

Ubiquitous and Comprehensive Healthcare: Expanding Technologies and Systems to Enable New Delivery Models

Benjamin Schooley, MBA, PhD
College of Engineering and Computing
University of South Carolina
Bschooley@cec.sc.edu

Nitin Patel, MD
School of Medicine
University of South Carolina
Nitin.Patel@prismahealth.org

Sue Feldman, RN, MEd, PhD
School of Health Professions
University of Alabama at Birmingham
Sfeldman@uab.edu

Gina Besenyi, PhD
Department of Kinesiology
College of Health and Human Sciences
Kansas State University
gbesenyi@ksu.edu

Abstract

Whether at home, work, school, or traveling abroad, digital healthcare is in demand. Rapidly changing delivery models are shaping the new healthcare landscape far beyond a COVID-19 world. The papers in this minitrack present innovative digital health applications that can be administered or used in a digital health setting outside the walls of traditional healthcare facilities. These papers present apps for parolee reentry into the community, training for audiology screening, and infectious disease risk assessments. Another paper addresses optimization of at-home triage, while the final manuscript focuses on empowering patients in health consultations using an online platform. Taken together, these papers highlight the growing importance of enabling new delivery models for ubiquitous and comprehensive healthcare.

1. Introduction

Our motivation for this minitrack was our collective experience in research and practice observing innovations come and go with mild to moderate effects on healthcare practice. Certainly, we've seen an increasing number of innovative apps, many that have gained notoriety and made significant impacts over the last decade. For example, digital health services and supporting technologies have expanded into new domains, remote patient monitoring has become common practice for certain conditions, patient engagement has become more commonplace, consumer facing apps have picked up steam, and augmented intelligence (AI) and machine learning applications are becoming a reality. Our observation was by and large

that that health is happening everywhere, though healthcare has traditionally been contained to predefined environments. Whether at home, work, school, or traveling abroad, healthcare is in demand outside the walls of traditional healthcare facilities. A wide range of organizations (e.g., pharmacies, retailers, tech firms, large employers) are filling gaps in the marketplace that current care delivery providers are not meeting. Such examples are functional medicine enterprises, at-home diagnostic kits, convenient on-premise-on-demand primary care, and synchronous or asynchronous virtual visits. Rapidly changing delivery models are shaping the new healthcare landscape. Again, COVID-19 has forced major changes in these areas.

In the new digital health landscape, innovators must be keenly aware of the ever-changing nature of business, financial and care delivery models, policy advancements, and the role of information systems and technology (IS&T) as enablers. Innovative researchers highlight emergent digital health information systems and technologies, including their design, field testing, evaluation, and broader impacts. Researchers are creating new and innovative models, frameworks, and technologies that delve into how IS&T enables and supports health to happen everywhere. Resulting technology artifacts include mobile devices, wearables and other IOT devices, sensors, telehealth applications, tele-monitoring, mHealth apps, EHR extension apps for non-traditional healthcare environments, and integrations with these technologies and EHRs. We propose that more applied research is needed to address how artifact designs, implementations, methodologies, and theories are affecting healthcare delivery models

and challenging current models to improve access, patient engagement, costs, and population health.

The papers in this minitrack address the above theme in varying health contexts, including musculoskeletal triage, training for audiology screening, infectious disease risk assessment, parolee reentry into the community, and health consultations. Each article addresses important capabilities enabled by digital health applications such as online learning tools, provider-patient communications, patient engagement from initial contact through follow-up, and ongoing monitoring. Each application also targets healthcare improvement in meaningful ways such as patient satisfaction, patient empowerment, improved education, healthcare process efficiency, and adherence.

The first article by Gehlot and colleagues present a simulation study modeling an episode of care for virtual musculoskeletal triage. A colored petri net (CPN) formalism was used to help optimize triage, diagnosis, and management of new patients virtually at home as their symptoms emerged, avoiding COVID-19 exposure to patient or physicians. The next paper by Schooley and Feldman takes a design science approach to present the design, development, deployment, and evaluation of a COVID-19 symptom checker used in Alabama as a central part of a back to school and work strategy. The system was used across 34 health and educational institutions with over 174k users and 4 million uses. Evaluation results indicate compliance with using the application was high reducing exposure to the disease and enabling a path back to work and school. The results of this study support future implementations of digital health tools to screen for a broader array of infectious diseases to lower patient and provider risk.

In our next paper, Li and colleagues explore how empowerment is embedded in online physician-patient communications, and how such empowerment might improve patient satisfaction with digital health services. Using text mining techniques and econometric analysis, their results indicate that informational and emotional support can extrinsically empower patients and increase the satisfaction they experience. The findings are interesting and an important indicator that the more

empowered and satisfied patients become with digital health services, so may the demand for such services.

Our fourth paper by Gerdes and colleagues applies a design science approach in the design and testing of an audiology screening simulator used to train healthcare providers to conduct hearing screening tests on patients. Again, the idea here was to provide an alternative to in-person interactions. The authors define a framework for developing simulation learning tools, an artifact for individualized, self-paced learning, and an extensible approach to supporting virtual subjects in audiological training. Readers may see this study as not just a new way to learn audiology screening skills, but also as the an important tool for online clinical assessments that could be applied in telehealth visits in the future.

Finally, Zhang et al present the user centered design, development and evaluation of an app that assists justice-involved people (e.g., prison inmates) with substance use disorder with reentry into their communities. Both healthcare and criminal justice experts were involved in design and development iterations with results indicating excellent usability, usefulness, and satisfaction for justice-involved people. This paper highlights the need for customized applications for one of many underserved and vulnerable populations, as well as the growing threat of substance use disorder in society – challenges that may be addressed more fully using digital health technologies.

Each paper in this mini track demonstrates technical, social, and health issues at the heart of the evolving digital health landscape supporting the notion that healthcare continues to advance towards ubiquitous and comprehensive digital delivery. Yet, the research also highlights that in order to enable new delivery models, socio-technical innovations must consider the deep contextual issues in earnest. Human centered design, deep clinical understanding, highly usable systems, broad societal reach, and tailored applications to the needs of all are core and central to meeting the access and quality goals that information technology promises the healthcare landscape.