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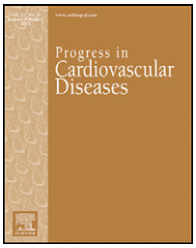

Consumer Health Informatics: Empowering Healthy-Living-Seekers Through mHealth

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ABSTRACT

People are at risk from noncommunicable diseases (NCD) and poor health habits, with interventions like medications and surgery carrying further risk of adverse effects. This paper addresses ways people are increasingly moving to healthy living medicine (HLM) to mitigate such health threats. HLM-seekers increasingly leverage mobile technologies that enable control of personal health information, collaboration with clinicians/other agents to establish healthy living practices. For example, outcomes from consumer health informatics research include empowering users to take charge of their health through active participation in decision-making about healthcare delivery. Because the success of health technology depends on its alignment/integration with a person's sociotechnical system, we introduce SEIPS 2.0 as a useful conceptual model and analytic tool. SEIPS 2.0 approaches human work (i.e., life's effortful activities) within the complexity of the design and implementation of mHealth technologies and their potential to emerge as consumer-facing NLM products that support NCDs like diabetes.

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How many times has it been said that "healthcare is a risky business?" Patients are at risk from noncommunicable diseases (NCD) and poor health habits,[1] with interventions like medications and surgery carrying the risk of adverse effects. The Institute of Medicine's report *To Err is Human: Building a Safer Health System*[2] highlighted the risk of adverse

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Abbreviations and Acronyms

AMIA = American Medical Informatics Association

BI = Biomedical informatics

CHI = Consumer health informatics

eHealth = Electronic health

EMR = Electronic medical records

HI = Health informatics

HIT = Health information technology

HLM = Healthy living medicine

mHealth = Mobile health

NCD = Noncommunicable diseases

WHO = World Health Organization

medical events in clinical settings, with patient deaths in United States (US) hospitals annually exceeding 44,000, at a cost of $38 billion. This paper will address ways that consumers are increasingly moving to healthy living medicine (HLM) to mitigate such health adversities.[3] The goal of HLM is not only to reduce the effects of NCD,[4] such as diabetes and heart attack, but to increase patient engagement and improve patient-health system interactions so that, ultimately, people establish and sustain healthy living practices.[5–7] Through decades of research in the field of consumer health informatics (CHI) and the exponential growth of mobile technology in the last decade, healthy living seekers increasingly have the means to control personal health information and engage with their health over time and space.[8] In particular, people from all walks-of-life now have access to a range of electronic health (eHealth) tools to support health and mitigate disease progression.

Consumer health informatics—a subdomain of biomedical informatics

To improve human health and advance the mission of healthcare in the US, biomedical informatics (BI) has evolved as an "interdisciplinary field that studies and pursues the effective uses of biomedical data, information, and knowledge for scientific inquiry, problem solving, and decision making, driven by efforts to improve human health."[9] Particularly, BMI is the management, study, and use of medical information,[10] including the "cognitive, information processing, and communication tasks of medical practice," with information science and technology to support such tasks.[11,12] Kulikowski and colleagues note that the phrase "biomedical and health informatics" is also used to describe the full range of application and research that underlies its scientific discipline. They continue—that BI is the core scientific discipline that supports applied research and practice, including health informatics (HI).

Hence, HI problems are solved by BI subspecialties who do applied research in the context of clinical and public health systems and organizations, often defined as clinical informatics and public health informatics.[13]

Another subdiscipline of HI is consumer health informatics (CHI), which is the study of consumer information needs and healthcare technologies, as well as the implementation of methods of making information accessible to consumers.[14] As perhaps one of the most challenging and rapidly expanding field in HI; it is paving the way for health care in the information age by integrating consumers' preferences into medical information system.[15] CHI draws upon the social and behavioral sciences to inform the design (e.g., mobile application interfaces) and evaluation of such technologies.[16] CHI research supports problem solving that impacts quality healthcare and the promotion of healthy behaviors, peer information exchange, and social support.[17] Particularly, CHI research is helping people with NCDs navigate the complex healthcare ecosystem with both real-time monitoring, mobile technologies, as well as easy access to evidenced-based guidelines that support disease management.[18]

Fig 1 illustrates the framework of BI, HI, and its multiple subdomains, of which CHI is subordinated. Although considerable overlap exists between CHI and eHealth, differences are apparent. For example, eHealth is a convergence of CHI products and services that include the Internet and mobile technology innovation from the perspective of health data analytics. That is to say, while CHI is a research discipline given to the study of problems related to electronic health information delivery to patients, eHealth refers more specifically to those electronic tools and services available over the Internet, including wireless media such as Web-compatible mobile phones (e.g., mobile health) and personal digital assistants (PDAs).[19] On one hand, CHI is an academic discipline devoted to the exploration of new possibilities that the Internet provides for public health and health education, while eHealth is concerned with designing solutions that facilitate people in accessing information in their personal electronic health record, such as diagnosis, lab work, and prescribed medications, etc.[20]

In one study, researchers did a systematic review of CHI literature from 1999 to 2013 regarding the impact of eHealth technologies on healthcare delivery. Their findings suggest that new CHI applications are being used on a variety of platforms, e.g., the Web, texting apps, and mobile phones, to assist patients with self-management. CHI applications included "reminders and prompts, delivery of real-time data on a patient's health condition to patients and providers, web-based communication and personal electronic health information." Their findings also suggest that such tools enhance healthcare decision making and are a means for clinicians, patients, and others to exchange health information for personal and public use. A key CHI trend noted was the integration of services, technologies, media, data, knowledge and communities, with increased collaboration among healthcare organizations, governments, and the IT industry in the innovation of new eHealth tools—tailored to the needs of the healthcare consumer.[21]

mHealth—empowering people and communities to collaborate

Ongoing research in CHI is showing promising results with eHealth technologies that provide the means to upload data to one's electronic health record (EHR) from wearable and

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