

BEYOND DISEASE: TECHNOLOGIES FOR HEALTH PROMOTION

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Health promotion is defined by the World Health Organization as “the process of enabling people to increase control over their health and its determinants, and thereby improve their health.” This is different from the bulk of formal healthcare processes, which are characterized by the treatment of an established disease. Much important human factors research and practice has been done to improve the healthcare delivery process and increasingly human factors professionals are also involved in work on health promotion. Such work has included examining the use and usability of wearable fitness tracking devices, studies of online health information seeking by healthy individuals, and human factors research on social robots for older adults, to name but a few examples. We discuss human factors applications in health promotion, focusing on examples from technology-related research.

THE PERSISTENCE OF STETHOSCOPES

As a thought experiment, conjure up a mental image of “health” or “healthcare.” Who is in this image? Where are they? What are the objects they are using or having used on them?

We would hypothesize that the typical mental model of health and healthcare will resemble the results of our April 2019 Google Images search of the terms “healthcare”:

- Uniformed people in lab coats, nursing scrubs, and surgical garb, often looking authoritative: their arms crossed, pointing at or explaining something.
- Rooms or hallways in hospitals and clinics, filled with display screens and equipment;
- Symbols of medicine: a conspicuous number of stethoscopes and clipboards, the caduceus, red crosses, hearts, and futuristic digital images, with the occasional pill or needle;

and “health”:

- Fewer photos of people, but among those, the most typical character is still a lab-coated, cross-armed physician. The remainder are slim, young people jogging or doing yoga;

- Generally few environmental cues, among which sunny outdoor settings prevail;
- A lot of symbolism and abstractions: hearts, apples, exercise, electrocardiograph (EKG) waveforms, few digital technologies but a *surprising persistence of stethoscopes* (Figure 1).

Figure 1. Typical image retrieved in a Google Images search for “health” or “healthcare” (note: image marked as public domain)



Without over-interpreting this informal content analysis exercise, we believe its results mirror prevailing mental models of Western health and healthcare today. In these models, the primary theme is professional care delivery, wherein

physicians and nurses use instruments—stethoscopes and syringes, but also computer screens—in formal clinical settings such as hospitals and examination rooms to deliver care to a patient. Patients are absent, implicit, or represented indirectly by a diseased organ or vital sign. Health is partly seen through a medical lens—or, perhaps, heard through the stethoscope—but it is also recognized as differing from the delivery of health care. Prevailing mental models of health depict it as a property one occasionally measures or strives for when eating and exercising: an outcome rather than a process. Health is depicted as a desirable, mostly physical state of being associated with youth and energy (a Google Images search of “disease” shows starkly contrasting results).

HUMAN FACTORS IN HEALTHCARE: CARE DELIVERY, PATIENT WORK, AND HEALTH PROMOTION

We have remarked elsewhere that the application of human factors and ergonomics (HFE) in health and healthcare has predominantly targeted the work of trained healthcare professionals in clinical settings, such as diagnostic or therapeutic tasks performed on patients (Holden et al., 2013, 2015; Valdez et al., 2014, 2016, 2017). Historically, these applications originated in hospitals on topics such as medication administration by nurses and the safety of surgical procedures. Over time, HFE research and practice were increasingly applied in non-hospital settings such as primary and specialty care clinics, retail pharmacies, and long-term care facilities (Carayon, 2012).

These applications of HFE to study and improve healthcare professional work are incredibly important, worthwhile, and can benefit outcomes such as quality, safety, patient satisfaction, and cost (Carayon et al., 2018; Hignett et al., 2013; Xie & Carayon, 2015). HFE professionals should continue investing in these efforts (Carayon et al., 2018).

At the same time—and without diminishing the importance of HFE focused on the work of healthcare professionals—we and others have challenged the HFE community to also consider the “work” done by patient, families, and other nonprofessionals in nonclinical settings including homes and communities (Holden et al., 2013;

Holden & Valdez, 2018; National Research Council, 2011). We advocate for *patient ergonomics* (loosely speaking, the “science of patient work”) defined as:

“the application of HFE or related disciplines (e.g., human-computer interaction, usability engineering) to study or improve patients’ and other non-professionals’ performance of effortful work activities in pursuit of health goals.”

(Holden & Valdez, 2018, p.466)

This definition includes work that patients and other non-professionals perform alone or in concert with healthcare professionals. The latter can be called “collaborative patient-professional work” and is exemplified by processes such as patient-clinician communication and shared decision making (Holden et al., 2013).

In unpublished analyses of publications in HFE outlets, we have seen a rising number of studies in patient ergonomics. We also estimate that in a given year of the International Symposium on Human Factors and Ergonomics in Health Care, as many as 1 in 4 presentations can be considered patient ergonomics.

Within patient ergonomics, one can further distinguish work performed by individuals with a chronic or acute illness, for example, taking medications to manage a medical condition, versus work performed in the service of health promotion, wellness, and illness prevention. Patient ergonomics studies of health promotion are rarer but no less important.

BEYOND DISEASE: HEALTH PROMOTION

Health promotion is defined by the World Health Organization (WHO) as “the process of enabling people to increase control over their health and its determinants, and thereby improve their health.” (WHO, 2005, p.2).

From an HFE perspective, health promotion can be viewed as effortful work activity towards health-related goals performed by individuals and teams. These individuals are not necessarily characterized by a disease condition, although studies often

examine groups bounded by age or other demographics (e.g., children, Latinos), geography (e.g., rural, residing in low and middle income countries), or disease risk factors (e.g., obesity, sedentary lifestyle). There have been a number of patient ergonomics studies on health promotion, such as people's use of anecdotal health information on the Internet (Madathil et al., 2014); understanding safety information on over-the-counter medication labels (Rojas & Li, 2017); and factors affecting sleep in adolescents (Vredenburgh, 2017). By far the largest segment of patient ergonomics studies in health promotion addresses technologies for health promotion.

HEALTH PROMOTION TECHNOLOGY

A number of HFE studies have been published examining the usability and acceptance of technologies for wellbeing or lifestyle activities, including fitness trackers (Rupp et al., 2016), bite counters (Scisco et al., 2011), activity monitoring products (Fausset et al., 2013), wearables (Chen et al., 2017), non-invasive blood hemoglobin devices (Borkenhagen et al., 2017), automated external defibrillators (Percival et al., 2012), robot companions (McGlynn et al., 2014), and health messages (Rezai et al., 2017).

Are these technologies effective?

We performed an informal review of recent systematic reviews and meta-analyses of randomized controlled trials (RCTs) of technologies for health promotion:

- Lee et al. (2018) reviewed 12 RCTs on mobile apps for health promotion;
- Stratton et al. (2017) reviewed 23 RCTs on eHealth for worker mental health;
- Lunde et al. (2018) reviewed 9 RCTs on smartphone apps for lifestyle change;
- Joiner et al. (2017) reviewed 22 studies (13 RCTs) on eHealth for diabetes prevention;
- Raaijmakers et al (2015) reviewed 27 technology interventions (25 RCTs) for overweight or obese adults;
- Abedtash and Holden (2017) reviewed 17 RCTs of portable activity sensing devices ("wearables");

- Gandhi et al. (2017) reviewed 27 RCTs on mobile health for secondary prevention of cardiovascular disease.

These 100+ clinical trials generally reported positive results for these technologies, particularly in improving proximal or intermediate outcomes such as physical activity, weight loss, and blood pressure control.

As an example, Abedtash and Holden's (2017) review of 17 trials showed that utilizing wearable activity trackers sometimes – but not always – improved physical activity and body-mass index. More interestingly, they reported that there was generally no health benefit from simply providing individuals with wearable technology and instructing them to self-monitor their activity. Instead, the studies that showed a positive effect on health outcomes were typically ones that incorporated wearable technology within a suite of three or more behavioral change techniques (Michie et al., 2013), such as self-monitoring, goal setting, motivational messages, coaching, education, and incentives.

Do people accept and use these technologies?

If the use of health promotion technologies is effective for improving health outcomes, continued research is necessary to assess these technologies' usability and acceptability. This is because the potential benefits of a technology will not be realized if the technology cannot be easily used or accepted, especially as time passes. The term "Law of Attrition" was coined over a decade ago to indicate that patients or other health consumers may abandon technology over time, even under the controlled conditions and frequent researcher contact inherent in clinical trials (Eysenbach, 2005). In contrast, believing that if you build information technology [IT], people will come to use it, is a case of magical thinking we have referred to as the Field of Dreams Fallacy (Holden et al., 2016; Holden & Karsh, 2009; Karsh et al., 2010).

To better understand people's perceptions, acceptance, and use of health promotion technologies over time, we are currently conducting a national study of a large cohort of employee and

family beneficiaries of an employer-sponsored health plan. Preliminary findings indicate that the acceptance and use of these technologies depends on multiple factors, including the extent to which technology use has become habitual and the level of individuals' intrinsic (enjoyment) and extrinsic (incentive) motivation.

Of interest to HFE professionals, many of the factors associated with technology acceptance and use transcend usability as traditionally defined (e.g., Nielsen, 1993); they are factors of motivation, behavior change, trust, and social influence, to name a few (e.g., Holden, 2012).

NEW OPPORTUNITIES FOR HFE IN HEALTH AND HEALTHCARE

A focus on health promotion, as one component of patient ergonomics, offers HFE professionals new, globally important targets for research and practice. Health promotion and wellness, including health promotion technologies, can be rewarding areas of work due to their societal impact and global ubiquity.

HFE for health promotion will require tailoring existing HFE methods and approaches and applying new ones, including ones that venture past disease and "beyond usability" (Karsh, 2004).

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