

2023 Advancing Healthcare Innovation Summit (AHIS): Executive Summary

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The Innovative Healthcare Institute (IHCI) is a US-based organization with a strong network of internationally renowned experts who focus on advancing innovative ways to improve human health and delivery of healthcare. IHCI promotes innovation in healthcare by disseminating the latest advances in the field through the publications of Innovations Journals, sharing the latest healthcare breakthroughs, and encouraging networking and collaboration through a variety of professional conferences and events.

On November 11, 2023, IHCI, in partnership with *Innovations in Digital Health, Diagnostics, and Biomarkers* (IDDB), presented the Advancing Healthcare Innovation Summit (AHIS) as a virtual event, welcoming presenters and attendees from five US states and four countries. The following is a summary of the event. Abstracts can be found in this issue of IDDB,^[1] and videos of presentations can be found on the InnoScholar.com knowledge hub.

SESSION 1: INNOVATION ACROSS BORDERS

Dr. William Barrett (University of Cincinnati Cancer Institute, USA) moderated the first session, titled “*Innovation Across Borders*” by Dr. Zisis Kozlakidis (International Agency for Research on Cancer, World Health Organization [WHO], France), who gave a fascinating insight into some initiatives of the WHO relating to longevity and regenerative health. An open Q & A session followed the talk, raising some interesting points.

Two examples were provided on the way projects are identified and funded: firstly, direct requests can come from member states; if the problem being addressed is not unique to the requestor state, a task force can be raised in the WHO and other countries will weigh in. Another example is from the bottom up: a group of scientists or a university would come together and approach WHO and provide evidence for high-impact projects.

Dr. Kozlakidis added that he would like to see innovation being repurposed for other areas of clinical practice. Telemedicine (a recent explosion in innovative technologies) is now being repurposed to provide care in rural areas, and yet the full potential has not been fully explored. Similarly, artificial intelligence (AI) could assist in improved distribution of resources to specialized patient groups. However, moving innovations from the laboratory to clinical practice is a long, highly regulated process with several stages. There is a requirement for proof of principle, then preclinical testing, large-scale testing, and even additional steps depending on the technology and jurisdiction. The WHO can pull from experiences in many countries and make recommendations that provide a strong basis for national healthcare regulations, but the WHO cannot enforce adoption by individual countries.

SESSION 2: ARTIFICIAL INTELLIGENCE INNOVATIONS IN HEALTHCARE ABSTRACT PRESENTATIONS

Session 2 (moderated by Drs. William Barrett and Zisis Kozlakidis) started with an intriguing application of game theory and immersive visualization to clinical decision-making, presented by Dr. Quang Vinh Nguyen (Western Sydney University, Australia). Gene expression data pertaining to a condition in a patient compared with another patient, or groups of patients represent a large data set, and it would be overwhelming to the observer without use of AI. Dr. Nguyen demonstrated use of AI in oncology, showing how visual immersion can aid the clinician in processing unwieldy data sets to guide therapeutic approaches.

Next, Anushka Sharma and Nakshatra Piduri (DiscoverSTEM, USA), a pair of high-school innovators, presented “*Communicate Discreetly by Translating Thoughts to Commands for Medical Emergencies*.” Evoking science-fiction-style futuristic healthcare, the students described how they took their idea to a product able to be tested and

trained on real patients, i.e., patients with paralysis in their project. There was great interest from the audience. The pair mentioned that they have presented only 4 of the 32 commands that have been tested successfully. Furthermore, 2500 trials in patients from ages 9–80 years have been conducted in noisy conditions, and a less than 8% error rate was observed; thus, there is confidence that this innovation will work in real-world situations. The technology may also be applied to patients with depression or for wellness goals.

The next presentation by Dr. Shyam Debsarkar (University of Cincinnati, USA) focused on using AI to analyze whole slide images and integrate that data with patient-based clinical information to guide differentiation of brain glioblastoma caused by *IDH1* mutation. Image analysis typically has low accuracy for identifying the gene mutation, but when combined with clinical data and deep learning (DL) methods, imaging can be clinically useful to guide treatment decisions, improving accuracy to over 85%. The next plans are to extend this methodology to colon or pancreatic cancer.

Dr. Balaji Iyer (University of Cincinnati, USA) presented an in-depth review of immunofluorescent image-based DL models for segmentation of Hep-2 cells, which is an important component of autoimmunity and some cancer pathways. New data generated by the group have improved upon existing methods, in both sensitivity and specificity, thus getting close to a reliable diagnostic product, and continuing to add images to the DL model.

Next, one of the world's leading advocates for AI use with gastrointestinal (GI) endoscopy, Dr. Abdul Monem Swied (SIU Medicine, USA), presented “*Artificial Intelligence/Machine Learning in GI Endoscopy*.” Owing to the large amount of imaging data associated with each patient, and the large number of screenings that need to be processed, GI endoscopy has been making good use of AI longer than most medical fields. Despite the progress, Dr. Swied stated that there are still roadblocks to comprehensive adoption of AI in medicine, and that more AI-based tools are needed to bring researchers together. Such AI technology is FDA approved for use in colonoscopy, and trainees in Dr. Swied's endoscopy unit are using AI to facilitate learning. It has not yet been applied in ultrasonography. Currently, the cost of the equipment is supported by grants, although the innovation has been designed with reasonable costs for diagnostic centers in mind.

Dr. Iyer then returned to present “*AI-Driven Gait Parameters Estimation from Videos for Patients with Cerebral Palsy*.” Currently, gait parameters require the patients to be assessed in a sophisticated laboratory under expert supervision, Dr. Iyer's team wondered if this serial assessment could be achieved with cell phone cameras. Initial findings indicate likely success once the identified barriers are overcome, including a need to minimize data input and eliminate background distractions in video analyses. The biggest barrier was the manual curation of

the data to make the current model AI-ready. Computational power and lack of data were also secondary barriers for training the models.

Then another high-school student, Isha Agrawal (DiscoverSTEM, USA), delivered an impressive presentation entitled “*Parkinson FOG Prevention*,” capturing the imagination of the audience. Inspired by her piano teacher who has Parkinson disease and suffered a traumatic injury caused by freezing of gait (FOG), Isha designed an algorithm that works with existing mobile phone technology (e.g., accelerometer to detect falls) to detect FOG and help the patient to return their focus to walking, thus preventing injuries from falling. Partnering with Parkinson disease advocacy groups and related organizations would be an ideal next step to get training data.

SESSION 3: DIGITAL HEALTH AND PERSONALIZED CARE ABSTRACT PRESENTATIONS

Ms. Desislava Ivanova (Metabio, Greece) started off session 3 (moderated by Drs. Burns and Jazieh) with a possible solution to the dilemma of having sufficient real-world data to train AI algorithms. Her talk was entitled “*Increasing the Value of Crowdsourcing Data by Novel Patient-Centric IT Infrastructure for Longitudinal Real-World Data Collection*.” Although research has focused on obtaining data from clinical trials, biobanks, and healthcare providers, the central resource, the patient, has been overlooked. Ms. Ivanova addressed potential roadblocks to patient-reported data, including consent,^[2] ownership, and reliability. This concept has distinct advantages such that the complexity of addressing these barriers is worth overcoming. This innovation is a platform (not a repository), and the data belong to the patient.

The next presentation by Dr. Beheshta Paiman (The Medical University of Graz, Austria; Marie Lannelongue Hospital, France) was “*Implementation of LIMS at the Medical University of Graz*.”^[3] She presented an evaluation of OpenSpecimen software as a laboratory information management system, including implementation and functional testing of the program. Biobanked specimens are an incredibly valuable resource to researchers and companies. Where the local and federal regulations allow, sharing specimens, especially of rare diseases, can expedite therapeutic development, approval, and implementation in clinical care. The testing is being repeated outside of Graz, to see if there are different challenges, outcomes, or other factors to be considered.

The next presentation was given by another very young innovator, Ms. Johanna Huelsman, a college freshman who spent the summer before college at Cincinnati Children's Hospital working on a mouse model of cardiomyopathy. Her project, entitled “*Molecular Characterization of Cardiac Defects in a Humanized Mouse Model of Phospholamban-R14del Disease*,” elucidated the role of phospholamban (a calcium regulatory protein in the heart) in excitation-contraction

coupling. A humanized mouse model lacking phospholamban was used to replicate human cardiomyopathy. Mitochondrial dysfunction and fat droplet accumulation were seen in these mice, similar to congenital cardiomyopathy in humans. The mice were 3 months old, equivalent to a human child, and have already demonstrated functional cardiomyopathy, although the reason for mitophagy and autophagy coinciding is not fully understood yet.

The next speaker, Ms. Karen Huelsman (TriHealth Precision Medicine Institute, USA), is a star in the field of genetic counselling with respect to precision oncology specifically breast and ovarian cancers. Her talk, “*Precision Oncology Implementation to Deliver Next-Generation Cancer Care*,” covered the barriers and best practices to deliver next-generation cancer care. Ms. Huelsman showed what can be done when a multidisciplinary team comes together to tackle complex problems in precision oncology. Historically, there have been tumor-specific protocols, but now the precision oncology team can give extra guidance in finding biomarkers. For example, the team at TriHealth includes experts in genetic counseling as well as information systems, laboratory testing, and other appropriate dedicated staff.

Karen Huelsman returned to present “*Innovations in Precision Oncology with EMR Integration and Discrete Genomic Data*.” In this talk, she addressed integration of the precision oncology process, including discrete genomic data, into the electronic medical record (EMR). The challenge is to integrate as much relevant data as possible without including the clinical management aspect of EMR. For instance, a particular gene mutation might be associated with a particular blood test that can be used to track therapeutic efficacy or disease progression. Ideally, integration would result in the provider being prompted by EMR to order that test as per best practices or guidelines. However, a challenge often faced with EMR integration is that a physician might get 15–20 best practice alerts for a single patient, yet few are used. The current approach is to trigger these alerts for germ line mutations, as this can be helpful for primary care physicians to guide specialty referrals. Medical oncologists already know about this challenge and are able to navigate in the background.

In the next presentation, Dr. Rajan Kamath (Lindner College of Business, University of Cincinnati, USA) presented “*Business Tools Enhance Patient Experience: Lessons Learned from the Customer’s Journey*.” He took us on a tour of customer experience improvement tools, and outlined the differences and similarities between customers and patients, highlighting where existing business tools could be used to assess and improve the patient experience. Many existing business practices are tracking a customer through their journey, and it is indeed efficient to track patients through their journey. Dr. Kamath explained that the EMR can only provide part of the patient’s journey. Application of AI tools can help process the large amount of information available in the EMR. Furthermore, COVID-19 changed the

way people think. Expectations have changed. Patients are more educated. Therefore, healthcare providers and institutions must take time and effort and use available resources to change the way they approach patients.

The next presenter, Andrew Bouras (VAROS Technologies Inc, USA), presented “*Evaluation of Understandability and Actionability of Audio/Visual Software Material [...] A Comparison with Traditional Paper-Based Patient Education*.” Using FibroScan examination as an example, Andrew demonstrated that helping the patient understand their condition using a visual method, without complex medical terminology and jargon, could help to improve compliance with physician and healthcare provider guidance and instructions. The more a patient understands when they leave their visit, the higher satisfaction they express regarding their interactions. It is important to note that this software is not a medical diagnostic tool.

The final talk in session 3 was “*Endoscopic Stenting Only for a Duodenal Perforation: An Alternative to Conventional Surgical Repair*,” given by Dr. Sachin Aggarwal (SIU Medicine, USA) regarding a minimally invasive approach to duodenal perforation. Dr. Aggarwal explained that in cases of suspected duodenal perforation, laparoscopic surgery is almost always performed. This increases risks for the patients, both as a complication of surgery in general, but specifically of peritonitis. He presented a case of a 93-year-old woman, suggesting that endoscopic stenting be a minimally invasive approach to duodenal perforation with similar efficacy and outcomes as conventional laparoscopic repair.

SESSION 4: CAREER PATHWAYS IN THE INNOVATIVE FIELD OF PRECISION HEALTH

The final session (moderated by Dr. Jazieh) included a fascinating and informative look at the multitude of career pathways for individuals who are interested in innovation in precision health. Dr. Burns C. Blaxall (University of Cincinnati, USA) presented “*Career Pathways in the Innovative Field of Precision Health*.” Dr. Blaxall’s long and storied career in precision health innovation has given him a unique 30,000-ft view of the field, and he has seen first-hand contributions from innovators from many backgrounds. Using his own experiences, Dr. Blaxall talked about the importance of mentorship in a career path choice. He gave a definition of precision health as it applies today, and described the training that could enable someone to get into the field. There was much productive discussion following the presentation, including the mention that many programs have components of precision health, but TriHealth and Christ Hospitals (Cincinnati, OH, USA) are leading the way in terms of having complete teams.

Dr. Blaxall explained that you must be willing to reinvent yourself every 10 years or so to avoid becoming stale. Although precision medicine has mostly been oncology focused, all aspects of medicine seem to be moving towards precision medicine. Thus, all stakeholders in healthcare, including administration and leadership, have to become

familiar with precision medicine. The healthcare system in the United States is based on procedure-based billing (in a for-profit system), but precision medicine is preventative, so C-level support is needed for implementation of precision medicine.

2023 AHIS AWARD WINNERS

Young Innovator Awards (Pre-College Students)

First Place:

Parkinson FOG Prevention

Isha Agrawal (DiscoverSTEM, Plano, TX, USA)

Runner Up:

Communicate Discreetly by Translating Thoughts to Commands for Medical Emergencies

Anushka Sharma, Nakshtra Piduri, and Advaita Piduri (DiscoverSTEM, Plano, TX, USA)

Aspiring Innovator Awards

First Place (joint):

Artificial Intelligence/Machine Learning in Gastrointestinal Endoscopy

Abdul Swied, MD (Division of Gastroenterology, SIU Medicine, Decatur, IL, USA)

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

Karen Huelsman MS LGC (TriHealth Precision Medicine Institute, Cincinnati, OH, USA)

Runner Up:

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

Balaji Iyer, MS (Department of Computer Science, University of Cincinnati, Cincinnati, OH, USA)

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