2023 TTRN International Scientific Conference

An International Perspective on Building Capacity in Health Care through Technology

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Perspectives on Building Capacity in Health Care through Technology:

Highlights from the Transatlantic Telehealth Research Network (TTRN) 2023 International Scientific Conference

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TTRN Transatlantic Telehealth Research Network

CITRIS AND THE BANATAO INSTITUTE

AALBORG UNIVERSITY DENMARK

INNOVATION CENTRE DENMARK

ISfTeH Your Global Partner in Digital Health — International Society for Telemedicine & eHealth

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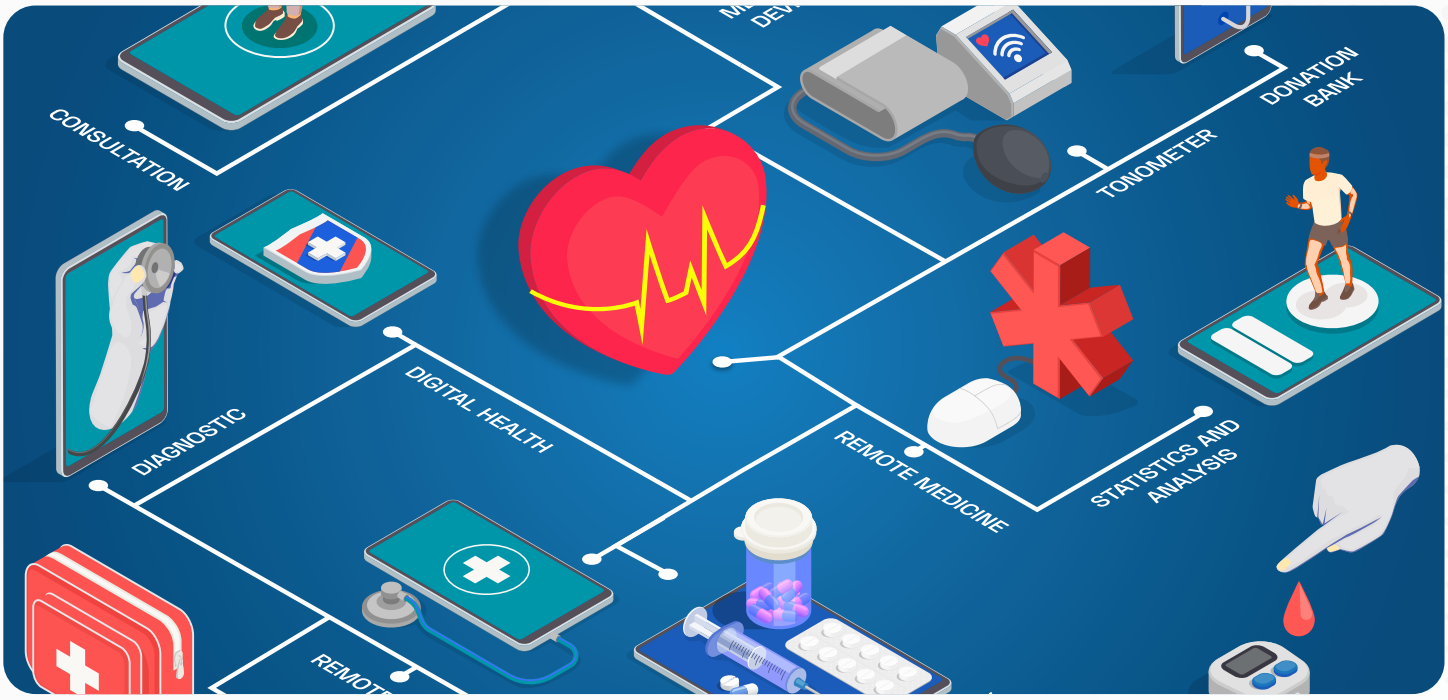
TABLE OF CONTENTS

EXECUTIVE SUMMARY



Despite the upheaval and excessive morbidity and mortality COVID-19 unleashed across the globe, the pandemic's silver lining was that it accelerated the use of telehealth and other digital health solutions. When these became the only alternatives to in-person care, institutions and governments suddenly found ways to accelerate digital health implementation, much faster and at much greater scale than would have seemed possible just a few years ago.

The 2023 Transatlantic Telehealth Research Network (TTRN) conference was full of examples of digital health's broader adoption and deployment as well as insights about what has been learned. Families of infants in neonatal intensive care units (NICUs) could interact with a bedside care team through a screen mounted on wheels, instead of traversing many miles or leaving a job hours before a shift ended. Cute AI-based social robots showed up in nursing homes, creating calm and sparking rare smiles among formerly aggressive or catatonic patients with dementia, and tele-operated mobile robots were used to reduce social isolation for children restricted to hospital or home with serious illnesses by representing them at their schools' recess and other events with peers. Elsewhere, a patient selected a bot to handle mental health triage or an epilepsy referral, connecting to appropriate care much faster than the inefficient maze that in-person referrals would have required. An app used sound waves to record urine flow, making a trip to the clinic unnecessary; another detected early manifestations of Alzheimer's Disease in recorded speech patterns. A breast cancer survivor wore a sensor embedded in an arm sling to provide early warning of lymphedema.

Young and old, urban and rural, with a range of conditions across multiple health settings and continents, these patients and their health care teams are exploring how digital health is changing health care. The 2023 TTRN conference brought their stories and insights to Berkeley, California, where 130 participants heard about digital health research, design, evaluation, and implementation challenges and opportunities.

Implications for the Health Care Workforce: Working Smarter, not Harder

The conference was organized around the theme of building capacity in health care through technology. Speakers described multiple options for deploying digital health technology to support the workforce and ease staff shortages, such as using artificial or augmented intelligence (AI), ChatGPT, robotics, and wearables to "work smarter, not harder." These innovations have been used to interact with patients, streamline clinical workflows, and provide education, training, and coaching for providers and teams. Despite numerous examples and research studies, though, the effects of these innovations on clinician time are poorly understood and rarely explored. Some interesting differences between patient and provider receptiveness to technology have emerged, with patients sometimes more open to digital health options than their providers, with intriguing differences across specialties. Technology is not a replacement for health care providers; instead, it can function as more of an adjunct that can contribute to meaningful improved outcomes for patients.

Telehealth Models and Implementation are Evolving Rapidly

The telehealth models featured at the conference addressed the health care needs of every age group, from infants to nursing home residents. Even hands-on specialties like physical therapy, physiatry and rehabilitation were offered as examples of effective digital health interventions.

Conference panelists highlighted the role of co-design in their innovations, involving both patients and providers in finding ways to make technology more engaging and useful. Online synchronous and asynchronous video consultations, web portals for patient education and self-care, gamification strategies to motivate patients, and on-demand care were all features that emerged from co-design strategies. Hospital at Home models, in which patients receive support to stay or recuperate in familiar and more comfortable surroundings at home, are just one of many examples of how technology can serve the needs of providers, health systems and patients simultaneously.

Assessing and Evaluating Telehealth Contributions Yields New Methods

How can we gauge the effectiveness of these innovative approaches to delivering care? Large Language Models (LLMs) offer opportunities to address challenges posed by vast volumes of data and interpreting data to inform translational health science research. Generative AI was described as the next-generation platform for diagnosing and treating patients, especially because most patients have very limited contact with health care providers. The effort to understand how and whether these interventions work as intended has led to innovations in collecting data, measuring outcomes, and assessing cost-effectiveness, as described by panelists sharing their evaluation approaches and findings. Several speakers commented on the urgent need to accelerate research on implementation, perhaps by adding more observational studies alongside more costly and time-intensive Randomized Control Trials (RCTs).

Health and Digital Equity are Closely Aligned

Health equity aligns closely with digital equity. As one speaker said, quoting the late Congressman John Lewis, "Access to the internet is the civil rights issue of the 21st century." In the United States, access to broadband is uneven, with serious implications for health care access and equity as more innovations rely on internet access. Despite the disparities in access, panelists noted that these can be overcome with investments in infrastructure, devices, and coaching and other support from staff and peers. From affordable senior housing communities to rural farmworker communities, researchers demonstrated that when these structural obstacles are addressed, the investments have the potential to yield huge dividends of trust between patients and providers, reductions in social isolation, and dramatic improvements in markers for chronic disease progression.

Looking Ahead

In the future, conference participants would like to explore how to get innovative ideas into health care systems and align with their revenue streams, along with more discussions about innovations in business models (such as open-source coalitions, public-private partnerships, and other approaches). In addition, identifying natural leaders or champions within institutions would be useful. Who are the internal innovators who can help diffuse digital health technology throughout organizations and systems?

Several speakers agreed that an ongoing challenge is the consistent demand on health care staff that leaves little time or bandwidth for exploring innovation, learning new technology, participating in research projects, and more. "Our biggest challenge," one reflected, "is that we don't have time to dream."

As one panelist said in closing, "It's not really transatlantic … it's not American, it's not Danish, it's not Chinese or any other nation. It's a global test that we have in front of us." Another speaker noted the potential global impact on climate change, through the reduction in carbon emissions secondary to the digitization of health care. At the next TTRN conference in 2025, panelists look forward to more questions answered, more models replicated and scaled up and out, more research methods and data sets deployed, and more innovation rippling through various systems—sparked and amplified by presentations and connections from the 2023 TTRN gathering of digital health innovators from around the world.

INTRODUCTION

The Transatlantic Telehealth Research Network (TTRN) 2023 conference was held in August 2023 at the University of California Berkeley's Sutardja Dai Hall, home to the Center for Information Technology Research in the Interest of Society (CITRIS) and the Banatao Institute. The conference brought together 130 researchers, health care providers, technology entrepreneurs and others from around the world, building on over a decade of partnership between colleagues in the United States and Denmark.

This summary provides highlights from the dozens of presentations that filled the two days of the conference. It is intended to capture the flow of ideas and resources for those who wish to refer to them in the future, as well as to spark additional collaborations and connections across organizational walls, sectoral siloes and national boundaries.

The summary is organized according to overlapping themes: training and practice implications for the health care workforce; telehealth models for specific age groups (particularly children and older adults); program models and their implementation; assessing and evaluating telehealth contributions; and presentations centered on digital equity.

Finally, reflections on the current state of telehealth and next steps that closed the conference also close this summary. Keynote talks are designated with a key icon, while panel presentations are designated with a group of silhouettes.

For a full list of presentations and speakers, please see Appendix A and note that the summaries below group the talks thematically, in a different sequence than the conference itself.

Implications for the Health Care Workforce

Easing Staff Shortages through Digital Health

Birthe Dinesen, MSc, PhD

Birthe Dinesen, MSc, PhD, Professor in the Department of Health Science and Technology at Denmark's Aalborg University, also leads the University's Laboratory for Welfare Technologies-Digital Health & Rehabilitation. Citing a World Health Organization (WHO) Workforce 2030 report projecting health care workforce needs, Dr. Dinesen noted the authors' forecast of global shortages by 2030 across regions of the world for physicians, nurses, and other providers. The question before us, Dr. Dinesen said, is whether existing digital health technology will be able to ease these staffing shortages. She reviewed several opportunities to do so:

- **Digital technology and Artificial Intelligence (AI).** A recent review of progress and applications of digital technologies in healthcare identified multiple settings (hospitals, laboratories, clinics) and uses (education, research, data and billing management).[1] Dr. Dinesen highlighted the importance of directing these resources to the patients most in need, while also helping health care professionals work smarter and not harder.
- **ChatGPT.** Summarizing findings from another recent paper,[2] Dr. Dinesen noted the many advantages and applications of ChatGPT in medicine, including as virtual assistants for telemedicine, clinical decision support, medical record keeping, disease surveillance, medical writing, patient triage, medical education, mental health support, and remote patient monitoring. These are paired with some limitations and ethical concerns, including medico-legal complications and the potential for inaccurate, biased, and/or harmful results.
- **Robotics.** Robotic Process Automation (RPA) uses a software robot to make multiple information technology (IT) application connect so they can seamlessly transfer data, making administrative workflows more efficient. Android robots, developed by Professor Yoshio Matsumoto at the University of Tokyo, are showing potential for communication with patients, among other scenarios.
- **Wearables.** Wearables (such as FitBits) are being tested for telerehabilitation of patients with atrial fibrillation and other heart conditions. These types of tools, Dr. Dinesen emphasized, have the potential to empower patients when they are used as teaching tools. They also have the potential to lead to social support as patients join in communities of practice, as shown in an early pilot study conducted by Dr. Dinesen and her colleagues in Denmark.

Dr. Dinesen closed her remarks by urging fast-track implementation, with both senior management and political support, to bring these promising technologies to more patients and providers in the near future.

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1 Senbekov M, Saliev T, Bukeyeva Z, et al. The recent progress and applications of digital technologies in healthcare: a review. *International Journal of Telemedicine and Applications*. 2020. Accessed via: https://doi.org/10.1155/2020/8830200.

2 Dave T, Athaluri SA, Singh S. ChatGPT in medicine: An overview of its applications, advantages, limitations, future prospects, and ethical considerations. *Front. Artif.* Intell. 2023;6. Accessed via: https://doi.org/10.3389/frai.2023.1169595.

Hybrid Care: The New Normal for Psychiatry Leads to Improved Provider Well-being and Global Workforce Capacity

Peter Yellowlees, MBBS, MD, CEO of AsyncHealth Inc., linked the role of technology in health care with another urgent global issue: accelerating climate change. Dr. Yellowlees reviewed the many ways the COVID pandemic created a forced experiment. "It has done many things to us," he said, "but the most important is to drive innovation, particularly in asynchronous care." He worries that as we emerge from COVID, some of these innovations are already eroding as providers and systems slip back into former ways of delivering care.

Adverse effects of COVID on clinicians include grief and loss, moral injury, burnout, and isolation, which have combined with other stressors to contribute to the "great resignation" among health care providers. Positive effects, he noted, include more flexibility due to being able to work from home, time and cost savings that improve quality of life and teamwork, and a move to hybrid care that combines aspects of in-person and remote care, benefitting both patients and providers.

Peter Yellowlees, MBBS, MD

An underappreciated and important positive impact of shifts to hybrid care, Dr. Yellowlees noted, is its environmental impact. In a University of California Davis study tracking 3 million patients over a 2-year period (during COVID), savings included 50 million miles traveled, $3 million in costs, and an estimated avoidance of 40 accidents from the miles not driven. "Climate change is going to be the new COVID," Dr. Yellowlees warned.

A useful, instructive model, Dr. Yellowlees suggested, is the online retail experience that is focused on consumers, offers them many more options, is generally trusted, and provides ongoing monitoring and feedback. The convenience, trust, choices, and feedback are the very same features patients would like to experience in health care, but do not. That's where Dr. Yellowlees' efforts to create apps for asynchronous care are focused. He hopes that asynchronous models of care, combined with augmented intelligence (his preferred term for artificial intelligence, or AI), will allow virtual home visits and other useful features of hybrid care, eventually becoming the new normal. This development would not only contribute to addressing climate change, but also would be beneficial for both providers and patients.

The Effects of Telemedicine on Clinician Time: A Blind Spot in Research

Kristian Kidholm, PhD, Professor and Head of Research at Odense University Hospital's Center for Innovative Medical Technology and the University of Southern Denmark, noted the health care staff shortages affecting countries and organizations all over the world, including his own hospital in Denmark. Like colleagues elsewhere, Dr. Kidholm and his team are hopeful that digital health technology may reduce demands on clinician time. Indeed, he and other researcher studied a program that moved premature infants to home care, reducing hospital bed days by an average of 12 days per infant while maintaining good clinical outcomes.

Successes like these are rare, however; most studies emphasize increased workloads for health care providers as the most frequent barrier to adoption of digital health interventions. Indeed, a recent piece published in the *British Medical Journal* argued that clinical guidelines should consider clinicians' time needed to treat (TNT) not just for one patient but to implement the recommendation for all eligible patients (absolute TNT). Using the latter, fuller measure would show how additional nurse and physician hours are required for a population of eligible patients.

Kristian Kidholm, PhD

Since measures like absolute TNT are rarely considered, the researchers conducted a brief review of RCTs to assess the degree to which clinical trials of telemedicine assess their impact on clinicians' time. Of 79 studies published between 2012-2022 that measured clinician time as a direct or indirect measure, 54 met the criteria, but only 6 studies (11 percent) measured these effects as a primary outcome. (Another 11 studies did include effects on clinician time as a secondary outcome.) As Dr. Kidholm noted, telemedicine is often expected to have an impact on clinician time, but studies generally do not assess this. In fact, telemedicine may in some cases actually increase the use of clinician time, by increasing the number of false positive screening results or otherwise increasing access to care. [3]

By incorporating a focus on clinician time into the design as well as the assessment of interventions, Dr. Kidholm believes the need for clinician time could be reduced and the value of digital health services improved. Until the blind spot is addressed by addressing clinician time as a primary or secondary outcome, however, we will continue to miss opportunities to improve implementation and convince providers that these solutions offer real value that is worth the investment of their time.

3 Kidholm K, Jensen LK, Johansson M, Montori VM. Telemedicine and the assessment of clinician time: a scoping review. *International Journal of Technology Assessment in Health Care*. 2024;40(1):e3. doi:10.1017/S0266462323002830.

Current State of Technology and the Need for Training and Educational Initiatives in Telehealth

Frederic Lievens, MSc, Vice Executive Director of the International Society for Telemedicine & eHealth (ISfTeH), drew amused chuckles from conference participants as he shared the familiar sing-song tones of a dial-up modem waiting to connect. Just like broadband connectivity today, he noted, connectivity is essential for all the telehealth advances being discussed throughout the conference sessions but cannot be assumed to be a given.

Even 20 years ago when dial-up was the standard, telehealth was already being deployed. Mr. Lievens shared images of tailor-made boxes then common in the marketplace. Most have disappeared. The boxes no longer made sense once the cloud made it possible to connect common consumer devices like smartwatches, phones, and tablets, providing the same services with much less bulk. In addition, he explained, the market wasn't quite ready for these devices, and in many ways, we're still not there yet.

Mr. Lievens shared a chart showing the time in days that it took various online services to reach 1 million users. Netflix, an early service, took the longest: about 1,250 days. Kickstarter, Airbnb, and Twitter reached the milestone between 500 and 1,000 days, while Foursquare, Dropbox, Spotify, and Instagram did so faster and faster, moving from a year to just weeks. ChatGPT got there in 5 days. Mr. Lievens said that this shows AI's potential. After all, he observed, "AI doesn't get tired or have a bad day; it performs as well in the evening as in the morning." All of this makes it a useful tool for telehealth, but it might still be overvalued (similar to the dot.com bubble of the past).

Mr. Lievens' organization, which provides both networking and specific services related to telehealth (such as compliance support, accreditation, and endorsements of educational and training programs), receives frequent requests from its member organizations for more training and education in telehealth. He and his colleagues are working on developing more online courses tailored to members' needs. He urged TTRN participants to join the ISfTeH network, participate in its upcoming events, reach out with questions or collaboration ideas, and consider submitting current research papers (whether presented at TTRN or not) to the organization's journal.

Membership applications can be found on the ISfTeH website, www.isfteh.org/members/how_to_join, along with information on submitting journal articles.

TELEHEALTH MODELS FOR SPECIFIC AGE GROUPS: CHILDREN AND OLDER ADULTS

Leveraging Telehealth Interventions to Better Serve Children's Hospitals and Communities

This panel was moderated by James Marcin, MD, MPH, with presentations from UC Davis colleagues Jennifer Rosenthal, MD, MAS; Veronica Ahumada-Newhart, MEd, PhD; and Sarah Haynes, PhD, MPH.

Jennifer Rosenthal, MD, MAS

Dr. Rosenthal, an Associate Professor in the Department of pediatrics at UC Davis Children's Hospital, described virtual family-centered rounds as a powerful way to promote digital health equity in pediatric care settings. Family-centered rounds are multidisciplinary bedside conversations about an infant's progress and care plan in the Neonatal Intensive Care Unit (NICU). They are considered best practice in pediatric NICU care because active engagement with the family leads to benefits for patients, parents/caregivers, and providers through an improved parent experience, reduced parental anxiety, improved provider teamwork, and shortened hospital stays.

However, these benefits are out of reach for families who cannot be physically present at an infant's bedside due to work, transportation, or other constraints. Dr. Rosenthal and her colleagues tested the feasibility of virtual family-centered care visits to increase access for families otherwise unable to engage in this way.

Their results were promising. The virtual visits were technically feasible (using a video monitor on wheels at the bedside) and did not increase the duration of rounds. Parental attendance improved by a factor of 3.4-fold. Post-hoc analyses found that virtual family-centered rounds reduced attendance disparities based on race/ethnicity, education, and neighborhood health conditions. For example, the intervention effect was more than 2 times more beneficial for racial/ethnic minorities than for non-Hispanic White subjects, mitigating the inequity in minority attendance relative rates. Similar patterns held for those with whose mothers reported no college education compared to those with some college education, as well as for those from a neighborhood with worse health conditions than those with better conditions.

> **"We can't blame *everything* on broadband. There are a lot of system things we had control over."**
>
> **Jennifer Rosenthal, MD, MAS**

Dr. Rosenthal encouraged the use of mixed-methods evaluations using implementation science frameworks to learn more about the nuances of factors affecting uptake. Future

plans include parent advisory boards and extending the project to other settings beyond the NICU. Lessons learned from the virtual family-centered rounds study also can be applied to other telehealth services, including ambulatory video visits.

"We can't blame everything on broadband," Dr. Rosenthal concluded about enhancing the reach of telehealth innovations. "There are a lot of system things we had control over." These included offering materials in diverse languages, offering more tech support to patients to mitigate digital literacy barriers, offering digital navigators, and creating user-friendly dashboards to monitor progress in digital equity efforts. In response to a question from the audience, Dr. Rosenthal also emphasized the importance of co-designing these programs with those who will use and deliver them. "My own ideas," she acknowledged, "flopped and failed!" However, she added, co-designing programs with patients, families, and frontline providers is critical to optimizing the relevance and useability of digital tools.

Sarah Haynes, PhD, MPH and Veronica Ahumada-Newhart, MEd, PhD

Dr. Ahumada-Newhart, Director of the Technology and Social Connectedness lab at UC Davis and an Assistant Professor in the School of Medicine, shared the results of a project piloting an online, synchronous, physical fitness class that was delivered via the Zoom platform to help create a sense of community and promote physical and mental wellness. Zoomba (a combination of Zoom and Zumba®) was offered by UC Davis School of Medicine faculty during COVID, building on work being done with telepresence robots who helped children restricted to their homes as a secondary consequence of illness. For example, children unable to attend school in person due to treatment for leukemia could attend classes and interact with peers and teachers through their robots.

In the Zoomba study, the team analyzed survey responses from 51 participants who reported on their motivation, perceived health benefits, relevant technologies, and demographics. Instead of asking participants to check a race/ethnicity box or category on the survey, the team invited self-reported descriptions, yielding a great deal of variety (e.g., multiple nationalities in the "Asian" category; many variations of multiracial identities). The participants were generally motivated to pursue their fitness goals using the technology and perceived benefits to their cardiovascular, mental, and musculoskeletal health. They did report challenges such as not receiving individual feedback on their performance and not being able to see whether their movements matched others in the classes, but these did not affect their participation.

Findings from this work provide preliminary support for the use of online platforms to facilitate synchronous fitness classes and deliver mental and physical activity interventions for health care workers during times when there is high risk of infection and increased clinical workload.

Dr. Haynes, Assistant Professor in the Department of Pediatrics at UC Davis, described a pediatric rehabilitation program that offered a comparison between hybrid and all-virtual approaches during

the COVID-19 pandemic. The School-based Tele-physiatry Assistance for Rehabilitative and Therapeutic Services (STARS) program is an attempt to increase access to physiatry services offered through California's medical therapy program for children with physical disabilities. Children with cerebral palsy, brain injury, muscular dystrophy, multiple sclerosis, amputation, stroke, spinal cord injury, and other conditions benefit from pediatric physiatry treatments such as physical and occupational therapy.

In California, physiatrists travel to 125 school-based Medical Therapy Units (MTUs). For some physiatrists and families, the existing MTUs are hard to reach: 21 California counties have just one MTU, while 16 counties have none. The STARS program offered telemedicine carts and support to MTUs so that physiatrists could provide specialty consultations via telemedicine, working with therapists on-site at the MTU with families and children. When the COVID-19 pandemic required a shift to all-virtual visits, the program onboarded new sites and began three-way Zoom video consultations with parents/patients, physiatrists, and therapists.

To assess the program's implementation, the team used the Practical, Robust Implementation and Sustainability Model (PRISM) framework to measure program outcomes and context. Using findings from surveys and focus groups, the team concluded that physicians believed the care quality of telemedicine visits in a hybrid model equaled the care they could provide in person for the vast majority of visits; therapists shared this view. Parents reported no differences in their experiences. Comparing an all-virtual model to in-person care, physicians were significantly less confident that the quality of care was equal and therapists reported even lower quality of care for visits. The qualitative data revealed that these lower perceptions of quality for all-virtual models were mainly due to the difficulty of conducting a high-quality physical exam. Again, parents did not report differences in their experiences.

Among seven MTUs in counties that adopted the hybrid model (virtual and in-person), three had high adoption rates, most likely because the average driving distance for a physiatrist to reach them was over 100 miles, compared to 45.6 for those that did not adopt the telemedicine MTU program. Factors that contributed to successful adoption included training with therapists in advance and establishing a relationship between parent and physician first, before turning to virtual visits. Despite preferences for the hybrid approach, respondents agreed that in some cases, all-virtual visits may be preferable, especially in situations where the therapist can observe features of a home environment that are relevant to treatment. Ten of the participating sites have completed sustainability plans to continue refining this approach.

Building Technology Capacity in Aging and Brain Health: An End-to-End Approach

This panel was moderated by Allison Sekuler, PhD, with additional presentations from Raquel Meyer, PhD, RN and Morris Freedman, MD, FRCPC, all affiliated with Baycrest Seniors Care in Ontario, Canada.

Dr. Sekuler provided the organizational context for the research shared during the panel presentations. Ontario-based Baycrest Seniors Care, she explained, is "all things aging." It includes a 300-bed hospital serving 1,500 older adults daily with care for complex medical and mental health

needs, rehabilitation, advanced dementia, and comprehensive ambulatory care, as well as end-of-life and palliative care. Three residential settings—ranging from a nursing home; supportive living, assisted living, and memory care; to fully independent senior living—offer integrated programs in aging and brain health, drawing from the research and innovations generated by affiliated Baycrest entities.

A consulting arm, Baycrest Global Solutions, shares senior care practices and standards around the world. The Baycrest Academy for Research and Education (the Rotman Research Institute), where Dr. Sekuler is President and Chief Scientist, convenes researchers to work on cognitive and sensory neuroscience, aging and brain health, Alzheimer's and related dementias, neuroinformatics and computational neuroscience, and translational research. The Centre for Aging and Brain Health Innovation (CABHI), which Dr. Sekuler also leads, has launched 359 projects across 130 unique trial sites, leveraging funding, research, and partnerships with clinicians and end users to design and implement solutions related to aging and brain health.

One of the innovations developed through this pipeline is an evidence-based simulation game: the Learning Inter-Professionally Healthcare Accelerator (LIPHA). Dr. Meyer, representing the Baycrest Academy for Research and Education, explained that LIPHA was developed in response to a gap between the staffing demands of the long-term care sector and the slow pathways to supply new nurses and care aides through local training and education facilities. In addition, long-term care settings had limited onboarding capacity. In particular, it overcomes barriers such as high turnover, lack of preceptoring capacity, infrastructure, and gerontological content in existing institutions, while appealing to students, 90 percent of whom are gamers.

The LIPHA simulation presents real-world problems and scenarios using simulated cases, quests, and scenarios in which learners can practice and master communication and care planning skills, as they are rewarded for problem solving that promotes relational care, safety, and teamwork. So far, LIPHA has delivered improvements in perceived knowledge, skills and confidence; high rates of learner satisfaction and intent to recommend; increased interest in aging care; improved study habits; and immediate application of learnings in practice.

Dr. Freedman, representing the Rotman Research Institute's Baycrest Academy for Research and Education, described the Virtual Behavioral Medicine (VBM) program, developed through Baycrest Health Sciences, the Rotman Research Institute, and University of Toronto. The inpatient Behavioural Neurology Unit at Baycrest, Dr. Freedman explained, focuses on treating agitation and aggression in dementia, but had a long waiting list for its 20 beds. For some patients, the wait for treatment can take up to a year. Referrals to the program involve disruptive and sometimes dangerous behaviors such as hitting, kicking, pushing, throwing things, scratching, and screaming, so the long wait times create prolonged difficult situations for family members and care teams.

A pilot program used VBM to assess and treat patients on the unit's waitlist. It was designed to be virtual because it was difficult for patients to visit the memory clinic. In effect, VBM functions as a virtual inpatient behavioral health unit. Dr. Freedman developed a 7-point rating scale to document the severity of a patient's neuropsychiatric symptoms, from needing admission with various levels of physical aggression or other behaviors to potentially or definitely not needing admission. Initially, 82 percent of patients referred to the unit were clearly in need of admission to the inpatient unit. However, after treatment through the VBM program, only 18 percent were. This constituted a 78 percent reduction in the most acute admission categories. Within several months, the waitlist was eliminated. Currently, the waitlist to enter the inpatient unit is zero, but the VBM program itself has a 2-week wait.

Dr. Freedman believes that this virtual program, which preceded COVID, is a scalable model with demonstrated success in reducing the need for admission to specialized behavioral units. By focusing on treatment of neuropsychiatric symptoms in dementia (particularly agitation and aggression), the VBM program achieved dramatic results relatively quickly, which Dr. Freedman shared in before-and-after treatment videos of a patient. More details and findings are available from a recent journal article by Dr. Freedman and his colleagues in the *Journal of Alzheimer's Disease*. [4]

Global Models for Telehealth Delivery for Older Adults

David Lindeman, PhD, Executive Director of CITRIS Health and Director of the Center for Technology and Aging, moderated this panel, which featured presentations from Liane Wardlow, MS, PhD, Senior Director of Clinical Research and Telehealth at West Health Institute, and Michael Kurliand, MS, RN-BC, Vice President of Clinical Quality and Integration at MedWand Solutions, Inc. Frederic Lievens, MSc, representing the International Society for Telemedicine and eHealth, served as discussant for the panel.

Dr. Wardlow described the Center of Excellence for Telehealth and Aging (CE4TA), a collaborative formed during the pandemic to advance remote care for older adults and develop telehealth principles and guidelines for providers and health systems serving older adults. Inaugural members included the West Health Institute, University of Virginia (UVA) and Mid-Atlantic Telehealth Resource Center, who have now been joined by several dozen organizations representing health systems, researchers, schools of medicine, start-ups, and associations focused on geriatrics and gerontology.

Echoing other speakers, Dr. Wardlow described how the "COVID effect" spurred the adoption of telehealth and improved attitudes towards its use. Before the pandemic only 20 percent of adults 65 and older had ever used a health app and only 4 percent of them had ever participated in a telehealth visit. Within a year, these indicators had jumped dramatically, with 92 percent of older adults using virtual care during the pandemic and 30 percent participating in a telehealth visit.

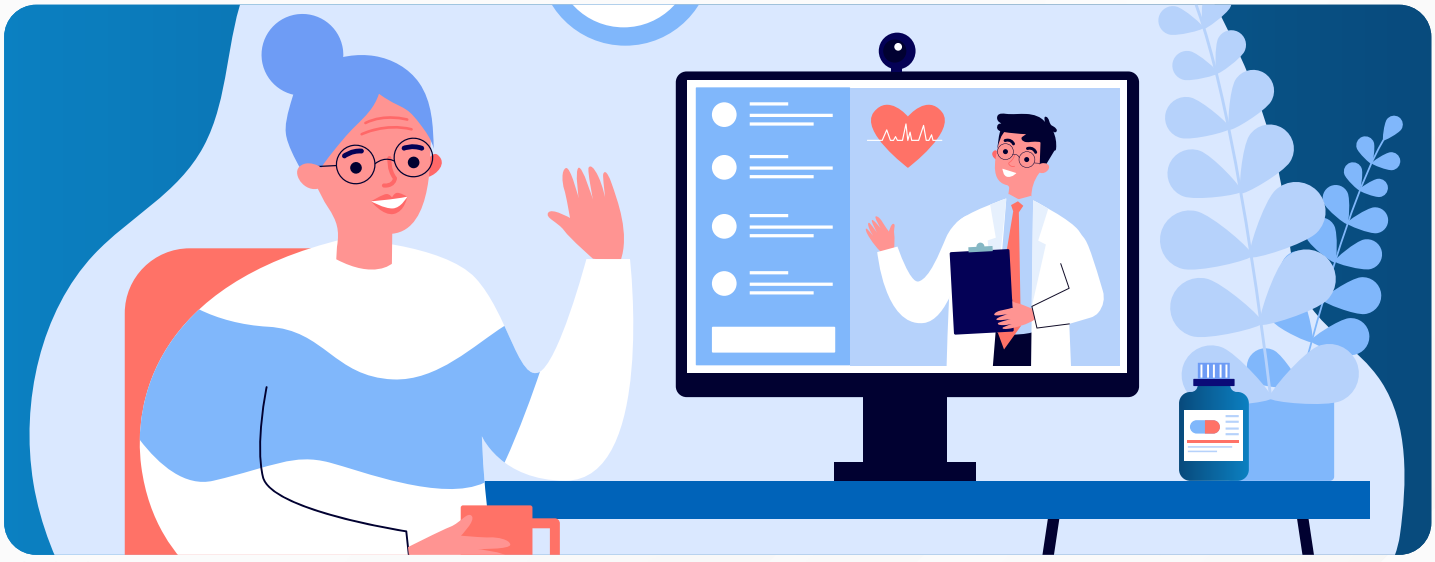
Despite these increases, many older adults and the providers who care for them remain "unready"

4 Freedman M, Binns MA, Serediuk F, et al. Virtual behavioural medicine program: a novel model of care for neuropsychiatric symptoms in dementia1. *Journal of Alzheimer's disease*. 2022;86(3):1169–1184. Accessed via: https://doi.org/10.3233/JAD-215403.

for telehealth. Patients often have difficulty hearing well enough to use a telephone, may have problems speaking and seeing screens, and/or contend with cognitive declines such as those associated with dementia. For the presenters and their colleagues, making telehealth systems, programs, and technology age-inclusive is imperative. CE4TA's principles and guidelines for telehealth and aging take these issues into account by emphasizing three main principles, each associated with additional detailed guidelines: equitable and accessible, person-centered, and integrated and coordinated programs and services.[5] Organizations are invited to join this effort by signing a pledge of support for age-inclusive telehealth practices. [6]

Mr. Kurliand shared examples of several telehealth models that are following these principles. Northwell Health's Telehealth Physician Extender Model has allowed providers to complete up to 10 visits per day (in comparison to half that amount with traveling providers) by deploying mobile telehealth technicians to patients' homes to support patients with equipment and connections to the primary care provider. Medically Home provides tools for decentralized care for patients with serious, complex or high-risk illnesses and is now being used by healthcare systems in 17 states to care for over 22,000 patients. The service has high rates of patient satisfaction, with 95 percent of patients saying they would recommend it to others, and is integrated with electronic health records. MedWand Solutions offers remote patient exams (RPEs) for post-acute and long-term care to prevent potentially preventable hospital readmissions. Care Coach uses avatars and video visit applications to integrate multidisciplinary teams and services, such as pharmacy, home care, rehabilitation, social work, dietitians, and behavioral health.

Following these examples, Frederic Lievens, MSc, Vice Executive Director of the International Society for Telemedicine & eHealth (ISfTeH), described similar efforts in Europe to fund and launch telehealth innovations to support health and active aging. These include the AAL Programme, which has deployed EU funding towards over 300 projects since 2008, the European Innovation Partnership on Active and Health Aging, the European Active and Healthy Living Coalition, and the International Interdisciplinary Network on Health and Wellbeing in an Age-friendly Digital World (Net4 Age-Friendly).



5 For a downloadable PDF of the principles and guidelines, visit CE4TA's website: https://ce4ta.matrc.org/principle-and-guidelines/.

6 To sign the CE4TA pledge, visit https://ce4ta.matrc.org/pledge/.

Barriers and Facilitators for Digital Health Technologies

Martin Vesterby, MD, PhD is the Head of Clinical Impact for Copenhagen's Health Tech Hub and also holds an appointment in the Department of Clinical Medicine at Aarhus University. Dr. Vesterby opened his talk with a question: Are health care providers playing a role as barriers or facilitators for the implementation of digital health technology? Citing a 2013 study published in the *Journal of the American Medical Association*,[7] Dr. Vesterby described overconfidence among physicians regarding their diagnostic capabilities—a gap that unfortunately (and dangerously) increases with the difficulty of the case and is replicated in other studies.

Given that technology innovations in the health care sector often begin by asking clinicians what they need, Dr. Vesterby wondered, should we think more critically about whether clinicians truly know what's needed? Questioning assumptions might require, for example, getting out of the hospital or clinic and collecting data on needs from a patient perspective, shifting the conversation about where value is truly added.

The so-called "iron triangle" requires trade-offs among improving quality, reducing costs, and expanding access (i.e., achieving all three simultaneously is not possible). In Dr. Vesterby's view, this is a pessimistic and limited interpretation. Far more data are now available to evaluate each of these points of the triangle, allowing for different conceptions of sustainability and scalability. Examples include health economics, cost minimization, and work sequence analyses that inform cost considerations; end-user, societal, and payer data that inform access; and real-world data trials, randomized clinical trials (RCTs), and observational studies that yield insights about quality. Instead of the iron triangle, Dr. Vesterby proposes the REMIS framework, which moves from a triangle of trade-offs to a Venn diagram with significant overlap across these domains: Reduce cost, Expand access, become More sustainable, and Improve quality, at Scale.

Returning to the question he posed at the outset, Dr. Vesterby concluded by saying that clinicians can serve as facilitators. Doing so, however, will require connecting to the "why" of their roles, at the heart of what drove most to be clinicians in the first place. Their medical expertise, Dr. Vesterby said, is still central, but is in service of integrating many other roles: as a communicator, collaborator, leader, health advocate, and scholar, among others.

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7 Meyer AND, Payne VL, Meeks DW, Rao R, Singh H. Physicians' diagnostic accuracy, confidence, and resource requests: a vignette study. *JAMA Intern Med*. 2013;173(21):1952–1958. Accessed via: doi:10.1001/jamainternmed.2013.10081.

Converting Existing Health Care to Technology vs. Exploring Technology's Innovative Potential

Helle Spindler, MSc, PhD, is an Associate Professor in the Department of Psychology and Behavioral Sciences at Aarhus University in Denmark. Echoing other speakers, she noted COVID-19's impact on health care. As services were converted to continue providing care, she observed, we did not pause to consider what might be done differently, in more innovative ways.

"We all agree on what we want: the right care for the right patient," she said. But standardized, one-size-fits-all care does not lead to this outcome, she continued, referring to a common image used to show how trying to meet different needs with the same solution can perpetuate or even exacerbate inequalities. Instead, she suggested, we should be designing platforms and interventions that are more personalized, meeting the needs of specific patients and clinicians so they are more able and motivated to work together to achieved shared health aspirations. When digital technologies make sense and are more engaging, then the chance that they will be adopted, used, and sustained are much higher.

Encouraging examples of this approach include:

- Online video consultation. In Denmark, Dr. Spindler explained, general practitioners use an app (Min Læge) for online consultations with specialists, either in real time or with a slight time lag (via email). A similar approach is used in Greenland to overcome geographic distances and scattered access to providers, including virtual exams.
- Web portals for patient education and self-care. Dr. Spindler described a pilot study she had been involved with that sought to increase self-care and self-management via telehealth access to overcome barriers for patients in need of rehabilitation. The researchers found patients to be just as motivated by the telehealth version as by in-person attention, but surprisingly felt more supported and connected in the telehealth version. They also were able to educate patients in using their own data (for example, noticing that a decrease in their number of steps might be correlated with a bit of weight gain).
- Gamification. To stimulate and maintain motivation, researchers used gamification to support cardiac rehabilitation by creating teams of a patient and a partner. The teams take on daily challenges and compete against one another. The approach was motivating, but Dr. Spindler noted that care must be taken to match the challenges to patient capacity so they are not discouraged.
- On-demand care and appointments. For a telesocial rehabilitation program for people experiencing mental illness, a user-friendly video connection was available to speak with a social

worker without a set appointment, whenever the patient wanted to talk. The patients did not consume more resources; in fact, some who had been consuming a lot of staff resources became more empowered and were able to achieve some life goals and more independent daily living. Overall, patients felt safer (because they were at home) and more supported.

In conclusion, Dr. Spindler highlighted the need to engage both patients and providers to come up with the best solutions, especially engaging patients early in the design process. When co-creation and participatory design are incorporated, as in the examples she shared, it can lead to better outcomes as well as more efficient use of scarce clinical resources.

Barriers and Facilitators for Implementation of Health Technology

This panel was moderated by Peter Yellowlees, MBBS, MD with presentations from Nupur Hajela, PT, DPT, PhD; Annalicia Pickering, MD; and Laurine Dargaud, MSc.

Dr. Yellowlees, CEO of AsyncHealth, Inc., described the AsyncHealth TeleTriage Tool (AT3) that his company has developed. AT3, Dr. Yellowlees explained, addresses the problem of demand from too many patients exceeding the capacity of too few mental health providers, leading to long waitlists, over half of patients receiving either no treatment or the wrong treatment for their situation, and extremely high costs (over $100 billion per year) of untreated mental health conditions in the United States alone.

Instead of the complicated workflow that is a hallmark of our inefficient, wasteful health system ("You couldn't make it more complicated if you tried really hard," Dr. Yellowlees commented), the AT3 workflow triages patients digitally to the right level of care, saving time (as much as halving psychiatrist time per patient) and improving the clinical experience (www.asynchealth.com). The streamlined process is a digital form of the "front-door" triage that is common in emergency departments and military settings. Initially tested for mental health triage, Dr. Yellowlees believes this approach has potential for many other disciplines. A key feature is the asynchronous nature of the triage tool, so that patients and clinicians do not have to communicate at the same time; this is well accepted by both providers and patients across different settings.[8]

Dr. Yellowlees described how the digital triage tool works. The patient receives a link directly from

8 Chan S, Li L, Torous J, Gratzer D, Yellowlees PM. Review of use of asynchronous technologies incorporated in mental health care. *Current Psychiatry Reports*. 2018;20(10);85. https://doi.org/10.1007/s11920-018-0954-3.

Yellowlees PM, Parish MB, Gonzalez AD, et al. Clinical outcomes of asynchronous versus synchronous telepsychiatry in primary care: randomized controlled trial. *Journal of Medical Internet Research*. 2021;23(7), e24047. Accessed via: https://doi.org/10.2196/24047

9 Hajela N, Kwon B, Penson, KA, Lee A. Telehealth implementation and teaching strategies during COVID-19 and beyond in gait, balance, and mobility clinic for community-dwelling older adults. *Topics in Geriatric Rehabilitation*. 2023;39(4):240-252. Accessed via: DOI: 10.1097/TGR.0000000000000408.

Nupur Hajela, PT, DPT, PhD

their electronic medical record and downloads the app. Once launched, the patient chooses their own interviewer (e.g., male or female) and interacts with a bot who collects answers to triage questions and collects video and audio clips. These are then reviewed to create a treatment plan. The secret sauce, Dr. Yellowlees said, is access to the right interviewer at the right time (even at 2:00 a.m., if the patient so chooses), with the patient routed to the right level of care far earlier in the process than would otherwise be the case. From a business perspective, the digital triage app can double psychiatrists' productivity, reducing the cost per patient by 10 percent per year by cutting wait times and reducing inefficiencies.

Dr. Yellowlees' company has signed a strategic agreement with UC Davis and hopes to expand this approach throughout the UC system and to other disciplines.

Dr. Hajela, Assistant Professor at California State University, Fresno and Director of Rehabilitation Technologies and Outcomes Research at the Central California Sports Science Institute, explored how telehealth simulations can be used in modern health care education. Dr. Hajela said that before COVID, she thought of her discipline of physical therapy (PT) as an extremely hands-on service to offer patients in medical settings. As she and her colleagues share in an article in *Topics in Geriatric Rehabilitation*, this is not necessarily the case, even among geriatric patients. [9]

The article describes how the team set up an 8-week telehealth PT program for older adults that also served as a training program for PT students. "We don't have to assume that elderly patients won't embrace technology," Dr. Hajela observed. Indeed, these patients are motivated to be independent and are receptive to help.

In addition, she explored how telehealth simulation can empower next generation of healthcare providers and prepared them through this innovative pedagogy. The telehealth-based simulation follows a World Health Organization framework for interprofessional education and collaborative practice. In this example, the team includes a student physical therapist (SPT) who evaluates balance and gait for a patient with Parkinson's disease, while a nursing student takes a medical history and reviews medication. The social work students then discuss discharge planning and financial and social factors. These team training experiences are relatively rare, but allow each team member to learn about the others' roles.

Dr. Hajela and her colleagues conclude that telehealth simulations have the potential to revolutionize health care education by offering opportunities for practical immersion and practice that boosts confidence and competence, collaborative training to foster interprofessional teamwork that replicates real-life dynamics and improves communication, and inclusive access for students who are geographically isolated and/or different types of learners.

Dr. Pickering, Clinical Instructor at the Stanford School of Medicine, also serves as Faculty Fellow at the Stanford Center for Innovation in Global Health and as a Clinical Advisor to Health Tech Without

Borders. She is a Board member of TeleHelp Ukraine, an organization that connects Western physicians to Ukrainians displaced by Russia's invasion (both in Ukraine and Poland).

Responding to global concerns about a digital health divide, Dr. Pickering and colleagues at VSee Labs, Harvard University and Yale University worked with the United Nations Institute for Training and Research and other partners to create a virtual educational platform for clinicians and health system teams designed to support local digital health champions. The course they developed brings together local teams with representatives from health care, IT, and administrative functions to complete modules on electronic medical records, telemedicine, AI, digital health systems, and supplemental technologies.

A large-scale pilot project in the Philippines tested implementation of a telehealth clinic model to improve primary care access. The project involved building a telehealth clinic in a centralized location in a rural region near Manila, with access to computers and Internet bandwidth. Patients could visit the center to complete video visits with physicians remotely, while also interacting with community health workers in person who could take their vital signs.

Dr. Pickering concluded by noting the the pilot affirmed how the digital health divide will continue to affect existing health disparities, but that the divide can be narrowed through educational collaboratives like this one.

Ms. Dargaud, a member of the Technical University of Denmark (DTU) faculty and co-founder and Chief Technology Officer of DemensAI, described a spontaneous speech-based AI used to detect early manifestations of Alzheimer's Disease, the most common form of dementia. Dementia, or the loss of cognitive functioning caused by damage to brain cells, is the seventh most common cause of death worldwide.

Although some promising drugs recently have been shown to slow cognitive declines in clinical trials, these are called "halting" drugs, Ms. Dargaud explained, because they only slow decline. They cannot recover what has been lost in terms of cognitive function. The current diagnostic pathway for Alzheimer's and other dementias, she continued, leaves approximately 75 percent of cases undetected because the traditional screening method—a pen and paper test—is not an efficient way to detect the presence of the condition. The diagnostic process is long and prolonged, averaging a 2-year interval between the onset of symptoms and a first visit to a physician.

A follow-up survey of patients found the majority to be pediatric patients; half were unemployed and nearly 40 percent had a previous medical visit over a year ago (and some over a decade ago). Although many had access to smartphones, they did not have laptops and found the central digital hub at the clinic helpful.

Language use is an early indicator of cognitive decline and one that can be analyzed well using AI. From syntax and usage (e.g., sentence complexity) to quality of pronunciation and spectral flux

(the energy in one's voice), AI can efficiently and accurately detect changes in speech patterns that are indicative of Alzheimer's Disease. Screening using voice recordings and transcripts offers several advantages over other methods, since it is non-intrusive, cost-effective and scalable. In addition, it has the potential to create screening opportunities much earlier in the disease progression, especially for patients reluctant to see a doctor.

In early tests of recordings of patients asked to describe a scene in a picture, the AI screening yielded accurate diagnoses 87 percent of the time after being trained with speech samples from patients with Alzheimer's Disease. A comparison with traditional screening questionnaires, which take 15 minutes to complete compared to the 2- to 5-minute recording, found a high level of correlation. This, Ms. Dargaud concluded, shows the potential of AI for detecting Alzheimer's Disease from speech patterns. A preliminary study is planned for a Danish clinic with more Danish speech inputs and more spontaneous speech testing.

Hospital at Home, Part 1

Kristian Kidholm, PhD moderated this panel, which featured presentations from Thea Kølsen Fischer, MD, DMSc(PhD); Signe Lindegaard Andersen, MSc, PhD; Maria Normand Larsen, MD; and Charlotte Von Sydow, MSc, all affiliated with North Zealand Hospital in Denmark.

Thea Fischer, Professor and Research Director in the Department of Clinical Research at North Zealand Hospital, described a randomized control trial (RCT) of the Influenz-er hospital-at-home project. Influenz-er, Dr. Fischer explained, follows a patient-centric model launched in the United States in the 1990s, designed to hospitalize patients in their own homes when hospital beds are limited, to reduce waiting times for virtual consultations, decrease the risk of falls, and offer patients more dignity and a sense of empowerment. In Denmark, she noted, "the place with the most beds is the patient's own home." She also observed that this model is not for everyone; some patients need to be cared for in a hospital environment.

The researchers originally intended to test the scalability of a nationwide hospital-at-home approach across Denmark, but their proposal was rejected by the hospital's ethical committee. However, when the team tried again with a narrower proof-of-concept feasibility study, their proposal landed with a different committee and was approved. The research team found that the model has been well received by patients, but hospital systems can create barriers to technology through their capacity constraints, standard operating procedures, risk management, training and equipment investments, and overall resistance to change. That's why research and evidence-based approaches are so important, she added. Looking ahead, the team hopes not only to improve hospitalization experiences for patients, but learn how to avoid hospitalizations altogether—especially in settings where these transfers make patients particularly vulnerable, such as nursing homes.

Dr. Andersen's presentation focused on another important constituency for hospital-at-home projects: caregivers. Middle-income countries, Dr. Andersen noted, are requiring more and more support from informal caregivers at home, but their concerns, health, and well-being is rarely studied. As part

of the Influenz-er feasibility study described by Dr. Fischer, Dr. Andersen and her colleague Tatjana Sandreva, MD and PhD candidate, interviewed 16 informal caregivers connected to patients discharged from the hospital after admission for lower tract respiratory infections to a virtual hospital-at-home. These caregivers, Dr. Andersen noted, take over the "clinical gaze" since they are around the patient 24 hours a day. Often, they help measure vital signs and are the first to notice changes and gather other important data.

In interviews, the caregivers did not necessarily experience these tasks as a burden, although the sense of stress and burden was understandably heightened when the patient's condition was not stable or improving. In conclusion, Dr. Andersen noted that building capacity in health care through technology-supported solutions (such as virtual hospital-at-home programs) will require involving informal caregivers independently in the design of these programs, not just as an "appendix" to the patient. "We have to begin caring for the carers in these settings," she added, "keeping in the foreground the invisible work and efforts that informal caregivers offer in the background."

> **"We have to begin caring for the carers in these settings, keeping in the foreground the invisible work and efforts that informal caregivers offer in the background.**
>
> **Signe Lindegaard Andersen, MSc, PhD**

Dr. Larsen added to Dr. Fischer's description of the RCT currently underway to evaluate the efficacy of the Influenz-er program. As part of a scoping review, the team conducted a literature review to identify characteristics of hospital-at-home models, review study designs, and identify common outcome measures. Although the review is still ongoing, Dr. Larsen noted that not much consensus had emerged so far.

Dr. Larsen shared a program theory that described the virtual hospital-at-home model *activities* (e.g., self-measurements, clinician video assessments, visits by a mobile hospital-based care team); the

mechanisms of change (increased physical activity levels, better sleep and nutrition); potential *outcomes* (reduced clinical complications associated with the original hospital admission, reduced length of stay, patient perceptions of safety, faster recovery and reduced readmission and mortality); and ultimate *impact* on the patient (such as increased satisfaction with health services and increased mental well-being from being in a safe, familiar environment at home) and societal levels (reduced costs due to better outcomes and use of scarce hospital resources).

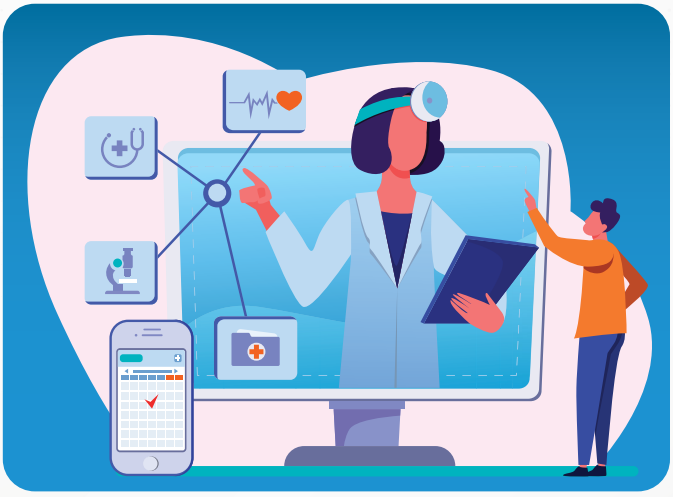
Ms. von Sydow, Senior Advisor and Project Manager to the hospital's Department of Clinical Research, shared lessons learned about public-private partnerships developed alongside implementation and testing of the Influenz-er program. Both sides—the public hospital and the private IT company responsible for the technology—had to learn about each other. Neither had experience with the other sector's realm, which made communication and progress difficult. The team was fortunate to identify a nurse with IT credentials and credibility, who effectively served as a liaison between the two camps.

Lessons learned including working with iterative processes to develop, test, and re-develop over and over by being willing to go back to the drawing board repeatedly to incorporate feedback; making effective use of translators; addressing the challenge of balancing profit motives with the public interest; placing developers within the hospital to better understand the challenges and environment; and finding the right people within clinical settings to take ownership of the project.

Hospital at Home, Part 2

Kristian Kidholm, PhD, moderated this panel on implementing Hospital at Home interventions in two U.S. settings: the Cleveland Clinic and UC Davis Hospitals.

Vimal Kirti Mishra, MD, MMCI, spotlighted the multifaceted crisis facing U.S. health systems, including access, patient experience, capacity, cost, and workforce issues. This crisis is underscored by alarming statistics: over 15,000 patients died in hospitals due to bed shortages in April 2020, and 63 percent of physicians reported burnout in 2021. Furthermore, patients encounter long waits for appointments—ranging from 24 to 61 days—and over 205 have missed consultations due to cost. Inflation and labor shortages have compounded the financial strain on hospitals and health systems, as reported by the American Hospital Association, with an average of 30 hospital closures per year, and 40 percent of rural hospitals at immediate or high risk of closure.



The challenges stem from a reliance on an analog care delivery system centered on facilities, offices, and hospitals, underscored by an inflexible fee-for-service model that does not incentivize value. This

delivery system has seen little change over decades. Dr. Mishra also highlighted the significant potential for shifting a considerable portion of care traditionally provided in clinics, facilities, and offices to patients' homes, including primary care, complex services like infusions, and acute care.[10] This shift leverages advanced digital health technologies to achieve better outcomes, experiences, quality, and lower costs. While some home-based care capabilities currently exist, they require scaling. A McKinsey & Company study supports this vision, estimating that more than 25 percent of care services could shift to the home by 2025.[11]

Dr. Mishra advocated for a transition to a digitally enabled care model that integrates in-person and virtual care, such as video visits, remote monitoring, and asynchronous telehealth, centered on clinical needs and appropriateness. This model promotes a higher degree of coordination between virtual and in-person care, focusing on patient-centered care rather than facility-based care. Furthermore, Dr. Mishra discussed the American Medical Association's Return on Health (ROH) framework,[12] which he helped develop. Launched in 2021, the ROH framework guides health care providers, payers, and policymakers in assessing the value of digital health solutions, emphasizing the comprehensive benefits of digital health innovations beyond traditional financial returns, focusing on the broader impact on patient care, system efficiency, and health outcomes.

Additionally, Dr. Mishra explored digital health opportunities further by describing an acute care at home model being developed at UC Davis. This model aims to provide acute urgent care at home through a Nurse Practitioner or Physician Assistant, supported by a medical technician and an on-call board-certified physician, showcasing the evolving landscape of healthcare delivery.

Nancy Albert, PhD, RN, FAAN, Associate Chief Nursing Officer at the Cleveland Clinic Health System, shared her health system's experiences delivering comprehensive acute hospital care in patients' homes. The program, launched in April 2023 in a Cleveland Clinic site in Florida, had already treated over 150 patients at home with conditions such as decompensated chronic heart failure, sepsis, pneumonia, diverticulitis, and chronic obstructive pulmonary disease (COPD). The key elements included a clinically integrated virtual command center staffed with hospitalists, nurses, and a multi-disciplinary clinical care team; a strong technology platform integrated with the system's EHR, as well as support for technology

10 Mishra V, Lloyd S, Barron M. The state of health at home models: key considerations and opportunities. American Medical Association [no date]. Accessed via: https://www.ama-assn.org/system/files/health-at-home-models.pdf.

11 Bestsennyy O, Chmielewski M, Koffel A, Shah A. From facility to home: how healthcare could shift by 2025. 2022. McKinsey & Company online article. Accessed via: https://www.mckinsey.com/industries/healthcare/our-insights/from-facility-to-home-how-healthcare-could-shift-by-2025.

12 Barron M, Mishra V, Lloyd S, Augenstein J. How to measure the value of virtual health care. *Harvard Business Review*. 2021. Accessed via: https://hbr.org/2021/06/how-to-measure-the-value-of-virtual-health-care.

in the home; and mobile in-home service providers for pharmacy, clinical, rehabilitation, laboratory, and other services (such as medical meals and supplies).

The average length of stay for the Florida patients was just over 5 days, which was about 1 day longer than a brick-and-mortar hospital stay. Although approximately 10.5 percent of patients experienced escalations of their conditions that required a transfer back to the hospital, Dr. Albert pointed out that this also meant that nearly 90 percent did not require care for decompensation or deterioration. Even though the severity of illness for the hospital-at-home patients was comparable to those hospitalized in the brick-and-mortar hospital, a total of 600 brick-and-mortar hospital days were avoided with no serious safety events, deaths, or hospital-acquired infections among those treated at home. The all-cause 30-day readmission rate was under 8 percent, reflecting that care in the home was optimized to the same extent or even better than what is done within a hospital setting.

“A total of 600 brick-and-mortar hospital days were avoided with no serious safety events, deaths, or hospital-acquired infections among those treated at home.

Dr. Albert attributed these outcomes to the effectiveness of early deterioration warning systems (VitalScout and SAVES [early warning-hemodynamic systems developed within the Cleveland Clinic to support ongoing monitoring of acute, non-intensive care adults and children, respectively]). In addition, remote patient monitoring systems include risk stratification for falls or other preventative events by utilizing virtual patient companions. Additional efficiencies that were accrued from previous programs and can be utilized in a hospital-at-home program include remote patient visits with providers via mobile devices or laptops and patient monitoring via wearable biosensors to detect changes relevant to outcomes (such as new onset atrial fibrillation, sudden drop in oxygen saturation or blood pressure or neutropenic events following chemotherapy).

Citing a recent systematic review of the literature on digital health and hospital-at-home approaches, very few reports were available on the use of digital tools and technologies in the home setting other than support tools that have been in use for many years.[13] Dr. Albert called for more clinical research on tools that aid in decision making, subtle changes in hemodynamic status and other aspects of the care model, such as optimal discharge readiness that may lower early readmission rates. In some recent studies, authors examined the effectiveness of digital health-supported platforms, including the feasibility and safety of digital health-supported home hospitalization platforms for patients with chronic heart failure (primarily measuring the outcome of satisfaction). Researchers found high satisfaction scores as well as solid usability, adherence, and safety ratings.[14] However, Dr. Albert concluded, we need to learn much more about how digital health solutions contribute to hospital-at-home programs and how these can better align with hospital-to-home transition programs. “This approach is still in its infancy,” she observed. “We need more research—and more experience.”

13 Denecke K, May R, Borycki E, Kushniruk AW. Digital health as an enabler for hospital@home: A rising trend or just a vision? *Frontiers in Public Health*; 2023(11). Accessed via: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1137798.

14 Scherrenberg M, Leenen JP, van der Velde AE, et alBringing the hospital to home: patient-reported outcome measures of a digital health-supported home hospitalisation platform to support hospital care at home for heart failure patients. *Digital health*. 2023(9). Accessed via: https://doi.org/10.1177/20552076231152178.

Improving Access, Empathy and Training with Technology

Gale Berkowitz, DrPH moderated this session, which featured presentations from Birthe Dinesen, MSc, PhD, Veronica Ahumada-Newhart, MEd, PhD and Carrie Shaw, MS.

Dr. Dinesen described an explorative Danish study of an AI-based social robot used to calm and communicate with people with dementia. Dr. Dinesen and her colleagues have enjoyed research partnerships with counterparts in Japan, which is how they first became aware of the robots used in their study. A Tokyo company, the Danish researchers discovered, made a popular robot called the Lovot, for "love" + "robot."

The robot, marketed in Japan more as a toy than a digital health device, is covered with a camera and dozens of sensors that make facial recognition possible. It can also generate body temperature changes and even mimic human-like motions like a hug or falling asleep in one's arms. Moreover, Dr. Dinesen said, the Lovots are adorable. They resemble Teletubbies, with sweet, nonthreatening features that make them look and feel less robot-like. A programmable app makes it possible to dictate and alter their personalities for different purposes. In short, Dr. Dinesen explained, they were ideal for testing the role of social robots in nursing homes to see whether they could help residents with severe dementia who were exhibiting symptoms like aggression or were noncommunicative.

Back in Denmark, Dr. Dinesen and her colleagues secured agreements with three nursing homes to test the social robots (including one whose staff were very resistant, making it a perfect testing ground) in group and individual sessions with 39 participants (28 in groups and 11 individually). Soon thereafter, COVID-19 shutdowns "closed the doors behind the robots." The natural experiment of the robots inside the nursing homes and the researchers unable to interfere, Dr. Dinesen said, created a "dreamy" research scenario in which to test outcomes of overall well-being, improved communication, and reduced arousal to aggressive behavior.

Although more research is needed, Dr. Dinesen found the initial results encouraging. Staff used the robots to comfort nursing home residents during COVID vaccinations, noticing how warmly the residents reacted to the robots. Some became attached. A woman who had not spoken for 2 years smiled and sought out the robot, holding it in her arms like a baby. Another resident said, "I know it is not a human or an animal, but I love it so much." Dr. Dinesen did note that some caution is required in matching residents to robots, since some might be overstimulated or have negative reactions. Next steps include testing the robots with children with autism and continuing to explore their benefits to people with severe dementia.

Dr. Ahumada-Newhart described another use of robots, in this case to interact with and on behalf of children who are homebound due to serious illness. Dr. Ahumada-Newhart explained that each year, 2.5 million children in the United States are unable to attend school due to illness, leading to feelings of loneliness, decreases in self-esteem, and the loss of a sense of belonging. The adverse consequences of these disruptions affect learning as well as social and emotional development.

To support children in these situations, the team deployed telerobots for non-clinical services, such as making it possible for children to interact from home with their peers at school and participate safely in fun social activities such as physical education, recess, and extracurricular activities. Dr. Ahumada-Newhart and her colleagues at UC Davis School of Medicine have developed a taxonomy of telehealth systems that includes three dimensions: functionality (consultation, diagnosis, mentoring, and monitoring), applications (specialty, disease, site, and treatment), and technology (synchronicity, network, connectivity). They used this taxonomy to assess the use of telerobots for this population of patients, incorporating multiple locations (e.g., home, hospital, and school) and seeking to understand the human-computer and human-robot interactions for the remote child as well as the robot's interactions with a child's peers at school.

> **Each year, 2.5 million children in the United States are unable to attend school due to illness, leading to feelings of loneliness, decreases in self-esteem, and the loss of a sense of belonging.**

Fitting emerging telehealth technology and practice into this type of taxonomy is important, Dr. Ahumada-Newhart explained, so that health care teams and clinicians can adopt a consistent approach for future studies of social robots and a broader population can understand their value. The robots are able to collect useful data such as how often they are accessed and which features are used by patients and their peer groups, making them ideal for behavioral and health informatics research.

Carrie Shaw, MSc, shared her history as a family caregiver to a parent with early-onset Alzheimer's Disease, starting in her teens. Ms. Shaw and her siblings struggled as their mother deteriorated and lost the ability to recognize them. In particular, Ms. Shaw's mother was experiencing right-brain atrophy (as a brain scan eventually revealed), which manifested in odd ways such as eating only half of the food on her plate (the half she could see). These early experiences gave Ms. Shaw the idea of developing immersive virtual reality goggles that would give health care providers and caregivers the ability to experience the world literally through the eyes of patients like her mother, and thus respond with what she termed "actionable empathy." The concept, she noted, is similar to simulations used routinely in other types of training, including in the military and other aspects of health care.

In 2020, Ms. Shaw's company, Embodied Labs, closed its first round of venture capital funding, which allowed the company to produce and ship not only devices but turnkey kits that can connect to a display for streaming group education sessions. Some nursing programs, Ms. Shaw said, have incorporated the approach into curricula to replace clinical hours (initially during COVID and then continuing). Some Veterans Administration (VA) medical centers and senior living facilities such as Front Porch have used the devices to support family caregivers in their networks as well, Ms. Shaw said. She sees great potential for other disciplines, including social work. Over the next year, she hopes to reach 100,000 family caregivers and 5,000 direct care workers, all of whom will receive financial compensation for completing the training. "We hope to grow this model to help people deal with this exhausting, isolating work so they can care for themselves while caring for someone else," she concluded.

Design Considerations in Developing Digital Health Solutions

Birthe Dinesen, MSc, PhD moderated this panel, featuring presentations from Pernille Christiansen, MSc, PhD and Julie Bønnelycke, PhD; Dina Ziadlou, DM, PhD; Kalpit Dilip Ballal; and Jose Cerdán-de-las-Heras, MSc, PhD.

Dr. Christiansen described the Healthier Together (Sundere Sammen) project that communicates with new parents to promote their health and well-being. The original project, which was the focus of her doctoral research, saw the post-partum period as a window of opportunity to focus on a healthier lifestyle, centered on mothers' exercise and diet. The initial study found unmet maternal health needs beyond physical ones. For example, during pregnancy, pregnant women were looked after by their midwifes and general practitioners, but after giving birth, all the focus transferred to the baby, leading to some insecurities and concerns among the mothers.

The researchers addressed these needs via a personal approach, offering motivating and informational (but nonjudgmental) podcasts and short videos. They also engaged partners (not just mothers), benefitting from the equal rights to parental leave that new parents in Denmark enjoy. Dr. Christiansen noted that many municipalities in Denmark now screen both parents for depression, acknowledging how stressful early parenting years can be.

> **"Providers can look at the data from many patients at once, and at the same time, machine learning can classify the EKG to warn patients and providers if certain parameters are met.**

The new app was informed by extensive co-design work with new parents, with special outreach to vulnerable groups and those isolated by language or other barriers. It sill addresses diet and physical activity, but expanded based on feedback to include topics such as mental health, partner involvement and relationship issues, and family workload and household management. The intervention helps new parents broach difficult topics such as bodily changes, sexuality, isolation and identity loss. The next steps are to test the broader app with users.

Dr. Cerdán, an Associate Researcher at Århus University Hospital in Denmark, described the use of a virtual autonomous agent for telerehabilitation for patients with chronic lung diseases. Trained as a physical therapist but also earning a master's degree in IT and e-business, Dr. Cerdán described his journey to develop and test a telerehabilitation platform. In 2009, Dr. Cerdán became interested in the idea of using then-emerging technologies such as augmented reality (AR) glasses, other virtual reality devices, and biometric sensors to create a Virtual Physiotherapist Agent. Early iterations gave feedback through subjective questionnaires and were well-received by patients with advanced chronic diseases (such as COPD and MS), who reported rapid and comprehensive gains in function, improved sleep, and other benefits.

15 Ziadlou D. Strategies during digital transformation to make progress in achievement of sustainable development by 2030. Leadership in Health Services. 2021;34(4):375-391. Accessed via: https://doi.org/10.1108/LHS-08-2020-0056

By 2017, the idea had evolved into a tablet form. This version was tested in three RCT studies. The first demonstrated that for 54 COPD patients, treatment with a virtual autonomous physiotherapist agent (VAPA) was not inferior to hospital rehabilitation treatments, with the primary outcome of exercise capacity. A second study of patients with idiopathic pulmonary fibrosis (IPF) found that patients in the trial arm maintained exercise capacity at 3- and 6-month follow-ups, in contrast to the control group (who lacked hospital rehabilitation, as is the standard of care). A third study of patients with sarcoidosis vasculitis and diffuse lung diseases found numerical improvements in exercise capacity but they were not statistically significant. Looking ahead, Dr. Cerdán hopes to conduct similar research with a larger cohort across more chronic conditions and to include more quality of life measures.

Mr. Ballal, representing the Technical University of Denmark, shared observations about the Internet of Things (IoT) and its implications for real-time heart monitors. IoT refers to the network of devices capable of sensing and interacting with their external environment and communicating with the network to transfer information. Examples surround us and include devices like smart lighting, Ring doorbells, and Nest thermostats. Because of the many potential uses, options, and demands of these devices (e.g., size, mobility, information transfer size and rates, and more), multiple technologies have been deployed alongside the various devices, including LPWAN (low power, wide area networks) technologies.

Of course, Mr. Ballal observed, some of these uses are more critical and require more reliable set-ups and bandwidth. Real-time heart monitoring for patients with cardiovascular disease risk factors would be one of these. In this case, Mr. Ballal explained, data (such as an electrocardiogram or EKG read-out) are pushed to a data center from an Android app. Providers can look at the data from many patients at once, and at the same time, machine learning can classify the EKG to warn patients and providers if certain parameters are met.

Dr. Ziadlou, a Board Member and Chair of the Digital Transformation Leadership Work Group at the International Society for Telemedicine and e-Health, described digital health care transformation strategies to achieve Sustainable Development Goal (SDG) 3 by 2030. Goal 3, focused on good health and well-being, is one of 17 goals set forth by the United Nations in pursuit of global prosperity, peace, partnership, protecting the planet, and supporting people by ending poverty. Dr. Ziadlou posed the question of which strategies health care leaders can adopt through digital transformation to achieve this goal.

Transformation, she noted, is distinct from change. It is an inside-out approach, whereas change is characterized as more of an outside-in approach, shifting from one situation to another while generally preserving or improving the status quo instead of innovating to create a different desired future. Digital transformation includes machine-based changes in processes, infrastructure and technologies as well as human-based transformations of intangible assets, such as human capital, mindsets and culture.

Dr. Ziadlou described a qualitative study of 10 health care leaders within the C-suites of U.S. hospitals who participated in in-depth interviews about their experiences and perspectives regarding digital transformation and potential strategies linked to making progress on the United Nations SDGs.[15] The findings covered six major thematic areas (innovation development, creating motivation and engagement, aligning local health care strategies with global ones, leadership support, partnership, and knowledge development/empowerment) as well as two minor ones (mindset change and creation of a new vision). Beyond creating thousands of digital technologies, Dr. Ziadlou explained, the study findings highlight the importance of human capital in motivating the types of changes that lead to thoughtful adoption of these technologies. As with COVID, we need to think and act globally and be in partnership, she concluded, in order to make progress. Dr. Ziadlou hopes future research will lead to replications of the study in local health care organizations as well as quantitative studies examining the relationship between SDGs and digital transformation strategies.

Health Technology Start-ups to Improve Diagnosis and Treatment

David Lindeman, PhD, moderated this panel featuring Ida Grønborg, MSc, PhD; Rachel Kuperman, MD; and Julia Schaletzky, PhD.

Dr. Grønborg is the co-CEO, with Mads Skak, of Cacta, a start-up that has developed MyLymphCare, a non-invasive home-monitoring device for the early detection of breast cancer-related lymphedema. Lymphedema is a chronic, progressive vascular disease that affects 1 in 5 breast cancer patients following their treatment, in part because of the removal of lymph nodes from the patient's armpit. This, in turn, can obstruct lymphatic vessels in the arm and thorax, resulting in pain, numbness and mobility issues. In addition to these physical symptoms, lymphedema serves as a constant reminder of the cancer experience, undermining patients' quality of life. Because it is common and debilitating, it is a major concern among patients during treatment.

Since there is no cure for breast cancer-related lymphedema, the goal of this intervention is to reduce chronic lymphedema by 75 percent through early detection of symptoms, leading to intensive preventive treatments to reduce the severity of symptoms and improve quality of life. Currently, lymphedema is detected using a tape measure to monitor arm volume—a method that is convenient and low-cost, but not terribly accurate. At a point when symptoms are visible enough to detect through swelling, the disease has already progressed.

Julia Schaletzky, PhD

MyLymphCare follows trends to make better use of remote patient monitoring (RPM, or home monitoring), which will be used by an estimated 70.6 million U.S. patients, or just over 26 percent of the population, by 2025. A survey of 250 U.S. breast cancer survivors found that the majority would have been receptive to home monitoring for lymphedema symptoms, drawn by the convenience, opportunity for early detection,

and avoidance of clinic and transportation time. The MyLymphCare home monitor is currently in testing against established lab equipment to ensure accurate readings and reproducibility; preliminary results show it to be as or more precise than other measures. It uses bio-impedance technology to provide a non-invasive sensor embedded into the fabric of an arm sling, which then sends data to an app. The team expects to complete feasibility studies in the first half of 2024 and then have the device available for a large-scale clinical study by early 2025.

Dr. Schaletzky, Executive Director of the Henry Wheeler Center for Emerging and Neglected Diseases (CEND) at UC Berkeley, opened her presentation by asking why scientific progress has not translated to radically better outcomes. Using COVID as an example, she noted that a virus sequence and diagnostic test for the new virus were available within days, but it took over a year to have testing broadly available in California. Moreover, when testing did become available, it was at 10 times the price than in Europe. COVID reflects a common issue preventing applications of scientific advances, Dr. Schaletzky contends: barriers that create needless impediments ("sand in the engine") such as a miniscule risk of litigation or unintended consequences of overly strict rules and regulations, often passed under the guise of safety to protect lucrative monopolies for the provision of services. In a crisis, these barriers are not automatically removed and continue to slow down and limit the delivery of care and critical information to patients. Even more troubling is that these lessons never seem to be learned, and the same issues continue to persist.

> **"The patient should be able to waive HIPAA rules by consenting to being told about COVID status using a regular email and text.**

Dr. Schaletzky called for appropriate regulation to spur the rapid adoption of new technologies to derive the maximum long-term benefit for patients, companies and society. Such regulation, she explained, must be patient-centered, provider-centered, and balance risks with potential benefits across domains, with the ability to make rapid adjustments if needed. Instead, we have a slow and cumbersome process. Under-regulation, she emphasized, is equally bad because it allows exploitative practices that lead to mistrust, which is then almost impossible to reverse. Examples include GMOs, electronic billing for doctors, drug pricing of off-patent generics, and some applications of telehealth (for examples, for controlled substances, hormones, or drugs with risks). "We need to find ways to make everyone play by the rules," she said.

Digital health technology is promising because it offers opportunities to increase access, lower costs, increase efficiency, and extend reach globally. However, technical innovation is necessary but insufficient to move the needle. We need to take a proactive approach to build a regulatory framework, she concluded, with particular attention to patient-centered regulation that levels the playing field and ensures that technology reaches those it can benefit. Critically, consent between patient and provider should override bureaucratic rules. For example, the patient should be able to waive HIPAA rules by consenting to being told about COVID status using a regular email and text; during the pandemic, many patients' results were withheld because no HIPAA-compliant communication methods were available, causing unnecessary morbidity and likely even mortality.

Dr. Kuperman, CEO of EYSZ, described her company's use of technology to accelerate the diagnosis and treatment of childhood absence epilepsy (CAE). CAE is the most common form of pediatric epilepsy,

16 AI in medicine: creating a safe and equitable future. *The Lancet* [Editorial]. August 12, 2023. Accessed via https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(23)01668-9/fulltext.

affecting approximately 275,000 children in the United States. Children with the condition experience frequent, brief seizures (as many as 10 to 30 each day), along with high rates of depression, anxiety and attention problems.

The process of diagnosing CAE is long and convoluted, Dr. Kuperman explained. She knows this firsthand as the former director of the UCSF Benioff Children's Hospital Pediatric Epilepsy Program in Oakland, California. Referrals, waits for initial consults with a neurologist and follow-up visits, interspersed with multiple EEG exams and often long travel times mean that many CAE symptoms are missed or ignored, leading to diagnostic delays and poor outcomes. To shorten this cycle, EYSZ is developing eye-tracking technology to measure seizures as well as comorbidities and side effects. The team has successfully completed a multicenter clinical study of 168 patients at risk for CAE, developing an algorithm that analyzed eye movements from a wearable eye tracker. Conversations with physicians about how they would use the information led to modifications, using hyperventilation (HV) instead. HV has been safely used for both diagnosis and CAE management for almost a century.

The revised app allows clinicians to guide children through hyperventilation while recording a selfie video of their faces. Once completed, the video is uploaded to the cloud and analyzed by a licensed epileptologist, with eye and face movements extracted from the video to train AI algorithms. Since the tool is a Class 1 medical device, clinicians can be reimbursed for its use in the clinic as well as in home environments. Dr. Kuperman and her colleagues plan a phased development, starting in clinics and then moving to remote patient monitoring and EHR integration.

With this technology in place, wait times for exams and consultations are reduced, caregiver stress is eased, trust is improved, and most importantly, patients can be diagnosed earlier and reach a state of freedom from seizures sooner.

ASSESSING AND EVALUATING TELEHEALTH CONTRIBUTIONS

Assessment of the Value of AI Technologies in Health Care, Part 1

David Lindeman, PhD, moderated the first of two panels on assessing the value of AI technologies in health care. Panelists included Haibo Wang, MBBS, MSc, MPH of the Research Center of Big Data and AI for Medicine at the First Affiliated Hospital of Sun Yat-Sen University; Nick Anderson, PhD, MS, a Professor of Biomedical Informatics and Chief of the UC Davis School of Medicine's Division of Health Informatics; and Shomit Ghose, a partner at Clearvision Ventures.

Dr. Wang discussed ways to harness the power of Large Language Models (LLMs) for medicine, speaking from his perspective as a physician scientist. *Emergent* abilities of LLMs are those that are evident only in larger models. In China, he explained, 114 of these models are under development. They have the potential to compress and extract vast amounts of knowledge. Dr. Wang distinguished between high entropy models that yield medical discoveries and low entropy ones geared to medical services.

Dr. Wang urged his audience to consider the objectives of AI in medicine and what can be achieved with LLMs, emphasizing efficiency, accuracy and the potential for new knowledge using synthetic data. AI needs to align with human values through Reinforced Learning Through Human Feedback (RLHF) and its association with data engineering. In the near future, Dr. Wang predicted, doctors who use AI will replace those who do not. AI will not replace doctors but will act as an enhancement or aid to their work, Dr. Wang concluded, citing a recent *Lancet* editorial: "… doctors cannot ignore AI. Medical educators must prepare health care workers for a digitally augmented future. Policy makers must work with technology firms, health experts, and governments to ensure that equity remains a priority. Above all, the medical community must amplify the urgent call for stringent regulation." [16]

Dr. Anderson addressed a specific application of LLMs: for translational health science research. Translational health science research is the process of translating discoveries from basic science "bench" research (T0) to clinical trials (T1 and T2), clinical practice (T3) and then broader community adoption (T4). In the United States, this research is supported by the National Institutes of Health (NIH) Center for Advancing Translational Science (NCATS) through over 60 national centers at a cost of approximately $800 million per year. Clinical trial research overall is a massive industry, Dr. Anderson said, constituting over $50 billion per year in the United States alone. This research is conducted within and across academic clinical environments, each of which manages hundreds of clinical trials in collaboration with partners.

Translational health science research poses many data challenges, Dr. Anderson explained. These include the vast data heterogeneity and representation scales that range from molecules to whole organisms and entire populations; huge volume of data with varying standards and provenance; and a

range of individual data management requirements for privacy, security, and legal issues. In addition to data challenges, this type of research faces infrastructure and knowledge changes, such as the investments required for computation infrastructure, the need for interdisciplinary expertise, and expectations for reproducibility, transparency, data sharing, and knowledge dissemination from multiple academic, government, funder, and societal stakeholders.

Dr. Anderson shared an evolving framework for academic health sciences systems that highlights data science, convergence science and practice, and equity, diversity, and inclusion goals. More specifically, he enumerated requirements for LLM applications in translational health science, including data collection and pre-processing design, model selection, validation, interpretability and explainability, and security and privacy. In Dr. Anderson's view, LLMs have the potential to transform translational science by learning from the artifacts of communication and translation and focusing attention (operationalizing very large language data processing through a means of training and understanding the relevance of input data, as with the Transformer architecture and Attention mechanism introduced by Vaswani et al. in 2017). New approaches using LLMs, he observed, are particularly applicable to translational science environments overflowing with information.

In closing, Dr. Anderson quoted Herbert Simon, a pioneer in AI, health economics, computer science, and economics: "What information consumes is rather obvious: it consumes the attention of its recipients. Hence a wealth of information creates a poverty of attention, and a need to allocate that attention efficiently among the overabundance of information sources that might consume it."

Shomit Ghose shared observations about generative AI's impact on scalable health care. The demand for health care far exceeds the supply of health care resources, he noted, with over 45 percent of WHO member states having fewer than 1 physician for every 1,000 people. Quickly moving through millennia of medical innovation through the ages, Mr. Ghose pointed out that we have always had both "soft" and "hard" technology at play: herbs and splints; leeches and the scalpel; antibiotics and x-rays, and now AI and smartphones.

Today, Mr. Ghose said, generative AI, particularly Transformers architecture, contributes to diagnoses and treatment. BEHRT (Transformer for EHRs) is another application of generative AI that can predict the likelihood of over 300 conditions in one's future visits based on EHR data. Generative Adversarial Networks (GANs) are another.

In conclusion, Mr. Ghose reiterated the potential of generative AI as a next-gen platform for diagnosing and treating patients, noting that most of our lives are spent without direct contact with medical care providers. Can data streams from devices like smartphones be combined with AI to provide scalable care across the health care continuum? He believes the answer is yes.

Assessment of the Value of AI Technologies in Health Care, Part 2

Kristian Kidholm, PhD, moderated a second panel on assessing the value of AI technologies in health care, featuring Iben Fasterholdt, MSE, PhD from the University Health Network and Odense University Hospital in Denmark; Nancy Albert, PhD, RN, FAAN, Associate Chief Nursing Officer at the Cleveland Clinic Health System; and Nick Anderson, PhD, Professor of Biomedical Informatics and Chief of the UC Davis School of Medicine's Division of Health Informatics.

Dr. Anderson discussed assessing ethical organizational maturity for AI adoption in translational science, focusing on the role and culture of academic medical centers. Reiterating some points from the previous session, Dr. Anderson described the significant investments by NIH/NCATS in translational science—approximately $800 million per year across 60 academic medical centers (AMCs) in the United States, devoted to a tri-part mission of research, education, and clinical care. AMCs, Dr. Anderson noted, are ideal environments for the adoption of AI into operational health practice. They have vast, heterogenous data resources on patient health that are collected under high-quality clinical and research conditions. They have access to advanced basic science, medicine, engineering, and legal and public health expertise, as well as significant institutional technology investments in physical and digital operational data management systems. Finally, they generally demonstrate broad enthusiasm for innovation across the translational science continuum.

> **"It is important to understand pragmatic use of a new device, and when possible, learn which factors are associated with desirability and overall use.**

However, Dr. Anderson noted, AMCs struggle to keep pace with identifying and vetting emergent opportunities that bridge clinical, operational and research areas. This may be due in part to the culture and organization of AMCs, which puts high quality and cost-effective patient care first, followed by education and innovation. Thus, technology skills may be isolated from the expertise required to asses impact on clinical populations (and the populations themselves).

As noted earlier, Dr. Anderson sees tremendous potential for AI tools such as LLMs to impact translational science, but these are dependent on the data on which they are trained. Translational science faces challenges in supporting accurate, ethical communication between domains and protecting these vast data sources. Domain-focused, explainable and validated LLMs, he believes, can translate across these areas and influence all parts of AMC missions. Crucial roles in this ecosystem are played by organizational entities such as Institutional Review Boards, Research Compliance Offices, Clinical Trials Offices, Contracting Offices, and IT functions.

17 For a full copy of the *Lighthouse for Older Adults Evaluation Report*, visit bit.ly/LighthouseEval.

Evolving AI safety and trust governance frameworks can help bridge the data-information gap. Assessing an organization's maturity and ability to ethically assess AI implementation should be both a concern and a focus going forward, Dr. Anderson concluded.

Dr. Albert described an assessment of the value and use of Artificial Registered Nurse Intelligence (aRNi) at the Cleveland Clinic during and after COVID-19. The innovation was developed by a former RN employee, who approached the Cleveland Clinic about assessing its use. The aRNi software was loaded with the Lippincott Nursing Procedures manual that provides evidence-based content on nursing procedures and practices and drug information from an online resource, Lexicomp Clinical Drug Information. Nurses could ask aRNi questions related to nursing practice policies, procedures, and medications and receive evidence-based responses immediately (similarly to receiving responses to questions from Google or Alexa).

In the research project, Dr. Albert and her colleagues examined the value of aRNi from nurse caregivers' perspectives by monitoring the frequency of overall interactions and themes (e.g., medications, procedures, and policies). At the outset, Dr. Albert explained, just because a new device is available for use does not mean that it will be embraced and used over time as expected. It is important to understand pragmatic use of a new device, and when possible, learn which factors are associated with desirability and overall use. Ultimately, research data must be used to help stakeholders understand its value.

The study used a prospective, two-cohort (by time) design, incorporating both quantitative and qualitative data. The intervention was used at four sites with 12 medical-surgical units during the COVID pandemic phase and at five sites with 15 medical-surgical units post-pandemic, but during a period when nursing and other caregiver shortages generated considerable work stress. In both cohorts, devices were placed in medication rooms when possible as they offered a quiet area for privacy in asking questions and less external hallway noise.

The results were disappointing. Investigators learned that there was a decrease in nurses' perceived value of aRNi over time (as well as a markedly decreased frequency of use in all work sites) and aRNi interactions mainly focused on medication-related questions. The device features (for example, the amount of data provided after asking a question) may need to be streamlined to facilitate quick answers to questions when applicable. Additionally, AI capabilities might need to be refined to enhance nurses' ability to receive responses to an initial request, without needing to revise their questions to receive useful information and create device value in the future, Dr. Albert concluded.

Dr. Fasterholdt's presentation described the Model of ASsessment of Artificial Intelligence (MAS-AI) that aimed to produce a model for assessing the value of AI in medical imaging. Users of the model include decision makers in health care (such as the heads of departments or procurement organizations)

and AI developers who guide AI research. The team conducted a literature review, interviewed AI experts, held two workshops in 2021 to collect feedback and change requests (including from patient representatives), and a final workshop in Canada in May 2022 to validate the model.

The multidisciplinary team identified nine domains for the assessment: the health problem and current use of technology, technology itself, ethical aspects, and legal aspects (all assessed through early MAS-AI); and safety, clinical aspects, economics, organizational aspects, and patients aspects (assessed through the full MAS-AI). The early MAS-AI data will come from pre-screening and data from companies and legal experts, while the full MAS-AI will be based on data from health care organizations. Following the workshops and feedback, the team has identified and refined content for each domain. Next steps include collecting interview data from Canadian provinces and then undergoing a second round of Delphi process to adapt the MAS-AI at a workshop in Canada by May 2024, for future use in Canada. Furthermore, MAS-AI is one of the building blocks in the recently funded Horizon Europe project EDiHTA (www.edihta-project.eu) and is currently being used to assess AI technologies in Denmark, Canada, and Italy in disciplines such as radiology, nuclear medicine, clinical management, and telehealth in psychiatry.

Evaluating the Effectiveness of Telehealth Interventions

Pauline deLange Martinez, MA, doctoral candidate and Research and Community Engagement Manager at the Betty Irene Moore School of Nursing - Family Caregiving Institute at UC Davis, moderated this panel on evaluating the effectiveness of telehealth interventions. The panel featured Ms. Martinez's own research as well as presentations from Heather Young, PhD, RN, FAAN and Orly Tonkikh, PhD, RN, also at the Betty Irene Moore School of Nursing – Family Caregiving Institute; Gonçalo Morais, MSc from the University of Southern Denmark; and Emmanuel Abara, MD, FRCSC, FACS, FICS, FWACS, MScCH, with the Northern Ontario School of Medicine (NOSM) University and the Richmond Hill Urology Practice and Prostate Institute in Ontario, Canada.

Ms. Martinez shared lessons learned from an evaluation of a telehealth intervention among language-diverse, low-income older adults across six affordable senior housing communities in California.[17] The Lighthouse for Older Adults project was designed to develop a scalable digital inclusion program for residents of these communities, ultimately reaching 836 residents with wi-fi installation in their apartments, tablets or voice-first devices and customized handbooks, digital literacy training classes, and a peer tech support model.

To evaluate the project, Ms. Martinez and her colleagues designed a mixed-methods evaluation to track implementation across the six communities. They faced multiple challenges as the project's implementation shifted in response to conditions (e.g., suddenly using hot spots when wi-fi was delayed) and variations across the six communities. Residents spoke 14 different languages and used 5 different devices, for starters. Some were offered two classes; others attended five. The class curriculum and tech support models varied too, as did changing COVID protocols that complicated everything required for the project, from visiting tech support to in-person classes.

Ms. Martinez shared an initial logic model for the project, which the team quickly realized was unrealistic in terms of its intended impact on residents using the devices for telemedicine purposes. As she pointed out, many residents were so new to the technology that they needed help turning the devices on and off, so more complex uses were not realistic. The evaluation team simplified the logic model to track "productive" uses of technology, variety of online activities, and attitudes towards technology.

Indeed, the most common use of the devices by residents was to listen to songs in their own languages on YouTube. Although this wasn't the type of telehealth use originally envisioned, qualitative data showed that access to technology did support communication and lessened social isolation. The health outcome scales yielded wide variations that may have been due to cultural and translation issues, the length of the instruments, negative wording of questions, and/or other confounding factors (such as COVID impacts), Ms. Martinez explained. Looking back, Ms. Martinez observed that single item measures worked best with this population, and a single item measure linked to the device ("Did the device help you feel more socially connected?") would have been useful for evaluation purposes. In addition, the 3-month follow-up may not have been a long enough interval to detect bigger changes. Qualitative data gathered through interviews with community staff and resident volunteers proved to be an invaluable, complementary source of information to better understand the intervention's impact.

> **"Comparing the two approaches, the evaluators found that the virtual PROMs approach reduced both the average number of contacts as well as the number of procedures required to generate a diagnosis.**

These findings underline the value of taking a developmental evaluation approach to telehealth interventions. Ms. Martinez emphasized the importance of maintaining a flexible mindset, being willing to reconsider 'what is a successful outcome,' analyzing and presenting findings as you go to learn what is most valued and adjust your approach and gathering diverse data sources to triangulate and verify findings.

Dr. Young and Dr. Tonkikh described an evaluation of statewide implementation of a web-based interactive platform (CareNav™) to enhance equitable support for caregivers. Dr. Young explained that the web-based platform relied on a network of 11 California Caregiver Resource Centers (CCRCs) across the state that serve as a point of entry for family caregivers (i.e., family and friends who are not paid to care for relatives). CareNav™ is a free, secure portal that offers a standardized assessment and then yields a personalized dashboard with resources that respond to the needs identified on the assessment, such as fact sheets and articles, webinars and classes, referrals to local programs, and communication with a family consultant. The evaluation design followed a Consolidated Framework for Implementation Research (CFIR); its objective was to assess implementation outcomes and population impact after two years of statewide implementation of the online portal. Qualitative and quantitative data were collected via an annual readiness survey to CCRC leadership and staff, biennial focus group interviews with staff, and quarterly client satisfaction surveys of 2,624 caregivers enrolled in CareNav™ or receiving services from the CCRCs.

Findings covered adoption (all 11 CCRCs were deploying CareNav™ and contributing data); variations in fidelity to moving through the phases of implementation; support for sustaining the program through long-term collaboration and appreciation for being connected to a statewide system; benefits to sites and caregivers such as improved communication and efficiencies; more service offerings for diverse

caregivers (though an ongoing need for more cultural and linguistic diversity); and high degrees of caregiver satisfaction with both the CRC services and CareNav™ in particular (98 percent satisfied; 94 percent would recommend the CRC to others; 84 percent satisfied with the portal, though only 25 percent of caregivers used it). The combination of CRC services and an online portal improved caregiver health and well-being.

The team plans a future longitudinal study to continue learning and to inform implementation planning as more caregivers are supported in using CareNav™.

Mr. Morais presented an economic evaluation of the use of patient-reported outcome measures (PROMs) to diagnose sleep disorders. The Danish context for his retrospective study, he explained, is the lack of specialized physicians to treat sleep disorders, leading to long waiting lists for patients seeking help. The lag in treatment is important because undiagnosed sleep disorders are related to increased mortality risk and lower productivity.

Although PROMs are sometimes used as an add-on to facilitate an initial consultation with a health professional, Mr. Morais and his colleagues were interested in determining whether they could be economically viable as a way to reduce costs to the healthcare system as a first step in a diagnostic procedure, while accelerating the speed of diagnoses without decreasing their quality.

> **“The combination of Caregiver Resource Center services and an online portal improved caregiver health and well-being.**

The evaluation compared diagnostics and their related costs under a usual (in-person) standard of care and a virtual process. In the standard progression, a patient sees a general practitioner, who then refers them to a specialist, who in turn refers to a sleep clinic. This is followed by outpatient consultation and another consultant to determine the best course of action, tests, another consultation, and finally a diagnosis. The virtual model streamlines this process by having the patient report outcome measures through an online questionnaire completed from their home without having to visit the sleep clinic. This is reviewed by the consultant, which may lead to an additional consultation, but usually leads to skipping the initial visit to a junior consultant.

To compare costs, the evaluation team considered wages of senior physician specialists, junior nonspecialists, travel time and time away from work for patients (i.e., the opportunity cost of their time), and administrative costs.

Comparing the two approaches, the evaluators found that the virtual PROMs approach reduced both the average number of contacts as well as the number of procedures required to generate a diagnosis. These combined results documented that PROMs deployed in this way have the potential to accelerate the diagnostic process, release health care personnel time to other uses, reduce the costs of diagnosis, and promote the standardization of care, but more needs to be understood about how it might change decisions by physicians, among other variables.

Dr. Abara described an assessment of telesonouroflowmetry: using audio-based uroflowmetry to make this type of testing available to patients in their homes, instead of having to visit a doctor’s office or facility. The study used a publicly available e-Uroflow smartphone app that uses sound waves to measure urine flow. Patients who had been referred with a urological condition in rural northern Ontario were given the opportunity to download the app to their phones, sending the results to a urologist for a

review and treatment decisions between June 2021 and March 2022. Patients, who each had a unique ID number, agreed to record all their pees for four consecutive days and send the data to the urologist, who followed up with a virtual or telephone visit.

Of the 105 patients who enrolled, 96 (91.4 percent) completed the trial. Their age ranged from 22 to 75 (average 64) and the majority were males. The patients had a variety of diagnoses, including voiding dysfunction, enlarged prostates, recurrent UTIs, overactive bladders, and other conditions. All found the app easy to download and were able to generate data from the convenience of their homes. Reduced anxiety association with in-facility uroflowmetry was one benefit, along with overall improved access for patients isolated by geography or other constraints (e.g., during COVID-19 shutdowns). Limitations included the individualized nature of the data (so conclusions were not generalizable). In some cases, surrounding noise affected the recordings (e.g., from the type of toilet bowl), as did the smartphone's distance from the toilet bowl or container. The current version of the app does not have the capacity to measure voided volume or average flow rates, but this could change in the future.

Dr. Abara concluded that the app shows promise for generating a large amount of e-urination data for monitoring, therapeutic and surveillance purposes. Multicenter trials and comparative studies against standard care (which were not conducted during the pandemic) would be useful next steps.

Perceptions of Telehealth Among Patients and Health Care Professionals

Helle Spindler, MSc, PhD moderated this panel, featuring presentations on her own research as well as Abdullah Virk of Arizona State University; Anders Nikolai Ørsted Schultz, MD from the University Hospital of Southern Denmark, University of Southern Denmark, and Odense University Hospital; and Jarl Voss Andersen Sigaard, MD, from the University Hospital of Southern Denmark and Aalborg University.

Dr. Spindler shared insights about incorporating technology-enhanced motivation in telerehabilitation. She explained the importance of rehabilitation to prevent disease progression and rehospitalization, noting that lack of motivation is a potential barrier for patients starting and then sustaining a rehabilitation program. Overcoming barriers to rehabilitation (such as distance, timing, motivation, and staff shortages/attention) is pivotal for increasing equality in health care, she suggested. Technology offers opportunities to overcome barriers such as distance and timing, but its effects on motivation are less clear.

Dr. Spindler reviewed a number of theoretical approaches that are relevant to increasing motivation, such as self-determination theory (SDT). This psychological theory of motivation is the one she used to evaluate the impact of a technology-based motivation component in telerehabilitation, starting with a literature review to explore whether SDT-based interventions increase motivation and whether there are interventions with technology-enabled elements based on this model.

A meta-analysis of 73 studies of SDT-informed interventions found modest effects, partly due to increases in self-determined motivation and support from social agents. Technology-enhanced motivation has been documented in studies across conditions and age groups, including diabetes,

heart failure, mobility impairment, psychosis risk among young people, cerebral palsy, pediatric motor rehabilitation, and falls prevention in older adults. However, Dr. Spindler noted, few studies combine SDT and technology in their design.

While the SDT studies so far show tentative support for the effects of technology, Dr. Spindler believes combining the two warrants further study, especially to explore user-driven, theory-based approaches to designing motivational interventions for telerehabilitation and continuing self-care across multiple patient groups. As a general theory of human motivation, she concluded, SDT may help us understand how to increase motivation, which in turn can contribute to increasing equality in care.

Helle Spindler, MSc, PhD

Mr. Virk shared findings from a qualitative study of provider perceptions about transitioning from in-person to telehealth home visits to support fragile infants released from Arizona neonatal intensive care units (NICUs). The in-person program required a change from in-person to telehealth visits during COVID, affecting the families of many Arizona babies admitted to the state's NICUs. By interviewing staff and caregivers, Mr. Virk and his colleagues explored acceptance of this technology using the Modified Technology Acceptance Model as their theoretical framework. The study sample was small (n=6), but themes from the interviews offer some insights about extending this and similar programs in the future.

In terms of the technology itself, Mr. Virk and his colleagues found that both staff and families struggled with the video component during the initial transition to telehealth. They could not use more familiar tools like Facetime due to confidentiality concerns, so staff had to rely on Zoom or phone calls instead. Still, staff found most families were comfortable with technology and had access to devices and wi-fi. Staff reported satisfaction with being able to provide services across a larger geographic area more responsively and managing their time more effectively. To make up for not being able to demonstrate techniques in person, some used a baby doll on the video and found this to be useful. Because the transition occurred during COVID, staff also felt there was a shared vulnerability with families that helped them connect.

Overall, Mr. Virk concluded, the model allows flexibility in meeting families' individual needs by combining both in-person and telehealth service delivery. Moreover, telehealth appears to be an effective mode of delivery for home visitation programs.

Dr. Schultz reported on comparisons of patient and provider preferences for telehealth from a regional study conducted in Denmark to explore whether and how COVID-19 might have changed perceptions and preferences. The team developed surveys for patients (n=221, response rate of 68 percent) and health care providers (n=271, corresponding to 83 percent of the patients seen at the outpatient clinic).

Among patients, 36 percent said they would consider a telehealth visit, with more (33 percent) preferring a telephone consultation to one via video (24 percent). Providers, on the other hand, estimated

that only 17 percent of consultations would be suitable to conduct over the phone and 18 percent by video. The surveys also assessed differences by specialty, which revealed more gaps between patient and provider preferences (patients more open to telehealth's suitability for diabetes- and pulmonology-related visits; providers more open to telehealth visits for endocrinology and nephrology). The difference was particularly stark for pulmonology visits. The most common reason given for not opting for telehealth visits was the need for special equipment.

There is potential for increased use of telehealth in outpatient settings, Dr. Schultz concluded, although there are likely to be variations across specialties and between provider and patient assessments of suitability.

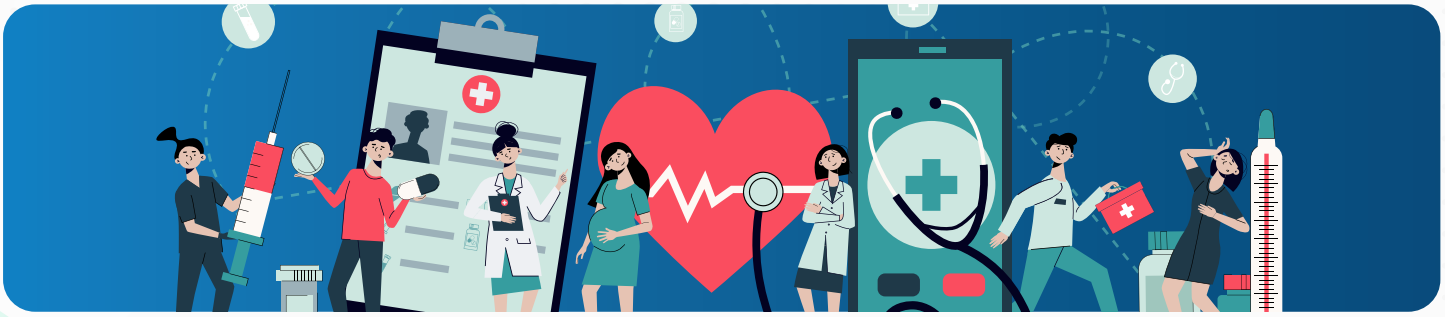
> **Telehealth appears to be an effective mode of delivery for home visitation programs.**

Dr. Sigaard reported on a study of the use of telehealth for palliative care for cancer patients in Denmark. Telepalliation, the term for this type of care, is a palliative effort using information and communication technologies such as video calls, informative websites, phone calls, and social media to support patients in a terminal phase of their illness. This application of telehealth, he noted, is still uncommon.

As with other telehealth applications, the telepalliation explored in this study was accelerated by COVID-19, which moved consultations to more virtual modes. Patients in this study used a telepalliation portal with an information module for patients and their relatives covering common subjects (e.g., pain management, diet, psychological aspects of terminal illness); a communication module for messaging, notes and video contacts; and patient-reported outcomes (feeling of security, pain, quality of life).

For the study, the team enrolled adults (18 years of age and older) living in a specific region of Denmark, with specific conditions referred to the Palliation Team at Denmark's Southwest Jutland Hospital, with basic computer skills (or a relative with these skills). An active psychiatric history other than depression or anxiety, or dementia or other cognitive decline excluded patients from the study.

Ultimately, 182 patients divided into two groups will be included: one receiving telepalliation and another receiving standard care. A qualitative substudy using Antonovsky's Sense of Coherence theory as a framework also was conducted, including participant-observation in patients' homes and qualitative interviews. Patients reported ease of communication, improved understanding of symptoms, a sense of security and coherence, increased freedom (from not having to drive, for example), but also sometimes reported feeling overwhelmed. A limitation, Dr. Sigaard acknowledged, is that the study only focused on one palliative care center and was limited to a Scandinavian/Western culture setting. Further research, he concluded, is needed to further explore the benefits and drawbacks of applying telehealth to palliative care.



HEALTH AND DIGITAL EQUITY

Centering Equity in Digital Health Transformation

Courtney Lyles, PhD, Professor of Public Health Sciences at UC Davis's Center for Health Policy and Research, recently joined UC Davis after 12 years at the University of California San Francisco (UCSF), where she and her colleagues have explored different approaches to centering equity in digital health transformations in health care settings. After reviewing the multiple factors driving digital health equity at the individual, family, community, service setting, and policy levels, Dr. Lyles noted that digital uptake requires influencing multiple levels and factors. She challenged the audience members to consider where their own work could cross levels and where they might have their own spheres of influence.

Courtney Lyles, PhD

Dr. Lyles emphasized the importance of gathering and using accurate data. For example, at the height of the COVID pandemic shut-downs, in August 2020, Dr. Lyles and her colleagues surveyed diverse safety-net patients and found that they were interested in video visits with their health care providers but faced barriers such as Internet access and limited data plans. With support, they were able to complete test video visits that could increase access, but resolving the barriers required working at a broader level than the clinic or hospital.

Dr. Lyles described how health equity work can align with digital health work to drive some needed changes. Sharing a visual of health equity pillars (build infrastructure, address determinants of health, eliminate racism and oppression, partner with the community, and focus on health equity as a strategic priority), Dr. Lyles noted that leaders across health systems must identify concrete strategies for telemedicine to contribute to each pillar. As just one example, making health equity a strategic priority dictates that health care institutions advocate for access to broadband as a health priority and screen to connect patients to resources that address social determinants of health, such as housing. Similarly, a focus on internal hiring and promotion practices can address racism that has excluded people of color from professional roles in health care settings—and in doing so, can create teams that are more trusted by and reflective of the communities they serve.

"We won't solve digital equity on our own," Dr. Lyles concluded. Partnering with communities is essential.

Additional Resources

- CCI Telemedicine for Health Equity Toolkit (https://www.careinnovations.org/virtualcare/virtual-care/toolkits-telemedicine-for-health-equity/)
- AMA Centering Equity in Digital Health Solution Design (https://edhub.ama-assn.org/ama-center-health-equity/interactive/18717941?resultClick=1&bypassSolrId=M_18717941) & Digital Health Implementation (https://edhub.ama-assn.org/ama-center-health-equity/interactive/18717729?widget=personalizedcontent&previousarticle=0)

- CHCF Bridging the Digital Health Divide (https://www.chcf.org/publication/bridging-digital-health-divide-series/)
- San Francisco Office of Digital Equity (https://sfmohcd.org/digital-equity)
- NDIA Free and low-cost internet plans (https://www.digitalinclusion.org/free-low-cost-internet-plans/)

Policy and Practice Issues in Digital Health and Digital Equity

Katherine Kim, MBA, MPH, PhD moderated this session, which also featured presentations from Leticia Alejandrez, MA; and Anh Nguyen, MPA.

Dr. Kim described an evolving framework for digital health equity, derived in part from her role as Principal for Consumer Health Informatics at MITRE. MITRE is a non-for-profit, private company chartered to operate in the public interest by tackling complex challenges with no commercial interest. They operate six federally funded research and development (R&D) centers that address issues as wide-ranging as aviation systems, enterprise modernization, health, homeland security and cybersecurity, as well as MIRE Labs and an independent research program.

In the health realm, Dr. Kim explained, digital inequity is reinforcing long-standing health inequities, especially as health becomes increasingly dependent on digital solutions. The federal government acknowledges the need to improve access to digital health for all populations through mechanisms such as expanded access to broadband and virtual care. However, community-based organizations (CBOs) are expected to translate federal and state funding streams into effective interventions, without much evidence informing how this supports digital health equity.

Dr. Kim enumerated elements of a connected health ecosystem that includes telehealth encounters with patients, remotely guided surgery, real-time patient monitoring for hospital at home and other approaches, data collection via sensors, data exchanges, various technologies that make treatment/consults and diagnostics more accessible, and virtual/augmented reality options for both treatment and provider education. She shared a continuum of these elements leading to high tech and high touch care. The challenge, Dr. Kim noted, is to offer the right tech and right touch at the same time.

Dr. Kim shared several proposed definitions of digital health equity that focus on access, fair opportunities to achieve a high level of health, the technology capacity of individuals and communities to full participate in society and the economy, and broadband equity in particular. She also noted a number of recent frameworks that have been proposed but are not specific to intervention developers, such as Multilevel Determinants of Digital Health Equity (described in a keynote address by Dr. Lyles).

Dr. Kim noted that a current gap is the lack of a validated framework that encompasses market and community conditions to guide intervention development. She and her colleagues at MITRE have been developing a community connectivity framework (CCF) to fill this gap and provide guidance for real-world interventions for digital health equity. So far, they have completed key informant interviews and a literature review. A national survey of CBOs is planned for the near future to validate the underlying concepts and illuminate different aspects of the ecosystem and how they interact.

Ms. Alejandrez, Director of Telehealth and Human Services at the California Emerging Technology Fund (CETF), reflected on some of the policy and practice issues raised by digital equity. CETF was established by the California Public Utilities Commission and is accountable to the state legislature, with the mission of closing the digital divide, promoting digital inclusion, and accelerating broadband deployment and adoption. The organization's mission is based on the principle that the digital divide is yet another manifestation of the economic divide, which itself has roots in institutionalized racism that has led to persistent, concentrated poverty. Ms. Alejandrez quoted the late Congressman John Lewis, who said "Access to the internet is the civil rights issue of the 21st century."

Ms. Alejandrez described how the "perfect storm" of the COVID-19 public health emergency and the shelter-in-place orders that accompanied it drove pivots in health care and government that illustrated what is possible, despite the backdrop of preventable tragedies and loss of life.

To capitalize on these possibilities, CETF has invested in studies of telehealth policy and practice through three key activities designed to generate data for policymakers to drive action: a telehealth pilot project focused on skilled nursing facilities (SNFs), telehealth fact-finding, and supporting digital literacy projects like Latinas Contra Cancer (a *promotora*-based model in San Jose, CA). More details about each of these projects are available on CETF's website, www.cetFund.org.

Anh Nguyen, MPA

CETF has learned a great deal from these explorations, translating data on barriers and opportunities into an action plan that makes COVID-era reimbursements for telehealth services permanent and comparable to in-person visits, invests in high-speed internet infrastructure, and institutionalizes telehealth with accountability for improving patient outcomes and overall population health. These elements are incorporated into Assemblymember Dr. Akila Weber's introduction of Assembly Bill (AB) 1275, the Telehealth for All Act of 2023. If passed, this legislation would affirm a digital equity Bill of Rights, Ms. Alejandrez concluded, and will advance the use of telehealth to increase access to health care and behavioral health for all California residents, but especially those who are underserved.

Ms. Nguyen, Engagement and Operations Manager at the California Department of Technology's Office of Broadband and Digital Literacy, described California's Broadband for All initiative and its implications for closing California's digital divide. She echoed some of the themes raised by Dr. Kim and Ms. Alejandrez, noting that the ability to access and use broadband can be the line between being able to fully engage in life or cut off from it. Ms. Nguyen shared a Venn diagram showing digital equity at the center of key barriers: access, adoption, and affordability.

Ms. Nguyen explained how a set of policy initiatives, starting with a Broadband Council formed in 2010, have steadily introduced legislation, investment, and planning to deliver both "middle mile" broadband initiatives and "last mile" programs. Noting that 1 in 5 Californians lacks access to high-speed, high-quality broadband, Ms. Nguyen shared three goals related to access, affordability, and adoption

contained in the 2020 Broadband Action Plan that include 24 different action items to address digital equity barriers, all prioritized due to the COVID-19 pandemic.

Although much progress has been made, Ms. Nguyen noted, there's always more to do related to the goal areas. An updated state Digital Equity Plan will collect insights from working groups, surveys, regional and local planning workshops, and statewide public engagement to guide future investments, including capacity grants that address specific barriers to digital equity. Among 40,000 respondents to the public online survey, 15 percent rarely or never access health services online; people who are unhoused, with limited English proficiency, or who are disabled are more likely to be among those who rarely or never access health care via the internet. The strategy recommendations to respond to the multiple streams of feedback are still being developed, but include leveraging broadband infrastructure investments to connect health-related anchor institutions (and encouraging sharing with networks of digital inclusion program information), promoting and providing enrollment assistance to subsidize connectivity for Medi-Cal enrollees, supporting health navigators to become digital navigators as well, and embedding telehealth into digital literacy training programs.

Bridging the Digital Divide: ACTIVATE's Impact on Diabetes and Hypertension Management in Rural and Agricultural Communities

Scott McGrath, PhD moderated this session, which featured presentations from Dr. McGrath as well as Katherine Kim, MBA, MPH, PhD; Juan Lopez-Solorza, MD; and Leslie Abasta-Cummings, MPH.

Dr. McGrath's presentation overview of remote patient monitoring (RPM) opened with a brief history of telemedicine, starting with x-ray images being shared via telephone wires in the late 1940s to Alan Shepard's vital signs monitored while in space in the early 1960s, followed by increasing adoption of RPM in subsequent decades and the arrival of smartphones, tables and connected devices in the 2000s. Alongside these developments is the explosion in global internet use, with an estimated 4.9 billion people using the internet in 2021. However, urban internet users still outnumber rural ones by nearly 2:1.

Lack of universal broadband access, Dr. McGrath noted, limits telehealth access for millions of Americans who live in rural areas, on tribal lands, or have lower socioeconomic status. Even during COVID-19, when telehealth use became much more common, underserved populations still had limited use of virtual visits.

RPM for rural and underserved populations offers many benefits, Dr. McGrath observed. These include better access to high-quality health care

Scott McGrath, PhD and Katherine Kim, MBA, MPH, PhD

when transportation is a barrier to care; options for asynchronous or synchronous contact, which can save time and costs for both patients and providers; reduced burnout and related staff shortages for providers; enhance patient satisfaction; and more equitable access to the resource of health services, which is a societal responsibility.

In addition to limited or unreliable broadband connectivity, challenges to providing RPM for rural and underserved populations include low levels of digital literacy, staffing constraints, a lack of patient engagement, and systems that do not offer seamless interoperability.

Dr. Kim from MITRE and Ms. Cummings and Dr. Lopez Solorza from Livingston Community Health described a model for chronic illness improvement called ACTIVATE, which is implemented at Livingston Community Health, evaluated by MITRE, and supported by CITRIS Health.

Ms. Cummings described Livingston Community Health (LCH) and its setting, a small rural, agricultural community in Merced County, fondly known as the sweet potato capitol of the nation. Ms. Cummings explained the long history of LCH's partnerships with academic medicine, going back to the 1970s when it was established as a nonprofit Community Health Center. Today, LCH operates eight sites in two counties. Its 240 staff deliver medical, dental, behavioral health, medication assisted treatment (MAT), pharmacy and other services to 23,000 patients, including many farmworkers employed in local agriculture.

In 2020, LCH faces a challenge familiar to other community health centers: maintaining the continuity of health services for patients with chronic diseases (such as diabetes and hypertension) that required ongoing monitoring. Both patients and clinics had to navigate around digital health barriers, including broadband and device access, RPM devices, digital health literacy, staff expertise, adapting digital health programs to culture and setting, interoperability challenges, and lack of funding to address these.

Dr. Kim explained how the ACTIVATE model for RPM was developed to respond to these issues, using a unique co-design approach. ACTIVATE already has yielded impressive outcomes, improving hemoglobinA1c by 3.8 points for patients with diabetes, systolic blood pressure by 19 points, and diastolic blood pressure by 5 points for patients with hypertension—all among one of the most medically disadvantaged populations in the state. Pilot outcomes (covering results among 50 patients) have been published in *Applied Clinical Informatics;* the team is continuing to enroll patients and track similar outcomes.

The ACTIVATE team developed a comprehensive implementation toolkit covering planning, training, outreach and engagement, and evaluation.

Dr. Kim credited the program's emphasis on co-design, including the LCH team as well as patient and community co-designers, with much of its adoption and success. Involving patients and families helped to build trust, a crucial ingredient in the relationship between them and LCH, and demonstrated that the providers cared about the patients' health.

To achieve the goal of making RPM convenient, accessible, and sustained by both patients and provider teams, the ACTIVATE team developed a comprehensive implementation toolkit covering planning, training, outreach and engagement, and evaluation. The outreach and engagement staff followed a care coordination model to identify and enroll patients, help them set up and use the technology, and incorporate the program into the clinic's workflow.

Dr. Solorza, LCH's Associate Medical Director, reflected on lessons learned during the ACTIVE pilot project and implementation. Dr. Solorza explained that some parameters of A1c control for people with diabetes are being questioned because of the fact that significant long-term damage occurs at blood glucose levels about 120 (approximately A1c levels of 5.6, not the 7.0/170 blood glucose levels considered "under control" by the American Diabetes Association) and the ranges vary significantly from one person to another. Even so, he explained, LCH achieved phenomenal results that exceed the effects of diabetes and blood pressure medications.

The process, though, involved "building the plane while you're flying it." The challenges were worthwhile, Dr. Solorza said, though he jokes about getting his daily steps in by running back and forth to interact with patients and the health coach. A team approach, relying on a health coach aligned with provider messages, language and culture-specific approaches, and other features contributed to the success. Most of all, building trust and a sense of community made a difference and helped everyone stay motivated.

CONCLUSION: PERSPECTIVES ON BUILDING CAPACITY IN HEALTH CARE THROUGH TECHNOLOGY

Gale Berkowitz, DrPH; Katherine Kim, MBA, MPH, PhD; Nancy Albert, PhD, RN, FAAN; Birthe Dinesen, MSc, PhD; Kristian Kidholm, PhD; Jon Steffen Therkildsen, MSc, MBA

To conclude the two-day conference, Gale Berkowitz, DrPH, asked several of the speakers to reflect on their reactions to the various presentations and conversations. What were the "a-ha!" moments—an insight, affirmation or connection that was particularly striking? What gaps did they see, or content missing from this convening but perhaps something to include in the future? What challenges and opportunities lie ahead? What are some specific research opportunities?

"A ha" moments included the realization that "telehealth is real." It's unfolding across countries and is now poised to move from research projects to models across populations and communities.

Since technology's impact on staff shortages was a theme of the conference, another "a ha" moment was the insight that technology is not a replacement for nurses and other health care providers, but is more of an adjunct that can contribute to meaningful improved outcomes for patients.

Several speakers commented on the urgent need to accelerate research on implementation, perhaps by adding more observational studies to the mix alongside more costly and time-intensive RCTs. "Let's get out and get some experience using the technology," one presenter urged.

Gaps included wishing for more exploration of how to get innovative ideas into health care systems and align with their revenue streams. This is a complex topic but one that warrants more discussion, especially as more models become available. Indeed, beyond revenue streams and reimbursement, more discussions about innovations in business models (such as open-source coalitions, public-private partnerships, and other approaches) would be welcome. In fact, some suggested, re-engineering of entire systems and processes might be required, beyond the immediate tasks of delivering better health to patients.

Another gap to explore is the different perceptions of technology between patients and providers. In addition, identifying natural leaders or champions within institutions would be useful. Who are the internal innovators who can help diffuse digital health technology throughout organizations and systems?

Several speakers agreed that an ongoing challenge is the consistent demands on health care staff that leave little time or bandwidth for exploring innovation, learning new technology, participating in research projects, and more. “Our biggest challenge,” one reflected, “is that we don’t have time to dream.”

The related opportunity is to deploy digital health technology so that staff can work smarter, not harder, but getting there is a challenge. The fear of inadvertently harming patients if technology goes awry is also part of the equation that needs to be acknowledged.

“The related opportunity is to deploy digital health technology so that staff can work smarter, not harder.

Several of the “a has,” gaps and challenges resurfaced as potential research opportunities as well: fast track implementation, faster and simpler research methods than RCTs (such as observational studies), accessing and using data sets for research, and learning more about what kinds of robots can work for (and with) providers to improve patient health.

As one panelist said in closing, “It’s not really transatlantic … it’s not American, it’s not Danish, it’s not Chinese or any other nation. It’s a global test that we have in front of us.” At the next TTRN conference in 2025, panelists look forward to more questions answered, more models replicated and scaled up and out, more research methods and data sets deployed, and more innovation rippling through various systems—sparked and amplified by presentations and connections from the 2023 gathering of digital health innovators from around the world.

APPENDIX A: CONFERENCE AGENDA

Transatlantic Telehealth Research Network (TTRN) International Scientific Conference 2023

August 22-23, 2023
Sutardja Dai Hall
University of California Berkeley

Day One

Tuesday, August 22, 2023

8:00	*Kvamme Atrium* **Registration and Breakfast**	
9:00	*Banatao Auditorium* **Welcome from Gale Berkowitz, Birthe Dinesen, and David Lindeman**	
9:15	*Banatao Auditorium* **Keynote: "Easing staff shortages through digital health"** Birthe Dinesen, MSc, PhD Department of Health Science and Technology, Aalborg University	
9:30	*Banatao Auditorium* Icebreaker	
9:45	*Banatao Auditorium* **Keynote: "Hybrid Care – The New Normal For Psychiatry Leads to Improved Provider Wellbeing and Global Workforce Capacity"** Peter Yellowlees, MBBS, MD University of California, Davis	
10:00 to 10:50	*Banatao Auditorium* **Panel: Leveraging Telehealth Interventions to Better Serve Children's Hospitals and Communities** Panel Moderator: ***James Marcin, MD, MPH*** UC Davis Speakers: ***Jennifer Rosenthal, MD, MAS*** UC Davis "Promoting Digital Health Equity in Pediatric Care" ***Veronica Ahumada-Newhart, MEd, PhD*** UC Davis "Exploring Telewellness: Health Perceptions and Practices of a Live Stream Virtual Fitness Class" ***Sarah Haynes, MPH, PhD*** UC Davis "Comparing models of virtual care to improve pediatric physiatry services for children with special healthcare needs" Discussion/Q&A	*Room 250* **Panel: Assessment of the Value of AI Technologies in Health Care, Part 1** Panel Moderator: ***David Lindeman, PhD*** CITRIS Health, UC Berkeley Speakers: ***Haibo Wang, MS, MPH*** Sun Yat-Sen University "Harnessing the Power of Large Language Models (LLMs) for Healthcare" ***Gerald Friedland, MSc, PhD*** UC Berkeley "Understanding the Opportunities and Limits of Large Language Models from a Technical Perspective" ***Shomit Ghose*** Clearvision Ventures "Not Just ChatGPT: Generative AI's Impact on Scalable Healthcare" ***Nick Anderson, PhD*** UC Davis "Applications of Large language models in translational health science research" Discussion/Q&A
11:00	**Break**	

Day One continued

11:15 to 12:05	*Banatao Auditorium* **Panel: Perception of Telehealth Among Patients and Health Care Professionals** Panel Moderator: ***Helle Spindler, MSc, PhD*** Aarhus University Speakers: ***Helle Spindler, MSc, PhD*** Aarhus University "Increasing equality in health care through technology-enhanced motivation in telerehabilitation" ***Abdullah Virk*** Arizona State University "Qualitative Study of Provider Perceptions of the Transition to Telehealth for Home Visitation Program to Support Fragile Infants" ***Anders Nikolai Ørsted Schultz, MD*** University Hospital of Southern Denmark, University of Southern Denmark, Odense University Hospital "Patients' Preferences for Telehealth Outpatient Consultations and Healthcare Professionals' Opinions of Suitability for their Patients: A single centre survey" ***Jarl Voss Andersen Sigaard, MD*** University Hospital of Southern Denmark, Aalborg University "Telepalliation – A way of increasing a feeling of coherence in the care of patients with terminal illness across sectors" Discussion/Q&A	*Room 250* **Panel: Building Technology Capacity in Aging and Brain Health: An End-to-End Approach** Panel Moderator: ***Allison B. Sekuler, PhD*** Rotman Research Institute, Baycrest Academy for Research and Education Speakers: ***Allison B. Sekuler, PhD*** Rotman Research Institute, Baycrest Academy for Research and Education "Enhancing end-user engagement, receptivity, and capacity for technology adoption: Integrated programs and processes in aging and brain health" ***Raquel Meyer, PhD, RN*** Ontario Centres for Learning, Research, and Innovation in Long-Term Care, Baycrest Academy for Research and Education "Innovative edTech for Workforce Acceleration: LIPHA Simulation Game Worlds to Strengthen Clinical Specialization, Professional Socialization, Teamwork and Values-Based Practice" ***Morris Freedman, MD, FRCPC*** Rotman Research Institute, Baycrest Academy for Research and Education "Virtual Behavioural Medicine Program: A Scalable Changer in Care for Neuropsychiatric Symptoms in Dementia" Discussion/Q&A
12:15	**Lunch**	

Day One continued

13:15 to 14:05	*Banatao Auditorium* **Panel: Evaluation and Effectiveness of Telehealth Interventions** Panel Moderator: ***Pauline deLange Martinez, MA*** UC Davis Speakers: ***Pauline deLange Martinez, MA*** UC Davis "Lessons Learned Evaluating a Rapid Cycle Telehealth Intervention Among Language-Diverse, Low-Income Older Adults" ***Heather M. Young, PhD, RN, FAAN*** Betty Irene Moore School of Nursing, UC Davis "Statewide implementation of a web-based interactive platform to enhance equitable support for caregivers: implementation outcomes" ***Gonçalo Morais*** University of Southern Denmark "Economic evaluation of the use of patient reported outcome methods in the diagnosis of sleep disorders – a retrospective study" ***Emmanuel Abara, MB, FRCSC, FACS, FICS, FWACS, MScCH*** Northern Ontario School of Medicine (NOSM) University "Telesonouroflowmetary: A Digital Strategy in Clinical Practice" Discussion/Q&A	*Room 250* **Panel: Global Models for Telehealth Delivery for Older Adults** Panel Moderator: ***David Lindeman, PhD*** CITRIS Health, UC Berkeley Speakers: ***Liane Wardlow, MS, PhD*** Senior Director, Clinical Research & Telehealth, West Health "C4TA: A Global Model for Telehealth Delivery for Older Adults" ***Michael Kurliand, MS, BSN, RN-BC*** Vice President, Clinical Quality and Integration MedWand Solutions, Inc. "C4TA: A Global Model for Telehealth Delivery for Older Adults" ***Discussant: Frederic Lievens, MSc*** International Society for Telemedicine and eHealth Discussion/Q&A
14:15	*Banatao Auditorium* **Keynote: "Barriers and Facilitators for Digital Health Technologies"** Martin Vesterby, MD, PhD Head of Clinical Impact, Health Tech Hub Copenhagen Department of Clinical Medicine, Health, Aarhus University	
14:30	*Banatao Auditorium* **Keynote: "Are we just converting existing health care to technology rather than exploring the innovative potential of technology in heath care?"** Helle Spindler, MSc, PhD Department of Psychology and Behavioral Sciences, Aarhus University	
14:45	**Break**	

Day One continued

15:00 to 15:50	*Banatao Auditorium* **Panel: Barriers and Facilitators for Implementation of Health Technology** Panel Moderator: ***Peter Yellowlees, MBBS, MD*** UC Davis Moderator Speakers: ***Peter Yellowlees, MBBS, MD*** UC Davis "The Asynchealth Tele Triage Tool (AT3): Mental Health can't wait" ***Nupur Hajela, PT, PhD*** California State University, Fresno "Revolutionizing Healthcare Education: Telehealth Simulations Empower Next-Generation Interprofessional Healthcare Teams" ***Annalicia Pickering, MD*** Stanford University School of Medicine "Creating Digital Health Champions Around the World: A Case Study and Collaborative Educational Initiative" ***Laurine Dargaud, MSc*** Co-founder & CTO of DemensAI "Developing a Spontaneous Speech-based Artificial Intelligence for Detecting Alzheimer's Disease" Discussion/Q&A	*Room 250* **Panel: Hospital At Home, Part 1** Panel Moderator: ***Kristian Kidholm, PhD*** Odense University Hospital and University of Southern Denmark Speakers: ***Thea Kølsen Fischer, MD, DMSc(PhD)*** North Zealand Hospital "Driving transformation of the healthcare sector - an innovation research project hospital@home model" ***Signe Lindegaard Andersen, MSc, PhD*** North Zealand Hospital "Caring for the Carers: a qualitative study of informal caregivers' physical and mental" ***Maria Normand Hansen, MD*** North Zealand Hospital "How to evaluate efficacy of a Hospital at Home model – planning a randomized controlled trial" ***Charlotte Von Sydow, MSc*** North Zealand Hospital "Public-Private partnerships – Lessons learned from collaborations with a private software company on developing a H@H monitoring solution in a public hospital setting" Discussion/Q&A
16:00	*Banatao Auditorium* **Afternoon Poll and Reflections**	
16:15	*Banatao Auditorium* **Closing Remarks for Day**	
16:30	*Kvamme Atrium* **Reception** New! Tech Demos: We are pleased to have several health technology innovators demonstrating their products during the reception. You will be able to view and chat with the researchers behind these exciting developments.	
17:30	**Reception Ends**	

Day Two

Wednesday, August 23, 2023

8:00	*Kvamme Atrium* **Registration and Breakfast**	
8:30	*Banatao Auditorium* **Welcome Back and Plans for the Day from Gale Berkowitz**	
8:45	*Banatao Auditorium* **Keynote: "The Effects of Telemedicine on Clinician Time – A Blind Spot in Research"** Kristian Kidholm, PhD Odense University Hospital and University of Southern Denmark	
9:10 to 10:00	*Banatao Auditorium* **Panel: Health Technology Start-ups to Improve Diagnosis and Treatment** Panel Moderator: ***David Lindeman, PhD*** CITRIS Health, UC Berkeley Speakers: ***Ida Groenberg, MSc, PhD*** Cacta, Denmark Aarhus University "Development of a home-monitoring device to detect pre-clinical lymphedema after breast cancer treatment" ***Rachel Kuperman, MD*** CEO of Eysz, Inc. "Improving outcomes in Childhood Absence Epilepsy" ***Julia Schaletzky, PhD*** UC Berkeley "Technology advances, systems lag behind" Discussion/Q&A	*Room 250* **Panel: Design Considerations in Developing Digital Health Solutions** Panel Moderator: ***Birthe Dinesen, MSc, PhD*** Professor, Department of Health Science and Technology | Professor, The Faculty of Medicine, Aalborg University Speakers: ***Pernille Kjærgaard Christiansen, MSc, PhD*** University College Lillebælt "Using participatory design to develop an app to promote health and wellbeing for new parents." ***Dina Ziadlou, DM, PhD*** Bryant and Stratton College, Colorado Technical University and ISfTeHA "Leading Digital Transformation in Healthcare toward Achieving Sustainable Development" ***Kalpit Dilip Ballal*** Technical University of Denmark "Remote Monitoring Heart Failure patients using C-IoT technologies." ***Jose Cerdán-de-las-Heras, MSc, PhD*** Aarhus University Hospital "Virtual Autonomous Physiotherapist Agent: A Feasible and Effective Tool for Delivering Virtual Physical Therapy to Patients with Chronic Pulmonary Disorders" Discussion/Q&A
10:00	**Break**	

Day Two continued

10:10 to 11:00	*Banatao Auditorium* **Panel: Hospital At Home, Part 2: Challenges and Facilitators for a Large Scale Implementation of Hospital at Home Interventions – Where do Cleveland Clinic and UC Davis Hospitals See the Potentials and the Challenges?** Panel Moderator: ***Kristian Kidholm, PhD*** Odense University Hospital and University of Southern Denmark Speakers: ***Vimal Kirti Mishra, MD, MMCi*** UC Davis "Driving Innovation through Care at Home Models" ***Nancy Albert, PhD, CCNS, CHFN, CCRN, NE-BC, FAHA, FCCM, FHFSA, FAAN*** Associate Chief Nursing Officer, Cleveland Clinic Health System "Digital Health in Hospital-At-Home Programs" Discussion/Q&A	*Room 250* **Panel: Improving Access, Empathy and Training with Technology** Panel Moderator: ***Gale Berkowitz, DrPH*** CITRIS Health, UC Berkeley Speakers: ***Birthe Dinesen, MSc, PhD*** Professor, Department of Health Science and Technology Professor, The Faculty of Medicine Aalborg University "AI based Social Robot for Persons With Dementia: An Exploratory Study" ***Veronica Ahumada-Newhart, MEd, PhD*** UC Davis "Robots in the Taxonomy of Pediatric Health" ***Carrie Shaw, MS*** CEO & Founder Embodied Labs "Leveraging first-person immersive narratives to accelerate lived experience and build adaptive skills at scale" Discussion/Q&A
11:00	**Break**	

Day Two continued

11:15 to 12:05	*Banatao Auditorium* **Panel: Policy and Practice Issues in Digital Health and Digital Equity** Panel Moderator: ***Katherine Kim, MBA, MPH, PhD*** UC Davis and MITRE Speakers: ***Katherine Kim, MBA, MPH, PhD*** UC Davis and MITRE "Frameworks for Digital Health Equity" ***Leticia Alejandrez, MA*** Director of Telehealth and Human Services, California Emerging Technology Fund (CETF) "Telehealth in California: Institutionalizing Policy" ***Anh Q. Nguyen, MPA*** Engagement and Operations Manager, Office of Broadband and Digital Literacy, California Department of Technology "Broadband for All & State Digital Equity Planning Process: Closing California's Digital Divide and Achieving Equitable Outcomes in Health" ***Scott Adams, MPA*** Deputy Director, Office of Broadband and Digital Literacy, California Department of Technology "Broadband for All & State Digital Equity Planning Process: Closing California's Digital Divide and Achieving Equitable Outcomes in Health" Discussion/Q&A	*Room 250* **Panel: Assessment of the Value of AI Technologies in Health Care, Part 2** Panel Moderator: ***Kristian Kidholm, PhD*** Odense University Hospital and University of Southern Denmark Speakers: ***Iben Fasterholdt, MSE, PhD*** University Health Network & Odense University Hospital "Model for Assessing the value of AI in medical imaging (MAS-AI) + the VR8 case" ***Nancy Albert, PhD, CCNS, CHFN, CCRN, NE-BC, FAAN*** Associate Chief Nursing Officer, Cleveland Clinic Health System "Artificial Registered Nurse Intelligence (aRNi): A Comparison of Value and Use During (Time 1) and After COVID-19 (Time 2)" ***Nick Anderson, PhD*** UC Davis "Assessing ethical organizational maturity in AI adoption in translational science" Discussion/Q&A
12:15	*Banatao Auditorium* **Keynote: "Centering Equity in Digital Health Transformation"** **Courtney Lyles, PhD** UC Davis	
12:30	**Lunch**	
13:30 to 13:45	*Banatao Auditorium* **Keynote: "Current State of Technology and the Need for Training and Educational Initiatives in Telehealth""** **Frederic Lievens, MSc** International Society for Telemedicine and eHealth	

Day Two continued

13:45 to 14:35	*Banatao Auditorium* **Panel: Bridging the Digital Divide: ACTIVATE's Impact on Diabetes and Hypertension Management in Rural and Agricultural Communities** Panel Moderator: ***Dr. Scott McGrath, PhD*** CITRIS Health, UC Berkeley Speakers: ***Dr. Scott McGrath, PhD*** CITRIS Health, UC Berkeley "Remote Patient Monitoring" ***Katherine Kim, MBA, MPH, PhD*** UC Davis and MITRE "ACTIVATE: a model for chronic illness improvement demonstrated at Livingston Community Health" ***Dr. Juan Lopez-Solorza, MD, and Leslie Abasta-Cummings, MPH*** Livingston Community Health "ACTIVATE: a model for chronic illness improvement demonstrated at Livingston Community Health" Discussion/Q&A
14:45	**Break**
15:00	*Banatao Auditorium* **Roundtable Conversation: Perspectives on Building Capacity in Health Care through Technology** Participants: ***Gale Berkowitz, DrPH*** - CITRIS Health, UC Berkeley ***Katherine Kim, MBA, MPH, PhD*** - UC Davis & MITRE ***Nancy Albert, PhD, CCNS, CHFN, CCRN, NE-BC, FAHA, FCCM, FHFSA, FAAN*** - Associate Chief Nursing Officer, Cleveland Clinic Health System ***Birthe Dinesen, MSc, PhD*** - Department of Health Science and Technology, Aalborg University ***Kristian Kidholm, PhD*** - Odense University Hospital and University of Southern Denmark ***Jon Steffen Therkildsen, MSc, MBA*** - Innovation Centre Denmark in Silicon Valley
15:30	*Banatao Auditorium* **Reflections and Closing Remarks**
15:45	**End of Conference**

Presentation summaries prepared by Nicole Lezin of Cole Communications, Inc. with graphic design by Violet Anna Bartle of MsVi