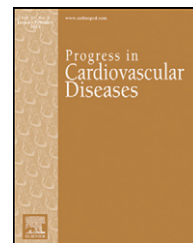


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# The Role of Technology in Chronic Disease Care



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## ABSTRACT

Chronic disease represents the epidemic of our time, present in half the adult population and responsible for 86% of United States (US) healthcare costs and 70% of deaths. The major chronic diseases are primarily due to health risk behaviors that are widely communicable across populations. As a nation, the US has performed poorly in managing chronic disease, in large part because of a failed delivery model of care. New opportunities exist as a result of recent advances in home-based wireless devices, apps and wearables, enabling health delivery systems to monitor disease metrics in near real time. These technologies provide a framework for patient engagement and a new model of care delivery utilizing integrated practice units, both of which are needed to navigate the healthcare needs of the 21st century.

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## Chronic disease and health behaviors

Chronic disease remains the epidemic of our time, impacting half of the adult population and responsible for 7 out of every 10 deaths in the US. Chronic diseases account for over 80% of US healthcare costs, and prevalence in the population continues to rise over time.<sup>1,2</sup> In the 5-year span from 2005–2010, the prevalence of chronic disease increased from 46% to 47% of the US population, or an extra 8 million Americans, and by 2020 it is projected to increase by an additional 16 million, equating to 48% of adult Americans.<sup>3</sup> Although most chronic diseases are not primarily due to infectious pathogens, its root causes are widely communicable across populations, thus validating it as a true epidemic.<sup>4</sup>

Chronic diseases are principally due to four health risk behaviors: physical inactivity, poor nutrition, tobacco use, and excess alcohol consumption. These health risk behaviors are easily communicable across socially connected groups and

therefore transmitted as a social contagion. Unhealthy eating behaviors and obesity are readily spread through social contacts, as are physical activity levels and smoking.<sup>5–7</sup> Social networks can effect the self-management of patients with chronic conditions, and in addition to influencing lifestyle choices, social connections can impact medication and appointment adherence, further impacting health outcomes and subsequent healthcare costs.<sup>8</sup> Prescribed aspirin (ASA) as a cardiovascular (CV) preventive makes an excellent case study, as it is inexpensive, has few side effects, and is available without prescription; accordingly much of the variation in adherence will likely be determined by factors outside of the clinical setting. In a recently published report utilizing data from the Framingham Heart Study, men were more likely to take ASA if a male friend had recently been taking ASA, and women were more likely to take ASA if a brother had recently been taking ASA.<sup>9</sup> Men were also more likely to take ASA if a brother recently had a CV event, and

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### Abbreviations and Acronyms

ASA = aspirin

BP = blood pressure

CV = cardiovascular

EMR = electronic medical record

HF = heart failure

HIPAA = Health Insurance Portability and Accountability Act

GDP = Gross Domestic Product

OECD = Organization for Economic Cooperation and Development

PGHD = patient-generated health data

PM = particulate matter

US = United States

women were more likely to take ASA if a female friend recently experienced a CV event. Consequently, recommended ASA use correlated most with the health and behavior of friends and family, an effect stronger than the recommendation by a health professional.

### The promise of technology in the treatment of chronic disease

In contrast to acute conditions, chronic diseases may last for the better part of the lifetime of the individual, be largely asymptomatic, and are highly subject to environmental and behavioral influences. Consequently, in order to effectively manage and provide appropriate real-time intervention and feedback, chronic conditions require a relatively small volume of patient-level data (i.e. blood glucose, blood pressure, weight, etc.) obtained at frequent intervals (i.e. daily, weekly) over the course of the chronic disease.

The current care delivery model of one to four, 15-minute office visits/year is a vestige of a previous era of reactive healthcare, and provides patient-level data too infrequently to efficiently course correct changes in disease control over time. This has led to a quality of care gap for patients with chronic disease that is described in the Institute of Medicine's report, *Crossing the Quality Chasm*: "Quality problems occur typically not because of failure of goodwill, knowledge, effort or resources devoted to healthcare, but because of fundamental shortcomings in the way care is organized."<sup>10</sup>

With the recent availability of home-based and wearable technologies, health delivery systems now have the capability to collect real-time patient-generated health data (PGHD) directly into the electronic medical record (EMR). Following patient consent, PGHD can be safely transferred into an EMR via a Health Insurance Portability and Accountability Act (HIPAA)-secure enterprise portal such as Apple's HealthKit®. The Apple Health® app can in turn incorporate data from a large and growing array of wearables, apps, and home-based devices that can share and display health data into one consumer-facing platform. Once organized within the EMR, PGHD can be utilized by health systems to create patient self-awareness, health education, and real-time disease-based monitoring and intervention. Additionally, PGHD can be further supplemented with other automated data including pharmacy information (i.e. fill and pick-up rates), activity levels, and even nightly continuous positive airway pressure usage to provide a more comprehensive picture of the patient's health status and health-related behaviors. Finally, based on each of the discrete data elements captured, risk scores

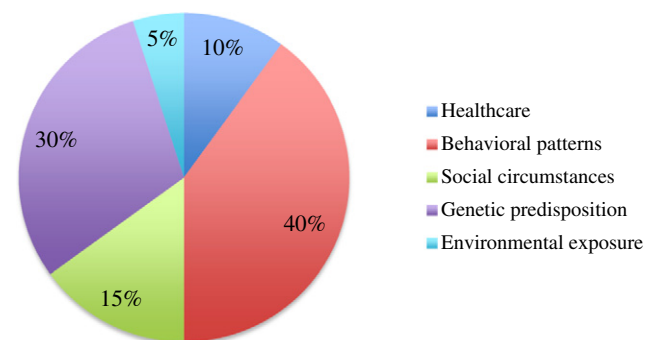
and alerts can be established within the EMR to highlight which patients need what intervention, by whom, and when.

Maximizing outcomes in patients with chronic disease however requires more than identifying the correct treatment plan. It necessitates understanding the components that determine health status (Fig 1) and what measures are needed to positively influence them.<sup>11</sup>

Overall, the healthcare delivery system has a relatively minor impact on an individual's lifetime health status, contributing just 10% to a patient's overall health.<sup>11</sup> Understanding this limitation necessitates that health delivery systems begin to explore other components of health status in order to achieve meaningful improvements in chronic disease outcomes. Yet even within this health delivery system domain, opportunities for improvement do exist, as only half of patients with chronic disease receive the recommended evidence-based care plan.<sup>12</sup>

Social determinants represent a slightly larger domain, comprising 15% of an individual's health status.<sup>11</sup> These include living conditions such as the number of people in the household, transportation capabilities, education level, medication affordability, access to care and social network support. Social service support for instance, has been shown to significantly influence overall healthcare costs. The US spends more on healthcare than any other nation, approximately 17.7% of the Gross Domestic Product (GDP), yet ranks last among Organization for Economic Cooperation and Development (OECD) member countries in quality, access and cost of care, where the average spend is 9.3% of GDP.<sup>13</sup> One of the striking differences is in the amount invested in social services. In the OECD, for every dollar spent on healthcare, about \$2 is spent on social services; in the US for every dollar spent on healthcare, about 55 cents is spent on social services.<sup>14</sup>

Behavioral patterns represent the largest domain governing health, comprising 40% of an individual's lifetime health status.<sup>11</sup> Behavioral factors include lifestyle habits (diet, exercise, etc.), medication adherence, patient engagement, depression, and the patient's perception of the health delivery system utilized. Patient engagement represents a



**Fig 1 – Determinants of health and their contribution to premature death. From: Reference 11: Schroeder SA. Shattuck Lecture. We can do better — improving the health of the American people. *The New England journal of medicine*. 2007;357(12):1221–1228.**

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