcing platforms have the potential to be improved and enabled with state-of-the-art technologies, empowering the different types of end-

users with unique opportunities for exploration, research, monitoring, and treatment management. Future goals of the system are to engage patients on a large scale and incorporate the platform with a substantial list of disease-related conditions, with the collaborative contribution from healthcare providers and research entities, creating a strong patient-centric network that would make the difference in future global healthcare. Further validation is needed.

Implementation of LIMS at the Medical University of Graz

Beheshta Paiman
The Medical University of Graz, Graz, Austria; Marie Lannelongue Hospital, Paris, France

Introduction: A laboratory information management system (LIMS) is a web-based biobanking management system that performs various operations, such as sample, container, freezer management, data storage, quality assurance, tracking, and annotation of specimens. In this study, we describe the Bio Safety Level 3 (BSL-3) laboratory establishment within the Medical University of Graz, an evaluation of the functionality of a digital biobank management system (OpenSpecimen), and shared experience with its various components and features, such as establishing protocols and managing freezers for biological materials. All procedures used in studies involving synthesized COVID-19 samples, OpenSpecimen software, and some internet publications were in accordance with the standards of the Ethics Committee of the Medical University of Graz and the 1964 Helsinki Declaration, and written consent was not required. **Methods**: A major undertaking in the BSL-3 laboratory at the Medical University of Graz was implementing a software-based management system for the biobank, in which we archived specimens obtained from autopsies of patients infected with high-risk pathogens such as SARS-CoV-2, as well as isolated and cultivated pathogens and infectious samples for diagnostic purposes. The use of the OpenSpecimen software for the biobank is a key component of the BSL-3 laboratory establishment project at the Medical University of Graz. The primary focus of OpenSpecimen software is to enable researchers to collect high-quality biospecimen data, extensive sample collection, research, and derivation of meaningful data from the cornerstones of translational research. This software was designed to simplify all the biobanking processes. **Results**: The OpenSpecimen software is useful software with lots of good features and options based on our experience regarding its implementation. Nevertheless, there are some issues with this software that require improvement. **Conclusion**: This is among the first studies to evaluate the utility of OpenSpecimen software for the electronic management systems of biobanks. Using OpenSpecimen may help biobanks overcome barriers to the information management system.

Molecular Characterization of Cardiac Defects in a Humanized Mouse Model of Phospholamban-R14del Disease

Johanna Huelsman, Cat Makarewich
Cincinnati Children's Hospital Heart Institute, Cincinnati, OH

Introduction: Phospholamban (PLN) is a critical calcium regulatory protein in the heart that reversibly regulates the activity of the sarcoplasmic reticulum calcium ATPase (SERCA) to control cardiac contraction. Mutations in PLN have been associated with heart failure and premature death. One such mutation caused by deletion of the conserved amino acid arginine at position 14 of PLN (PLN-R14del) is associated with heart failure in patients that present with a unique phenotype of arrhythmogenic and dilated cardiomyopathy. It is unknown how the molecular hallmarks develop into the clinical phenotypes of the PLN-R14del disease. Consequently, there are currently no specific treatments for the disease. **Methods**: Using a newly developed humanized mouse model of PLN-R14del disease, our lab has generated preliminary data suggesting that defects in both the sarcoplasmic reticulum (SR) and mitochondrial compartments contribute directly to early-stage PLN-R14del disease. Our humanized PLN-R14del mouse model develops arrhythmogenic right ventricular cardiomyopathy (ARVC) with unknown etiology. The goal of my research project is to comprehensively analyze the cardiac phenotype of PLN-R14del mice at the molecular level to gain new insight into the mechanisms that contribute to PLN-R14del disease. We ran western blots using isolated heart tissue from our WT and PLN-R14del mice to quantify expression of PLN and other protein markers. We also did live and fixed cell immunostaining of cardiomyocytes from WT and R14del mice to localize and quantify protein markers and other organelles. **Results**: In our western blots, we found that total PLN expression is reduced in heart tissue from PLN-R14del mice. This may be an interesting feature of PLN-R14del disease, or it could be due to an inability for the PLN antibody to effectively bind to the mutated protein. To test this, we ran the same experiment with homozygous mice where all of the encoded protein is mutated, rather than heterozygotes that still have one WT-PLN gene that encodes functional protein. The

homozygous PLN-R14del mice still expressed PLN, though at much lower levels than both the WT and heterozygous PLN-R14del mice. We plan to follow up this result by investigating mRNA levels and protein folding complications. In our immunostains, we found comparable PLN localization, lysosomal content, excitation-contraction (EC) coupling structure, nuclear envelope integrity, and connexin localization in WT and R14del cardiomyocytes. PLN-R14del cardiomyocytes exhibited increased lipid droplets compared to WT cardiomyocytes. PLN-R14del cardiomyocytes also showed increased autophagy and mitophagy with altered p62 and parkin expression. In a western blot detecting mitochondrial stress response protein HSP60, PLN-R14del mice exhibited increased HSP60 protein. These results indicate that increased mitochondrial stress and dysfunction contribute to the arrhythmic phenotype associated with PLN-R14del disease. **Conclusion**: Analyzing the molecular mechanisms of a disease is the first step to finding a specialized treatment or cure for a disorder. Discovering molecular patterns in the PLN-R14del mice models provides a foundation for further research into the relationship between each of the molecular phenotypes and their causes and effects. We speculate that the mitochondrial defects could be a direct result of PLN localization to mitochondrial associated membrane domains (MAMs) in junction with the SR, which is seen in normal hearts. It could also be an indirect effect of calcium dysregulation on the amount of reactive oxygen species. In the future, we plan to investigate the relationship between increased mitochondrial stress and PLN-R14del disease phenotypes. We hope to continue to identify possible mechanisms that contribute to abnormalities in the EM images of PLN-R14del cardiomyocytes and explore the sequence of molecular characteristics in the disease by analyzing older/younger mice in our studies. This will hopefully allow us to identify the mechanism of how the molecular features translate into the clinical phenotypes of PLN-R14del and provide helpful information for developing targeted therapies.

Precision Oncology Implementation to Deliver Next Generation Cancer Care: Barriers and Best Practices

Karen Huelsman[1], Courtney Rice[1], Karen Wernke[1], James Maher[2], Leah Vasiliadis[3], Adam Liette[3], Andrew Parchman[2]

[1]TriHealth Precision Medicine, TriHealth, Cincinnati, OH, USA; [2]TriHealth Cancer and Blood Institute, Cincinnati, OH, USA; [3]TriHealth Information Systems, Cincinnati, OH, USA

Background*:* The rapid expansion of precision oncology applications for therapy and clinical trial decision making has led to an overwhelming amount of clinical data and information that clinicians must consider. Opportunities to support the clinical teams in delivering world class oncology care with streamlined workflow and best practices are described. **Methods***:* A landscape review of barriers and best practices is described based on the evolution of the precision oncology program since 2014. **Results**: With implementation of precision oncology at TriHealth and lessons learned, this community cancer center has identified 12 best practices. TriHealth created a Precision Oncology Workgroup (POW), which brings together a multi-disciplinary team of thought leaders across the system to optimize the application of precision oncology. We include unique roles such as Precision Oncology Lead and Precision Medicine Test Coordinator. Like many centers, a regular Molecular Tumor Board is coordinated to provide opportunity for education and optimal patient care. Tumor-specific genomic testing protocols are in constant evolution and broad testing platform includes tumor agnostic biomarkers. The paired tumor/germline process for patients with ovarian cancer is described, with increases to consistent uptake range of 88-94%. To complement tumor profiling, pharmacogenomic testing is available across multiple service lines with support from a PharmD trained in pharmacogenomics. Several quality improvement processes were addressed. A collaborative multidisciplinary approach led to decreases in QNS (quality/quantity not sufficient). Education led to a 93% matched tumor normal rate with solid tumor profiling orders. Downstream processes include clinical decision support for incidental germline cases and collaboration with germline teams. Recognizing tumor heterogeneity, we have shown an increase in concurrent testing with up front ordering of solid tumor and liquid biopsy. Several best practices are related to the Epic EMR integration of precision oncology testing with multiple labs. Clinically, Epic HL7 integration has allowed customizations, clinical interface, and clinical decision support builds with best practice alerts.

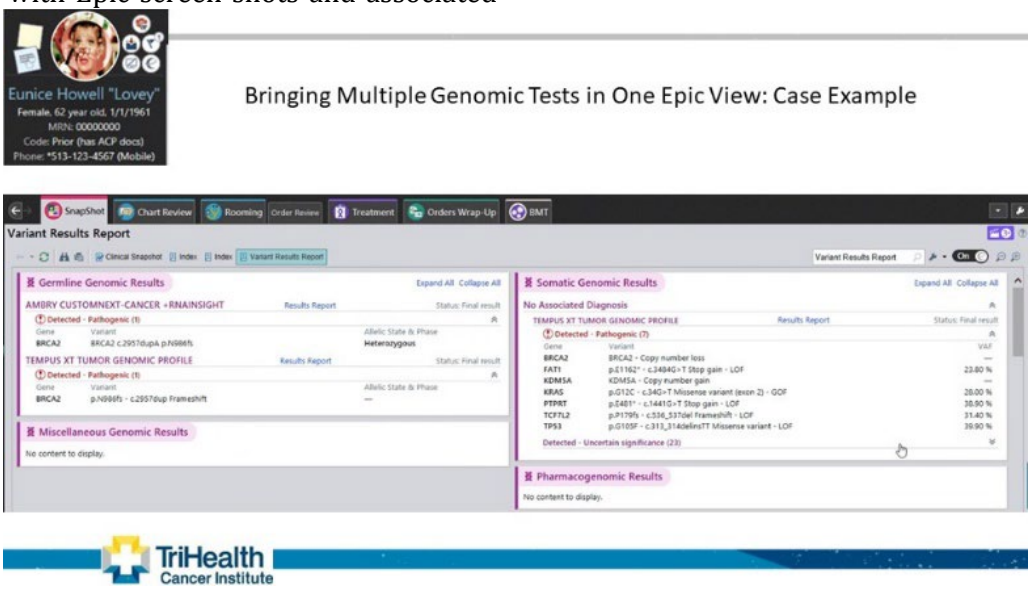
Reporting capabilities with discrete lab results (somatic, germline, and pharmacogenomics) catalyze capabilities for metrics, QA, and reporting. To reduce barriers to testing, a novel automated strategy through MyChart is applied to increase financial support. Lastly, discrete variants in the EMR contribute to health equity reporting capabilities. TriHealth demonstrated that tumor profile testing was completed with no statistically different differences by race or zip code. **Conclusion***:* TriHealth is a community cancer center with a collaborative and innovative precision oncology team demonstrating 12 best practices in delivering precision oncology testing for patients with cancer.

Innovations in Precision Oncology with Electronic Medical Record Integration and Discrete Genomic Data

Karen Huelsman[1], Leah Vasiliadis[2], Courtney Rice[1], Karen Wernke[1], James Maher[3], Andrew Parchman[3], Adam Liette[2]

[1]TriHealth Precision Medicine, Cincinnati, OH, USA; [2]TriHealth Information Systems, Cincinnati, OH, USA;[3]TriHealth Cancer and Blood Institute, Cincinnati, OH, USA

Introduction: TriHealth was an early Epic EMR integration partner, with its first HL7 complete integration in 2020 in tandem with Genomics Module, two additional HL7 integrations completed, and seven in pipeline. TriHealth will demonstrate the required staff, the benefits of integrated ordering and discrete results for clinical and reporting innovations. **Methods:** TriHealth has built innovative clinical decision support and leveraged discrete genomic elements to design, build, and customize multiple tools. Innovations and customizations in 10 key areas are described with Epic screen shots and associated metrics. **Results:** Post integration, precision oncology testing through EMR order interface correlates with an increase in testing volume by 20% year to year. EMR integration correlates with reduction in time to enter orders, fewer errors, and ability to reliably find genomic results from multiple labs. Efficient adoption of new testing components is supported by integration. Clinical user experience is also optimized by integration. Discrete variants lead to customized smart phrases and reduced documentation time and errors. Order and result information is accessible across the hospital system allowing review by multidisciplinary teams and strategies to reduce cancelled tests for insufficient quantity and decrease turnaround time. A universal starting place for all tumor profiling allows multiple tests in integration pipeline while maintaining consistent clinical workflow. Integration also allows clinical decision support tools in the Epic environment. This includes automatic genomic indicator trigger for incidental germline on tumor profile, care gap logic for patients with specific indicators, and best practice alerts (BPA) to drive workflows and guide patient care. Reporting capabilities are supported with discrete lab results that can be combined with patient demographics. This led to demonstrated health equity showing that tumor profiling was offered to patients with cancer with no statistical differences by race or zip code. Continuous update of discrete data allows real-time dashboards for efficient reporting. Discrete variant data allows identification of patients with specific genomic results for updated therapy or clinical trials. **Conclusion:** TriHealth is a community cancer center demonstrating the process and best practices with Epic integration in precision oncology. Downstream benefits for clinicians and administrators are demonstrated with associated metrics and visualizations.



Business Tools Enhance Patient Experience: Lessons Learned from the Customer's Journey

Rajan Kamath[1], Ratee Apana[2]
[1]University of Cincinnati Lindner College of Business, Cincinnati, OH, USA; [2]Artesiaa Consulting, Cincinnati, OH, USA

Introduction: To maintain a competitive edge, businesses monitor a customer's needs and concerns as they evolve over the stages in a customer's journey and use a variety of tools to deliver outstanding customer experience. Can we learn how to enhance a patient's experience of healthcare delivery using business tools that improve a customer's journey? **Methods:** First, we draw a parallel between a customer's journey in a business and a patient's journey in a healthcare system. The seven stages in a customer's journey are (1) out-of-market, (2) trigger, (3) initial consideration, (4) active evaluation, (5) purchase decision, (6) experience, and (7) loyalty. These stages correspond to the patient's journey: (1) normal, (2) test or episode, (3) research or chat, (4) select, (5) get treatment, (6) recover, (7) advocate or critic. A comparative analysis of these two parallel processes yields a list of business tools that may have tremendous potential to improve the patient's experience. **Results:** See Table. **Conclusion:** Business tools, used carefully, can enhance a patient's experience in a healthcare system.

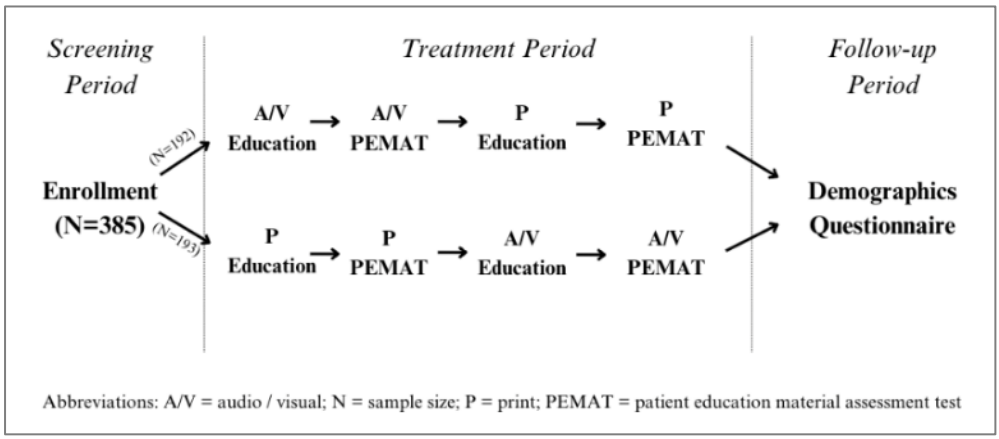
Steps Customer's Journey	Ways to Enhance Experience	Stages in Patient's Journey
Out-of-Market	Thoughtful targeting, SEO, Ad "If this, consider that"	Normal / Routine
Trigger	Content marketing, education, keyword optimized blogs	Test /Episode / Diagnosis
Initial Consideration	Push USP, monitor reviews, respond to positive as well as negative	Research / Chat / Second Opinion
Active Evaluation	Touchpoints, demos, stay fresh	Select / Get recommendation of a healing pathway
Purchase Decision	Barrier-free, quick, and easy, inquire about after-sales support	Treatment
User Experience	Training, support, FAQs, services	Convalescence / Recovery
Loyalty	Measure satisfaction, offer updates, referral programs, new features, and releases	Advocate / Critic

A Multi-Site, Randomized Study to Evaluate the Understandability and Actionability of an Audio/Visual Software Material in Adult Subjects Having Undergone a FibroScan® Examination: A Comparison with Traditional Paper-Based Patient Education

Andrew Bouras, Saket Bikmal, Michael Joseph, Joshua Bradley, Kian Maranon
VAROS Technologies Inc., Ashburn, VA, USA

Introduction: This multi-center, randomized trial aims to assess the understandability and actionability of OrganXplorer, an audio/visual software material developed by VAROS Technologies, in adult subjects who have undergone a FibroScan® examination. The study seeks to compare the effectiveness of this novel tool with a traditional paper-based patient education approach. This trial aims to contribute valuable insights into the efficacy of OrganXplorer as a patient education tool in enhancing the understandability and actionability of FibroScan results. **Methods:** The study design includes a screening period, followed by a treatment period, and then a follow-up period. Eligible participants will be randomly assigned to one of two study arms. In arm 1, participants will receive an audio/visual interpretation of their FibroScan results through the VAROS software, followed by a paper-based interpretation. In arm 2, participants will first receive the paper-based interpretation, followed by the software-based interpretation. After each interpretation, all participants will complete the Patient Education Materials Assessment Tool (PEMAT) questionnaire. The primary objective is to assess the understandability and actionability of the information provided by OrganXplorer compared to the traditional paper-based approach. Secondary objectives include exploring potential correlations between demographic factors and the understandability and actionability scores, gathering user feedback to identify areas for improvement, and examining the applicability of OrganXplorer for explaining other medical tests or conditions. The study design and flow are summarized in Figure 1. **Results:** Results will be reported following the completion of the study, including detailed analysis of the understandability and actionability of the OrganXplorer tool compared to traditional paper-based methods. Statistical methods, demographic analysis, user feedback, and applicability for explaining other medical tests or conditions will be explored. **Conclusion:** The findings may inform the optimization of patient education methods in the context of liver health management and have broader implications for healthcare communication and patient empowerment

.



Endoscopic Stenting Only for a Duodenal Perforation: An Alternative to Conventional Surgical Repair

Sachin Aggarwal, Harris Siddiqui, Ashley Gagen

Southern Illinois University School of Medicine, Springfield, IL, USA

Introduction: Perforation of the duodenum is a rare life-threatening complication of balloon dilation of duodenal strictures that is managed surgically. Surgery, however, has its associated risks, thus, with the availability of endoscopic stenting, duodenal perforations can be managed endoscopically. **Methods:** The aim of this study was to assess feasibility of using endoscopic stenting as an alternative to conventional surgical repair for iatrogenic duodenal perforations secondary to recurring duodenal strictures. **Results:** The perforation and stenosis were successfully managed by placement of an 18 mm × 12.3 cm WallFlex fully covered stent secured by clips to prevent migration. A follow-up endoscopy with stent removal revealed no perforation and resolution of the duodenal stricture. **Conclusion:** Our case emphasizes endoscopic stenting as an alternative to conventional surgical repair for iatrogenic duodenal perforations secondary to recurring duodenal strictures. However, close surveillance is necessary after this intervention to ensure that stent stenosis, stent migration, or additional perforation does not occur. The usage of this intervention may be associated with lower risks of postoperative complications, faster recovery, and decreased length of stay compared to open surgical repair.