THE GRAINGER COLLEGE OF ENGINEERING

10 Year Anniversary Celebration

Health Care Engineering Systems Center

IHOTEL AND CONFERENCE CENTER

May 5, 2025

» **Rashid Bashir**
Dean, College of Engineering Grainger Distinguished Chair in Engineering University of Illinois Urbana-Champaign, The Grainger College of Engineering

Forefront of Innovation »

For the past decade, the Health Care Engineering Systems Center has been at the forefront of innovation, bridging engineering and medicine to transform patient care, medical training, and health technologies. This milestone would not have been possible without the generous support of the Jump ARCHES Endowment, whose vision and investment helped establish the center as a leader in health care engineering. We look forward to another decade of groundbreaking research and real-world solutions that improve lives.

» **Noel Adams**
Vice President of Academic Collaborations for OSF Innovation

Innovation Into Impact »

I want to take a moment to recognize the invaluable contributions of the Health Care Engineering Systems Center (HCESC) through the Jump ARCHES collaboration. Their partnership with OSF HealthCare has been instrumental in advancing innovative health care solutions. By pairing clinicians with engineers, HCESC has helped us tackle real-world challenges in ways that were once unimaginable. This collaboration has truly been a game-changer, allowing us to solve complex health problems with fresh perspectives and cutting-edge technology.

Their commitment to interdisciplinary research has led to groundbreaking projects that enhance patient care, transform medical education and push the boundaries of health care technology. Thanks to this collaboration, we've been able to turn innovation into impact, developing solutions that not only support health care providers but also improve outcomes for the patients we serve. We are grateful for this collaboration and excited about the future possibilities it will continue to unlock.

» **Brian Cunningham**
Electrical & Computer Engineering Professor University of Illinois Urbana-Champaign, The Grainger College of Engineering

Evolve »

I served a term on the HCSEC steering committee for five years, so I had the great experience of participating in the establishment of a system for peer-reviewing the proposals and discussing with the other members of the steering committee to advise the Director about the projects that were selected for funding. It was amazing to see the level of innovation and the variety of innovative concepts that some from across the university to have an impact upon health care. The engagement between UIUC faculty researchers and OSF clinicians helped set the initial conditions that focused the research plans in a very practical way towards ideas that could evolve towards helping patients.

Special Thanks

to OSF HealthCare for a decade
of prolific collaboration and friendship

OSF HEALTHCARE

OSF INNOVATION

Academic Partnership Programs

jump | ARCHES

AN OSF HEALTHCARE,
UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN,
AND UNIVERSITY OF ILLINOIS COLLEGE OF
MEDICINE PEORIA COLLABORATION

The Grainger College of Engineering
UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

10 Year Anniversary of Health Care Engineering Systems Center

Celebrating 10 years of achievements

May 5, 2025
8:30 am – 3:30 pm

Heritage Hall, I Hotel and Illinois Conference Center

For a decade the Health Care Engineering Systems Center (HCESC) has enabled close collaborations between the University of Illinois Urbana-Champaign (UIUC) faculty and clinical investigators at OSF HealthCare and its associated institutions.

HCESC was established in 2014 as a research center under the Coordinated Science Laboratory within The Grainger College of Engineering (GCOE). It has served as a hub where engineering innovation intersects with medicine, advancing simulation technologies, smart health systems, health data analytics, human factors, medical robotics, and clinician education.

A key responsibility of the center is managing the Jump Applied Research for Community Health through Engineering and Simulation (ARCHES) seed grant program, which was established in 2014 by a $62.5 million gift. In 2019, the Jump ARCHES partnership was expanded with new commitments of $50 million, backed by a total of $112.5 million in endowment support. This multifaceted endowment includes a $50 million gift from the DiSomma Family Foundation, held within the OSF HealthCare Foundation, an additional $37.5 million commitment from the OSF HealthCare Foundation, and an equivalent $25 million in endowment support from the University of Illinois at Urbana-Champaign (GCOE & OVCR).

The seed grant program provides competitive grant opportunities for UIUC faculty, engineers, and clinicians across UIUC, OSF HealthCare, and University of Illinois College of Medicine Peoria and catalyzes interdisciplinary collaboration to tackle pressing healthcare challenges. Since its inception, Jump ARCHES has provided over $12 million in internal grants, funding over 170 proposals.

10 Year Anniversary of Health Care Engineering Systems Center (HCESC)
May 5, 2025
Heritage Hall | I Hotel and Illinois Conference Center
1900 S 1st St, Champaign, IL 61820

AGENDA

8:30-9:00 AM	**Breakfast and Registration**
9:00-9:30 AM	**Welcome-Introductions-Opening remarks** Professor Jim Rehg, PhD, Director HCESC Professor Susan Martinis, PhD, Vice Chancellor for Research & Innovation **History of HCESC** Professor Rashid Bashir, PhD, Dean of The Grainger College of Engineering **10 years of collaboration through Jump ARCHES Program** Professor John Vozenilek, MD, FACEP Vice President and Chief Medical Officer for OSF Innovation and Digital Health
9:30-10:00 AM	Professor Jim Rehg-----**New Direction**
10:00 AM-12:00 NOON	**Jump ARCHES relevant projects** *Moderator: Professor John Vozenilek* Professor Matthew Bramlet, MD Professor Brad Sutton, PhD Professor Liz Hsiao -Wecksler, PHD Ms. Anusha Muralidharan, MS Mr. Harris Nisar, MS Professor Brian Cunningham, PhD
12:00-1:00 PM	**Lunch**
1:00-2:00 PM	**Keynote 1** Professor Niteesh Choudry, MD, PhD
2:00-2:15 PM	**Break**
2:15-3:15 PM	**Keynote 2** Professor Santosh Kumar, PhD
3:15 -3:30 PM	**AI 4Community Health Cluster** Professor Jeff Woods, PhD, Associate Dean for Research of the College of Applied Science, Director of the Center of Health, Aging and Disability
3:30 PM	Professor Jim Rehg----**Adjourn**

James Rehg, PhD

» *Director, Health Care Engineering Systems Center*
Founder Professor, Siebel School of Computing and Data Science,
and Industrial and Enterprise Systems Engineering
University of Illinois Urbana-Champaign

Dr. Rehg's research is focused on AI and computer vision, and the use of these technologies to measure, model, and analyze health-related behaviors from sensor data. A significant theme is the creation of AI methods for modeling and analyzing social and cognitive behavior and its emergence in child development. His lab has pioneered egocentric computer vision, which studies the visual world via the analysis of head-worn camera images. He and his collaborators developed an egocentric approach to automatically quantifying bouts of eye contact during naturalistic face-to-face interactions. It was the first example of an AI model performing at human-level accuracy in assessing social communication behavior. His lab is developing computational methods for understanding the behavioral underpinnings of autism, with a focus on the development of novel diagnostic and therapeutic approaches. A second theme is mobile health, with a focus on the development of AI methods for time series and biosignal data and their use in analyzing wearable sensor data to model risk factors and develop interventions for chronic health conditions.

Dr. Rehg was the lead PI of an NSF Expedition to develop novel computational approaches to modeling social and communicative behavior via multi-modal sensing. He is currently the Deputy Director and TR&D1 Lead for the mHealth Center for Discovery, Optimization, and Translation of Temporally-Precise Interventions (mDOT), funded by NIH NIBIB, which is developing novel on-body sensing and predictive analytics for improving health outcomes (https://mdot.md2k.org/)

Susan Martinis, PhD

» *Vice Chancellor for Research and Innovation*
University of Illinois Urbana-Champaign

Susan Martinis is Vice Chancellor for Research & Innovation at the University of Illinois Urbana-Champaign, where she provides leadership for the campus-wide interdisciplinary research institutes, promotes new research initiatives, and oversees the administrative and business processes that ensure the safe, ethical, and productive conduct of research at Illinois.

Dr. Martinis, the Stephen G. Sligar Professor of Molecular and Cellular Biology, studies the mechanisms, evolution, and biomedical applications of protein synthesis and RNA-protein interactions. She is a successful researcher, engaged in entrepreneurial and corporate partnerships, a committed educator, and an experienced administrator.

Rashid Bashir, PhD

» *Dean, The Grainger College of Engineering*
University of Illinois Urbana-Champaign

Rashid Bashir is Professor of Bioengineering, the Grainger Distinguished Chair in Engineering, and is currently the 15th Dean of Grainger College of Engineering at the University of Illinois at Urbana-Champaign.

He started his academic career at Purdue University where he spent 10 years. He held a Visiting Scientist position at Massachusetts General Hospital and Shriner's Hospital for Children and was Visiting Professor of Surgery at Harvard Medical School, Cambridge, MA. He has served as the Director of the Holonyak Micro and Nanotechnology Laboratory and Head of the Department of Bioengineering. He was member of the core founding team for the Carle Illinois College of Medicine, the world's first engineering-based College of Medicine at the University of Illinois Urbana-Champaign. He was founding interim director of the HCESC and worked with leaders at UIUC and OSF to realize and later expand Bill DiSomma's vision of Jump ARCHES to fruition. More recently, he was on the founding team of the Chan Zuckerberg Biohub Chicago, awarded in 2023 and now is a member of the Executive Advisory Committee.

He is an internationally renowned scholar in micro-fluidics and nanotechnology based diagnostic technologies for precision and personalized medicine, and 3D bio-fabrication of multi-cellular engineered living systems for biological soft robotics. He has authored or co-authored over 320 journal papers and has been granted over 65 patents. He was elected to the National Academy of Inventors in 2018, National Academy of Medicine in 2023, and to the American Academy of Arts and Sciences in 2024. He is also academic co-founder of Prenosis, Inc. and VedaBio, Inc.

John Vozenilek, MD, FACEP

» *Vice President, Chief Medical Officer, Innovation and Digital Health*
OSF HealthCare, Duane and Mary Cullinan Professor in Simulation Outcomes
Professor Clinical Emergency, Medicine University of Illinois College of Medicine at Peoria,
Clinical Professor BioEngineering, University of Illinois College of Engineering, Urbana Champaign

Dr. John Vozenilek is the vice president and chief medical officer for Innovation and Digital Health at Jump Trading Simulation & Education Center, a collaboration between OSF HealthCare and the University of Illinois College of Medicine Peoria (UICOMP). In this role, Dr. Vozenilek provides central coordination and oversight for undergraduate, graduate, interdisciplinary and continuing medical education programs for OSF HealthCare. Under his direction, OSF HealthCare and UICOMP have built resources for educators who wish to use innovative learning technologies for teaching and assessment. As the Duane and Mary Cullinan Professor in Simulation Outcomes, Dr. Vozenilek is actively involved in academic programs across traditional departmental boundaries and in clinical practice at OSF HealthCare. In addition to his role in simulation, Dr. Vozenilek teaches master's degree candidates in the fields of simulation, health care quality and safety and is formally appointed to teach biodesign at the University of Illinois at Urbana-Champaign.

4D Heart, the Next... Next Dimension in Medical Imaging

Matthew T. Bramlet MD,

» *Associate Professor of Clinical Pediatrics*
Director, Advanced Imaging and Modeling (AIM) Lab
University of Illinois College of Medicine at Peoria
OSF Children's Hospital, Peoria IL
Associate Professor, Bioengineering
University of Illinois Urbana Champaign

Matthew Bramlet, MD is a pediatric cardiologist directing the congenital cardiac MRI program at the Childrens Hospital of Illinois and the University of Illinois College of Medicine at Peoria. His success in congenital heart disease surgical planning through 3D printing led to the creation of the Advanced Imaging and Modeling (AIM) Lab within Jump Simulation which offers up free segmentation for programs seeking 3D modeling for pre-surgical planning of complex congenital heart disease. The AIM lab invented a virtual reality authoring capability to meet the needs of teams needing to rapidly convey complex 3D problems. He founded Enduvo, Inc. to transition the tool from a research model to a scaled solution. His current research at U of I focuses on machine learning models to automate segmentation of anatomic digital twins while also studying the efficiency and effectiveness of VR educational models.

Abstract

Background: The AIM lab has created approximately 500 anatomic digital twins for pre-surgical planning over the past decade. This expertise focuses the lab's research efforts onto solutions that decrease barriers to adoption of this next-generation imaging technology; mainly, automated segmentation. While 3D models of complex congenital heart disease provide significant treatment insights, in some cases, the dynamic nature of the heart characterizes the main clinical problem. Problem: manually segmenting a static 3D heart can occur within a clinical timeframe, while the ability to segment ~20, 3D hearts and stitch them together into a beating 4D heart remains a barrier. Manual segmentation is not a scalble solution. Solution: automating 3D anatomic digital twin generation from medical imaging is the key to unlocking the next generation of medical imaging analysis. In this project we create an automated beating heart segmentation pipeline to introduce 3D/4D anatomic digital twin integration into medical decision-making. Methods: Utilizing our extensive 3D cardiac anatomic digital twin database, we applied a uu-Net machine learning (ML) algorithm to train our CT automated segmentation tool. We then applied this method against retrospectively gated CTs and found that non-trained data emerged from the models exceeding expectations. Finally, we stitched the sequential models together in Blender for clinical review of a fully immersive 4D beating heart. Results: This methodology resulted in DICE scores over 90%. Quality of automated segmented models qualitatively exceeds human performance. While it took 10 years for the AIM lab to generate 200 models; within 2 weeks, this algorithm exceeded that number and more than doubled the number of hearts in our database. A complex congenital heart case was selected for congenital cardiac surgical opinion. 5 congenital heart surgeons were independently asked to provide a surgical plan based on 1) standard of care medical imaging and then 2) evaluation of the 4D heart. All 5 surgeons agreed that a 2 ventricle repair was the likely outcome from 1, but once presented with the 4D heart information (2) they universally agreed that a single ventricle step was likely. The patient underwent repair, and indeed, the single ventricle step was chosen. Conclusion: Dynamic cardiac complexities cannot benefit from 3D modeling without automated segmentation and stitching solutions. This niche use case represents the canary in the coal mine for standard of care medical imaging tools. Investment in 3D/4D anatomic digital twin technologies represents the next-generation of imaging post-processing advancements.

SEEG4D: Using VR to Improve Seizure Localization in Epilepsy

Brad Sutton, PhD

» *Professor, Bioengineering and Carle Illinois College of Medicine*
Technical Director, Biomedical Imaging Center, Beckman institute
University of Illinois Urbana Champaign

Brad Sutton holds a PhD in Biomedical Engineering from the University of Michigan after his undergraduate at University of Illinois Urbana Champaign in General Engineering. He is currently a Professor of Bioengineering, a Health Innovation Professor with the Carle Illinois College of Medicine, a CZ Biohub Chicago Investigator, and a fellow of NCSA. He also serves as the technical director of the Biomedical Imaging Center at Beckman Institute. He has over 180 peer reviewed publications and 9 patents in the development of medical imaging technologies. He is a fellow of the American Institute for Medical and Biological Engineering (AIMBE) and a fellow of the International Society of Magnetic Resonance in Medicine (ISMRM). Dr. Sutton's research is in the development of magnetic resonance imaging acquisition, reconstruction, and image analysis methods to understand brain function and dysfunction, along with developing methods to directly translate imaging data into actionable virtual reality objects for presurgical planning.

Abstract

Over 2.8 million adults in the US have active epilepsy with approximately 30% having uncontrolled seizures even with antiepileptic drugs. In drug resistant epilepsy patients, there are two intervention approaches approaches that have been shown to be effective: surgical resection and repetitive neural stimulation. Each of these approaches, require the care team to accurately localize the seizure onset zone (SOZ) to intervene at the source of the seizures. In challenging cases, stereoelectroencephalographic (SEEG) electrodes are placed deep in a patient's brain to record seizure and non-seizure activity over days in the clinic to help with identification of the SOZ. The epileptologist must review and integrate across the multimodal (MRI, CT, and SEEG) imaging data to understand the patient's condition and localize the SOZ prior to intervention. This task requires significant working memory load to integrate spatial and temporal information across modalities to create a 3D mental model of the patient. In addition, the epileptologist will need to communicate the surgical plan to the neurosurgeon and the rest of the care team. We are creating virtual reality models that integrate this multimodal clinical information into a patient-specific 4D model of seizure activity an non-seizure biomarkers. Our analysis pipeline automatically processes the CT, MRI, and EEG data to produce a presurgical VR model of the brain, recording electrodes, and activity to help visualize the seizure activity in the patient.

Medical Education Task Trainers for Neurological Examinations and Cardiac Surgery Procedures

Elizabeth Hsiao-Wecksler, PhD

» *Grayce Wicall Gauthier Professor,*
Mechanical Science and Engineering
University of Illinois Urbana-Champaign

Prof. Hsiao-Wecksler was the Interim Director of the HCESC from 01/21-08/23 and has been on the HCESC/Jump ARCHES Steering Committee since 2019. Her team received one of the two first Jump ARCHES grants in 2015. She is an Affiliate of CIMED, Neuroscience Prog, Center for Autonomy, Beckman, CSL, CHAD, CARD (Collaborations in the Advancement of Research on Disability), DRES, and departments of BIOE and ISE. She is Past President of the American Society of Biomechanics (ASB), a Fellow of ASME and ASB, and Associate Editor of J Med Dev. Her research interests are to investigate and improve the quality of life of individuals with disabilities through the development of assistive technologies and healthcare education task trainers by applying principles from user-centered design, robotics, control theory, and musculoskeletal biomechanics.

Abstract

I will share exciting news about our team's work related to developing medical education task trainers. These robotic trainers mimic different patient behaviors to help healthcare learners practice motor and haptic skills and improve their clinical techniques, which ultimately will improve patient treatments and outcomes. We have developed task trainers for practicing neurological exam assessment techniques for identifying types and severity levels of abnormal muscle behaviors in the arm (e.g., spasticity, rigidity, weakness), ankle (clonus, tendon reflex), and hand (weakness). A soft robotics trainer was developed to mimic the compliance and beating of the human heart to practice the cardiac procedure of transseptal puncture. These projects, which have been partially supported by the Jump ARCHES program, involve large teams of faculty and students across Grainger College of Engineering and OSF clinicians in neurology, physical & occupational therapy, and cardiology.

Design and Development of a High-Fidelity ECMO Training Simulator for Clinical Education

Anusha Muralidharan, MS

» *PhD candidate in Electrical Engineering at Cornell University*

Mrs. Muralidharan was a Simulation Engineer at the Health Care Engineering Systems Center (HCESC) at the University of Illinois at Urbana Champaign (UIUC) from 2018 - 2023. She received her Master of Engineering (M.Eng) in Bioengineering (May'18) from UIUC and Bachelor of Engineering (B.E) in Electronics and Instrumentation Engineering (April'17) from Kumaraguru College of Technology. During her time at HCESC, she led and contributed to a range of healthcare systems engineering projects. Her research included instrumentation and control for surgical training, device development and testing, physiology modelling and IoT.

Currently, she is pursuing a Ph.D. in Electrical and Computer Engineering at Cornell University. Her research focuses on near-field radio frequency (RF) sensing, time-frequency analysis, and noise and nonlinearity characterization in RF transceiver systems.

Abstract

Extra Corporeal Membrane Oxygenation (ECMO) is a complex and invasive life-support procedure used to resuscitate critically ill patients experiencing acute heart or lung failure. Often performed during cardiac or pulmonary surgeries, where ventilators are ineffective, ECMO temporarily takes over the function of the heart and lungs by oxygenating and circulating blood outside the body. However, the widespread adoption of ECMO has been limited by clinical unfamiliarity, particularly with respect to cannulation techniques and safe handling of ECMO equipment.

To address this gap in hands-on training and reduce the risk of errors during live procedures, we present a novel ECMO training simulator. This ultrasound-compatible system includes realistic features such as a phantom to simulate blood vessels, interchangeable cannulation pads, and a programmable pump connected to software that models and controls physiological flow conditions. The system allows simulation of critical clinical states creating a high-fidelity, immersive training environment. In this talk, we present the design of the ECMO training simulator and describe its current deployment in clinical training settings, and its potential to enhance ECMO training while preparing teams for high-risk, time-sensitive interventions.

Establishing Transfer Validity of a VR Umbilical Venous Catheter Simulation

Harris Nisar, MS

» *Research Engineer*
Health Care Engineering Systems Center
University of Illinois Urbana-Champaign

Harris Nisar is a Research Engineer in the Health Care Engineering Systems Center. Harris holds a BS in Bioengineering and an MS in Industrial and Enterprise Systems Engineering from the University of Illinois at Urbana-Champaign. After graduating, he worked at the Jump Simulation Center in Peoria as a Simulation Engineer. During his time in Peoria, he used 3D modeling, 3D printing, and software engineering for medical simulation. At the Health Care Engineering Systems Center, his main research is on mixed reality technologies, computer vision, human-computer interaction, and haptics. In particular, he is interested in how these areas can be used to improve patient intervention and healthcare professional training and is leading several projects towards these goals.

Abstract

Do the skills trained in virtual environments transfer to real life? This is an important question to answer as virtual reality (VR) has shown promising impact in the healthcare space with surgical simulators demonstrating both efficacy and cost effectiveness. This talk will aim to answer this question, particularly, in the context of the neonatal procedure known as umbilical venous catheter (UVC) placement, which is infrequently performed but highly emergent. The infrequency of performing these procedures may lead to skill atrophy and so having an effective method to refresh the skills and steps of the procedure is important. This talk will cover how we developed a VR simulator for UVC placement and established its validity and usability. Further the talk will describe how we compared the transfer of skills between traditional education modalities (video) and our VR simulator.

Point of Care Cancer Molecular Diagnostics: 30 Minutes from Sample-To-Answer in the Oncologist's Office

Brian T. Cunningham, PhD

» *Intel Alumni Endowed Chair Professor*
Department of Electrical and Computer Engineering
Department of Bioengineering
Department of Chemistry
Carl Woese Institute for Genomic Biology
Holonyak Micro and Nanotechnology Laboratory
Cancer Center at Illinois

Professor Cunningham's research interests include biophotonics, bionanophotonics, micro/nanofabrication processes & materials, Bio-MEMS, lab-on-a-chip, microfluidics, biosensing, and applications in drug discovery, health diagnostics, mobile point-of-use detection systems, life science research, environmental monitoring, animal health, and food safety. He has authored or co-authored over 200 peer-reviewed journal papers and holds 92 patents. He is most known for his invention and application of nanostructured photonic surfaces that efficiently couple electromagnetic energy into biological analytes, enabling high signal-to-noise sensing of materials that include small molecules, nucleic acids, proteins, virus particles, cells, and tissues.

Professor Cunningham is a Fellow of the Institute of Electrical and Electronics Engineers, American Association for the Advancement of Science, National Academy of Inventors, Optica, and American Institute for Medical and Biological Engineering. His work has been recognized through the IEEE Sensors Council Technical Achievement Award (2010) the Engineering in Medicine and Biology Society (EMBS) Technical Achievement Award (2014), the IEEE Sensors Council Distinguished Lectureship (2013), the IEEE Photonics Society Distinguished Lectureship (2018-2019), and the Feld Biophotonics Award (Optica - 2022).

Abstract

Cancer detection and management would benefit from routine, rapid, inexpensive and sensitive detection of biomarker molecules from noninvasively-obtained body fluids. Initial diagnosis, sub-type classification, therapy selection, therapy effectiveness monitoring, drug resistance monitoring, and remission monitoring represent situations of the cancer patient's journey that currently incur extensive delays and high costs that cause anxiety and barriers to healthcare access. Our driving goal is to put control of cancer diagnostics more directly into the hands of healthcare providers to provide targeted, actionable, and clinically relevant information while the patient is with their doctor. With support from the HCESC, we are developing a novel biomolecular detection platform technology that enables ultrasensitive "digital" resolution counting of cancer-related biomarkers that include micro-RNA, proteins, and circulating tumor DNA. Our biosensor detection approach, called Photonic Resonator Absorption Microscopy (PRAM), uses gold nanoparticle tags and a photonic crystal biosensor surface, in combination with novel biochemistry methods to overcome the limitations of existing laboratory-based methods. We are demonstrating limits of detection in the zeptomolar and attomolar concentration range with simple workflows that provide results in less than 30 minutes, while utilizing a small and inexpensive detection instrument with a cost of ~$500.

Non-adherence to Medications for Chronic Conditions: Intervention Refinement Using Big(ger) and Small(er) Data

Niteesh Choudhry, MD, PhD

» *Professor of Medicine, Harvard Medical School*
Professor, Department of Health Policy and Management, Harvard T.H. Chan School of Public Health
Executive Director, Center for Healthcare Delivery Sciences, Brigham and Women's Hospital

Dr. Niteesh K. Choudhry, MD, PhD, is a professor of Medicine at Harvard Medical School, professor in the Department of Health Policy and Management at the Harvard T.H. Chan School of Public Health, and executive director for the Center for Healthcare Delivery Sciences at Brigham and Women's Hospital, where he also a practicing hospitalist. He is also associate director of the Workforce Development Program and co-director of Dissemination and Implementation for Harvard's National Institutes of Health-funded Clinical and Translational Science Center (Harvard Catalyst). He directs two National Institute on Aging-funded research centers: the Roybal Center for Therapeutic Optimization using Behavioral Science, which is evaluating the impact of principle-driven interventions to improve medication adherence, and the Massachusetts Artificial Intelligence and Technology Center that fosters the development of AI-enhanced technologies to support healthy aging at home for older adults and individuals with Alzheimer's disease.

Much of Dr. Choudhry's current research deals with design and evaluation of novel strategies to enhance medication adherence and improve the quality of prescribing for common health care conditions such as heart disease and diabetes. He has led numerous pragmatic trials testing a variety of potential interventions to address these issues in partnership with large delivery systems and health insurers around the U.S. These include the use of financial incentives, pharmacist-led interventions, behavioral interviewing techniques, nudges, smartphone applications, and reminder devices. In ongoing work, he and his colleagues are testing the use of reinforcement learning to personalize text messages, electronic health record decision support, and health information technology tools.

Dr. Choudhry has also done extensive work attempting to predict which patients will ultimately become non-adherent to their prescribed therapies and why and when this will occur. He and his colleagues have applied and evaluated novel quantitative methods for clustering patients into longitudinal and dynamic adherence trajectories, shown their relationship to long-term clinical outcomes, and demonstrated the capacity to predict a patient's membership in each of these adherence trajectories with great accuracy. He has also explored the ability of novel data sources, such as retail purchasing information and electronic health record data, to improve the ability to predict future non-adherence.

Dr. Choudhry attended McGill University, received his MD, and completed his residency training in Internal Medicine at the University of Toronto. He then served as chief medical resident for the Toronto General and Toronto Western Hospitals. He earned his PhD in Health Policy from Harvard University with a concentration in Statistics and the Evaluative Sciences and was concurrently a post-doctoral fellow in Drug Policy Research at Harvard Medical School. His research has published over 300 papers in leading medical and policy journals and has won numerous awards for excellence in research, teaching, and mentorship.

Abstract

Non-adherence to evidence-based medications is exceptionally common and results in a substantial amount of preventable morbidity, mortality and health spending. Numerous interventions to improve have been tested but most have had only modest effect. In this talk, I will describe two inter-related challenges that must be overcome to improve the effectiveness of adherence interventions. First, we need "bigger" data that provides rich contextual information to accurately predict why patients are non-adherent and to what approaches they will respond. Second, we also need "smaller" fine-grained data to facilitate the application of temporally-precise interventions, especially those using mobile technologies.

The Future of mHealth: Wearable AI, Generative AI, and Just-in-time Adaptive Interventions

Santosh Kumar, PhD

» *Director, NIH mDOT Center*
Director, MD2K Center of Excellence
Lillian and Morrie Moss Chair of Excellence Professor in Computer Science
CEO & Co-founder, CuesHub, PBC

Dr. Santosh Kumar joined the Department in Fall 2006 after completing his PhD at The Ohio State University, where his dissertation was selected for the Presidential Fellowship award. In 2010, he was selected as one of America's ten most brilliant scientists under the age of 38 (called the "Brilliant Ten") by Popular Science magazine, becoming the first person in the Mid-South region to receive this honor. At the University of Memphis, he received an Early Career Research Award in 2008, the Faudree Professorship in 2011, and Distinguished Research Award in 2013. In 2015, he was promoted to full professor and named Tennessee's first chair of excellence in Computer Science. In 2021, he received an Alumni Association Distinguished Award for Academic Excellence by the College of Engineering at The Ohio State University.

Dr. Kumar's research focusses on mobile health (or mHealth). He and his students have developed Wearable AI to infer human health and behavior such as stress, stressful conversations, smoking, craving, brushing, flossing, and drug use from wearable sensors. His team has developed software platforms for smartphone, smartwatches, and cloud that has been used across the country for collecting 400+ terabytes of mobile sensor data from over 3,000+ human volunteers in their natural environments in health studies that are being used for developing foundation models for wearables.

Professor Kumar has led several large multidisciplinary projects in mHealth funded by both National Institutes of Health (NIH) and National Science Foundation (NSF), worth $50 million. As a leading expert on mobile health, Dr. Kumar is frequently invited to chair national meetings on mobile health and speak at national and international meetings in both computing and health. He has been co-organizing mHealth Training Institutes since 2011 to train young faculty in computing, engineering, medicine, nursing, and behavioral science to work in multidisciplinary teams to advance mHealth.

Abstract

For mHealth interventions to be effective, they must be delivered at the right time (when), with the right content (what), and in the right way (how). Wearable AI and Generative AI offer the strongest potential yet to address these three pillars, enabling engaging and efficacious interventions at the most opportune moments. Using the examples of smoking cessation and stress management, this talk will showcase recent progress and articulate a research agenda for further advancing both AI to truly realize this exciting vision. By transforming daily health behaviors, these advancements could improve our health, enhance job performance, strengthen relationships, and help curb the rising cost of healthcare—particularly given that chronic diseases and mental health conditions account for 90% of healthcare expenses.

Overview of Cluster in AI for Community Health

Jeffrey A. Woods, PhD

» *Mottier Family Professor, Director of the Center of Health, Aging and Disability*
Associate Dean for Research of the College of Applied Science
University of Illinois Urbana-Champaign

Professor Woods is currently a Professor of Kinesiology and Community Health with additional appointments in the Division of Nutritional Sciences and the new Carle-Illinois College of Medicine at the University of Illinois at Urbana/Champaign (UIUC). His expertise is in exercise physiology, and more specifically on the effects of exercise on the immune system, the gut microbiome, and aging.

He has mentored 30 graduate students, 2 post-doctoral fellows, and have received campus recognition for guiding undergraduate research. He has authored over 140 peer-reviewed scientific journal articles and has been a Principal Investigator or Co-Investigator on over $22 million of funded federal and industry sponsored research. He is an active Fellow of the American College of Sports Medicine (ACSM) and the National Academy of Kinesiology and past-President of the International Society for Exercise and Immunology, and current President of the PsychoNeuroImmunology Research Society. He served on numerous National Institute of Health (NIH) review groups, was Chair of the ACSM Research Review Committee, and has served as an Associate Editor for several journals in his field. He is currently the Director of UIUC's Center of Health, Aging and Disability and an Associate Dean for Research for the College of Applied Health Sciences where he plays a leadership role.

Scan for more
news

CONTACT

Health Care Engineering Systems Center
The Grainger College of Engineering
University of Illinois Urbana-Champaign

1206 W. Clark Street
Urbana, IL 61801

healtheng.*illinois.edu*
healthengsymp.*illinois.edu*

Follow hcesc

The Grainger College of Engineering
UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

Follow on social media: @hcescillinois
Facebook, X, linkedIn