

HEALTH-RELATED SELF-EFFICACY CULTIVATED IN THE ECOSYSTEMS OF
INFORMATION AND COMMUNICATIONS TECHNOLOGIES

Todd Swartz

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Master's Thesis Committee

Alexandra Sousa, Ph.D.

Veronica Medina, Ph.D.

Deborah Finkel, Ph.D.

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Todd Swartz

HEALTH-RELATED SELF-EFFICACY CULTIVATED IN THE ECOSYSTEMS OF INFORMATION AND COMMUNICATIONS TECHNOLOGIES (ICT)

This systematic literature review is an exploration of individual and socially cultivated health-related self-efficacy (HRSE), effected in the environments of information and communication technology (ICT). This exploration approaches ICT as a digitally living and highly fluid ecosystem of interconnected and often integrated devices and systems - not as disparate or segregated components. Further, the ICT ecosystem is an omni-present, persistent, and often invasive environment and entity that provides access and exposure to overwhelming content, influence, and perception manipulation. The ICT ecosystem is an underestimated variable of human influence and perception manipulation fully interwoven into the social fabric of Western civilization. While it provides access and exposure to all forms of information and media, it observes, collects, and analyzes individual and social activity to craft and curate interest, engagement, influence, perception, belief, and other behaviors. How technology, commerce, and other entities use the ICT ecosystem to manipulate health-related beliefs and behaviors, and ultimately HRSE, is a matter of significant individual and social concern.

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LIST OF ABBREVIATIONS

CGM	Continuous Glucose Monitor
CVD	Cardiovascular Disease
EHR	Electronic Health Record – cross-platform, multi-practice record, comprehensive
EMR	Electronic Medical Record – usually single medical practice record, limited scope
FoMO	Fear of Missing Out
HRSE	Health-Related Self-Efficacy
HTSE	Health(care) Technology Self-Efficacy
ICT	Information and Communications Technology
MTI	Mobile Technology Identity
PEOU	Perceived Ease of Use
PP	Patient Portal
PTSD	Post-Traumatic Stress Disorder
PU	Perceived Usefulness
SCT	Social Cognitive Theory
SE	Self-Efficacy
SST	Self-Service Technology
TAM	Technology Acceptance Model
TAM2	Extended Technology Acceptance Model
TPB	Theory of Planned Behavior
UTAUT	Unified Theory of Acceptance and Use of Technology

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Chapter 1: Introduction

Healthcare is a complex and expensive socioeconomic industry in the United States. It is also a contentious sociopolitical arena. Affordability, accessibility, and efficacy of healthcare across the population are key concerns (Seid, 2020; Wagner, 2021). The rising costs of healthcare, as well as fiscal ability to participate in healthcare seeking, and general issues of public health are ever present complications in an ocean of current and future dilemmas (Seid, 2020; Wagner, 2021). Current and evolving information and communications technology (ICT) are tools that can help address these healthcare concerns (Wagner, 2021), but there are human complexities such as self-efficacy that directly interact with the influences of ICT which ultimately impact the efficacy and outcome potential of healthcare.

Tracking U.S. healthcare spending since 1960, The Centers for Medicare and Medicaid Services record a 4.1 percent annual increase in 2022 to \$4.5 trillion dollars, representing 17.3 percent of the U.S. Gross Domestic Product (GDP), and estimated \$13,493 per person (Centers for Medicare and Medicaid Services [CMS], 2023). Further, their tables reflect year-over-year increases averaging 4.8 percent a year from 2012-2022. During the same period, U.S. GDP growth only averaged 2.3 percent a year. Data for 2022 show a historic 92 percent of the population with insurance, with Medicaid enrollment increasing 6.1 million and retirees expanding Medicare rolls. However, at the same time poverty increased for children under the age of 19 from 1.6 percent in 2018 to 9.3 percent in 2020 (Keisler-Starkey & Bunch, 2021). Despite disproportionate healthcare spending that nearly doubles the average spent by many advanced and affluent European nations, U.S. health outcomes are poorer in comparison (Kisa, 2021). Healthcare costs outpacing GDP growth, expanding subsidized healthcare, inflation, national debt concerns, and poor return on healthcare dollars contribute to brewing social crisis.

Technology is a promising means to help address and mitigate many concerns of healthcare delivery regarding access, cost, efficiency, and patient experience (Freymann-Fontenot, 2014; Dugas, 2017; Wang, Su, Zhang, & Li, 2021), but it also has limits and caveats (Dorrance & Clement, 2021; Vitak, Liao, Subramaniam, & Kumar, 2018). Technology can facilitate and improve patient inertia (the inability or failure to make good health decisions or timely health initiations) by acting as a “decision aid” via passive, active, or interactive means (Dugas, 2017). Despite the multi-faceted attributes that technology can contribute to addressing issues of cost, social inclusion, and efficiency, it is only one component solution to a broader concern.

The individual human element is also compelling to the calculus of overall healthcare affordability, accessibility, and efficacy. To maximize these attributes, positive self-efficacy regarding personal health appears to be an essential catalyst. Self-efficacy is a psychological term that refers to a judgment or expectation that an individual is capable of performing a given task or behavior (Levy, 2019; Hu, Liu & Gu, 2018; Burrell, Allan, Williams, & Johnston, 2018). Health self-efficacy is an extension of self-efficacy and is the belief in the self-capacity to affect actions and behaviors that yield desired health outcomes (Choi, 2020; Bandura, 1997). It is usually associated with healthy behaviors such as nutritious and balanced diets, maintenance of healthy weight, regular exercise, physical activity (Levy, 2019; Kwong, 2017) and engaging in preventative and diagnostic examination and testing to reduce risk and elevate quality of life (Bandura, 1997). Stress mitigation activities and avoidance of unhealthy behaviors like illicit drug use, unprotected casual sex, or excessive alcohol or sugar consumption are also relevant. Within the domain of self-efficacy (SE), health self-efficacy and health-related self-efficacy (HRSE) are interchangeable in this discussion.

If health self-efficacy does not materialize into ideal outcomes, the opposite may occur. These undesirable outcomes can create adverse and multifold effects. Patients may not achieve optimum health, may worsen their health condition, may extend their treatment requirement, may create a persistent or permanent condition, and could create other cascading adverse personal socioeconomic conditions (Linge, Jensen, Laake, & Bjørkly, 2021). Self-efficacy sustained for specific health-related concerns can suffer lapses or failures due to numerous influences, regardless of overall self-efficacy strengths – especially with great range and contemplations of perceptions, consequences, intentions, competencies, and expectancies (Schwarzer & Luszczynska, 2008). These outcomes produce additional personal health inconveniences, consequences, and costs. Further, healthcare systems must commit additional medical resources to re-address unresolved or chronic issues or newly created ones, which diminishes healthcare efficiency, utilization, and funding across society (Liu, Zhang, Susarla, & Padman, 2020).

The perceptions that drive individual beliefs and HRSE that then manifest as health-related actions and behaviors are driven by a wide range of influences. These influences are experienced through relationships with close family, friends, education, vocation, and other social groups. Influences are also absorbed through exposure to a wide range of media such as news media, broadcast and streaming entertainment and advertisements, and online information and social media. These personal influences are increasingly propagated and accessed via ICTs. Further, individuals of supportive and influential inner circles often consume and share experiences of similar media and ICT influences amongst themselves.

Modern technologies are deeply entrenched in healthcare systems and networks, and many of these technologies extend healthcare management and communication outside the clinic

and hospital (Dorrance & Clement, 2021). ICTs like smartphones, computers, cellular networks, internet, software applications, health portals, and social media platforms are particularly impactful as healthcare extensions. The connective nature of these technologies encourage and support HRSE of the patient during remote healthcare interactions and for daily living. The intent is to optimize patient health outcomes by motivating and harnessing new and existing health self-efficacy behaviors (Bocking, Russell-Bennett, & Letheren, 2021; Bao, Bardhan, Singh, Meyer, & Kirksey, 2020).

Before the prevalence and convenience of these communication technologies, healthcare system cultivation and support of patient self-efficacy outside the interaction of patient-provider appointments was limited (Liu et al., 2020). Commerce driven digital device and platform technology companies are the architects that create and sustain the connective, interactive, and informative environments benefiting today's healthcare systems. These health technology infrastructures can help build and support individual health self-efficacies that are hoped to result in desirable health behaviors and outcomes (Liu et al., 2020; Holland, Hatcher, & Meares, 2018). They are further hoped to broaden and enable accessibility of healthcare and health-related information to increasing demographics and underserved populations (Holland et al., 2018). Many of these emergent health supportive technologies are for-profit entities independent from formal healthcare systems or networks.

Problem. ICT enables interactions and efficiencies that improve health and health efficacy, efficiency, affordability, and accessibility; improvements that open the potential of a more universal mechanism of healthcare (Ross, 2020). With ICT ushering in advancing conveniences and efficiencies of delivering modern healthcare, it also increases exposure to exploitations that can impact patient-consumer HRSE and associated behaviors that contribute to

unreliable expectations and adverse outcomes of individuals and healthcare processes. For example, the prevalence and capabilities of online health information seeking is exposing users to increasing misinformation and bias (Zuo, Mathur, Kela, Salek Faramarzi, & Banerjee, 2022; Suarez-Lledo & Álvarez-Gálvez, 2021; Wang, McKee, Torbica, & Stuckler, 2019) and could be contributing to adverse health outcomes (Wang et al, 2019). These results are due to the exponential growth of information streams and platforms facilitated by ICT. Information, news, and social media websites and platforms routinely host or promote incorrect and/or conflicting narratives that often contradict official or commonly accepted medical information – with collective accuracy rates barely over 50 percent (Zuo et al., 2022). Online exploitations capitalizing on digital illiteracies, identity and privacy abuse, financial theft, harassment, and the socioeconomic and isolation challenged, result in billions of dollars in loss, mental anguish, and impede broader digital technology opportunities (Vitak et al., 2018). This can mislead and antagonize patient-consumers, exploit literacy or knowledge vulnerabilities, or politicize or polarize medical concerns or issues that inform and enable HRSE.

HRSE is often approached within the literature in ways that appear to imply common perceptions and expectations amongst patients, providers, health systems, and researchers (Linge et al., 2021; Cochrane, 2008; Burrell et al., 2018). This is an unreasonable expectation considering extreme variability of individual background and demographics, as well as a complex and influential ICT ecosystem and content. The interpretive complications and/or expectations of health self-efficacy are often shallowly discussed in medical literature – and often addressed as literacy, communications, compliance, or adherence issues (Kwong, 20217). This can include socioeconomic details overlooked between patient-provider such as: literacy and education disparity, unclear conversations leading to misinterpretation of advice versus

life/health required compliance (Kwong, 2017), inability to afford recommended lifestyle modifications, or cultural or religious concerns for example. Patients may hold views unaligned with the medical system on numerous issues such as body weight and mass, smoking, recreational drug use, or dietary concerns (Freymann-Fontenot, 2014). Within healthcare, providers have cultivated perceptions of what patient health self-efficacy should be, often appearing as expectations of patient acceptance of advice and compliance – promulgated by educational, institutional, and professional doctrines and systems (Kwong, 2017). These ideas are sometimes in conflict with health self-efficacy beliefs and behaviors of the patient-consumer. Patients, not unlike healthcare providers, have developed and sustained their own self-efficacy ideas and behaviors within complex familial and socioeconomic environments (Freymann-Fontenot, 2014). These ideas and behaviors, fostered through observation and modeling, are reinforced with individual interpretations of success of outcomes (Bandura, 1977). The literature speaks of patient self-efficacy in various veins to include its tangible benefits, and methods to encourage, cultivate, and supplement it. On rarer occasions, it discusses adverse conditions that affect self-efficacy – accessibility and literacy issues, adverse influences, misinformation, confusion, and alarm, for example (ElKefi & Asan, 2021; Bao et al., 2020; Hong, Hossain, & Chou, 2020; Sanders & Linn, 2018; Jiang & Hong, 2018). While there are many discussions on how technology benefits self-efficacy, there appears to be gaps in the literature regarding its potential for deleterious effects. Further, ICT appears to directly facilitate an environment of potential patient-provider disparities in health self-efficacy views.

Connective and communicative ICT platforms and digital devices have extraordinary benefits within healthcare systems. With universal appeal, use, and reach, ICT can also conversely contribute to adversity in health self-efficacy and outcomes. While useful for health

information, education, and management, ICT facilitates numerous conduits to platforms of media, information, and influence content that can encourage discourse or behavior in conflict with information or the status quo (Hu et al., 2018). This extends into the realm of common medical doctrine, health practices, or recommendations.

The disconnect between the patient and provider is becoming more common. The expectations of providers are often out-of-sync with the self-efficacy of patients (Wagner, 2021; Cochrane, 2008). This discrepancy in the patient-provider relationship is a complexity of psychosocial implications that inhibit a simplification of compliance versus non-compliance, or healthy versus un-healthy assessments (Freyman-Fontenot, 2014; Cochrane, 2008) – a complexity that ICT facilitates and complicates. Contributing to this disconnect are corporations and commercial interests that increasingly insert themselves into the complexity of health-related issues. Some of these companies provide the digital infrastructures, environmental platforms, accessibility, and devices that support health-related industries and information sources. Some of these companies directly contribute to the content and propagation of health-related discourse in conflict with the medical establishment (Andrade, 2020).

The digital noise in and around the ICT ecosystem is contributing to an array of concerns that both enable and impede HRSE and health outcomes. The content and influence that permeates from this environment crafts perceptions and motivates behaviors that can produce both beneficial and adverse effects and outcomes. It is relatively unknown how broad and potent that ICT bolstered influence and perception manipulation has become in terms of affecting health-related social norms, beliefs, and behaviors that provide structure to individual HRSE.

Purpose. The purpose of this study is to explore how ICT is contributing to information and influence overload and perception manipulations that contribute to such concerns as HRSE

re-conceptualization and adverse health-related behaviors. Through an extensive systematic review of the relevant literature, this study hopes to reveal breath, depth, and potentiality of ICT ecosystem machinations and influence that produce outcomes of health-related consequence. Under the view of a more comprehensive optic, the serious potential of collective impact will be more evident. It is acknowledged that without the proliferation and reach of ICT-related devices and platforms, the benefits of a necessary public discourse related to health might be less impactful to concerns of personal health self-efficacy and behaviors that contribute to perceptions of a healthy life.

This study proposes that the concept of HRSE is not so definitive and instead is subject to suggestion and exploitation through effects of ICT ecosystem facilitated influences and perception manipulation. The concept of health self-efficacy has been approached from unilateral perspectives that have slowly or failed to adequately accommodate varied viewpoints of the modern patient-consumer navigating the complex evolutions of modern society cradled in a manipulative and exploitive ICT ecosystem. Despite great benefits, it is proposed that ICT has been the prime facilitator of evolving an interpretive and fluid patient-consumer view of contemporary health and subsequent HRSE. This interpretive and fluid view can conflict with the patient-consumer's best health interests.

Importance. Patient-consumers are at risk of failing to experience optimum health outcomes due to the extraordinary diversity, reach, and impact of ICT-enabled influences impacting HRSE and healthcare approaches to it (Dorrance & Clement, 2021; Suarez-Lledo & Álvarez-Gálvez, 2021). The variability and independence of patient-centric ideas of health self-efficacy may have considerable conflict with some medical and institutional expectations of self-efficacy that are associated with beneficial outcomes (Kwong, 2017). Ultimately, the onus is on

patient-consumers to identify and control for external influences that could contribute to adverse personal consequences, and to actively drive health self-interest and engagement with providers. This research hopes to amplify potential concerns of patient-consumers experiencing ICT effected influences that could impede optimum health outcomes.

The public are increasingly reliant on the conveniences of ICT, and information dispensed and shared utilizing ICT-related devices and platforms (Goulbourne & Yanovitzky, 2021). Healthcare systems are increasingly reliant on ICT devices and platforms to dispense reputable medical services and information by extending the continuum of care in support of patient outcomes and health self-efficacy. The recent COVID-19 pandemic has been a red-flag that reveals issues of concern in the intersection of ICT, health self-efficacy, and health outcomes. Technology evolves quickly, but experts have acknowledged that the COVID-19 pandemic has greatly accelerated ICT environment implementations, to include medicine and healthcare, by many years (Wang et al., 2021). This acceleration of ICT may be outpacing existing research and literature relevant to this area of inquiry. To achieve good health self-efficacy and enable desirable health outcomes, patients and providers alike must be aware of, discuss, and evaluate the reliability and accuracy of health-related information and advice.

The ICT ecosystem is a highly beneficial resource for supporting and advancing HRSE while also enabling and promoting potential HRSE adversity. This study explores and identifies concerns to this dilemma of unrestrained influence and perception propagations tangible to ICT. Further, it illustrates a cascade of complications ICT contributes to health-related interpretations and concerns in the social spaces and between patients, providers, and health systems.

Chapter 2: Literature Review

The purpose of this literature review is to establish a framework that identifies bodies of knowledge and key concepts that will be unpacked in the analysis. Central to this discussion is the idea of self-efficacy and how self-efficacy is observed in terms of health. Another key purpose is to identify how ICT innervates across individual and society health-related concerns and activities in the social fabric, consumer interests, and healthcare industry. It is crucial to understand how ICT enables and facilitates health information, narratives, discourse, beliefs, and behaviors in broader society. This approach is intended to fuel the culminating thesis analysis of ICT-facilitated influences across broader society, how it impacts HRSE, and the outcomes that result from it.

Self-Efficacy. Self-efficacy is a term that was coined by Albert Bandura in 1977. It refers to the expectation that a person is able to conduct a particular task, but more notably it centers on the individual's belief they can accomplish the task (Bandura, 1977). Self-efficacy and the expected outcome(s) are key elements of behavior, and central to Bandura's social cognitive theory which is a common thread in literature regarding health behaviors (Armitage & Conner, 2000; Hu et al., 2018). As a person successfully and repeatedly performs a particular task, their confidence and capacity grow, they develop resistance to internal and external discouragement, and self-efficacy manifests and increases (Levy, 2019). This efficacy is developed through external experiences, can include (vicarious) observations, as well the individual's self-perception (Bandura, 1977; Levy, 2019).

In Bandura's *Unifying Theory of Behavioral Change*, there are four principal sources of information that affect self-efficacy: performance accomplishments, vicarious experience, verbal persuasion, and physiological states (Bandura, 1977). Behavior change is achieved through a

personal cognitive restructuring that is influenced from a broad array of highly-influential media (ICT facilitated) induced social cues and justifications (Bandura, 2001). Self-efficacy gained from the successful performance of tasks can induce motivations to accomplish and seek other familiar and unfamiliar tasks (Bandura, 1977). The cyclical potential of positive task(s) outcome motivating continued and expanding task behavior(s) has created some questions in the literature in clarifying a cause-or-effect dilemma regarding self-efficacy. Does higher-level self-efficacy result in the accomplishment of task or behavior, or is it the successful accomplishment that builds self-efficacy (Levy, 2019)?

Sheeran et al. (2016) discussed a similar concern of cause-or-effect in the accomplishment of task or behavior. *Intention* was a key criterion that they found lacking in representation in many studies across a meta-analysis of health behaviors related to self-efficacy. Past behaviors as catalysts are a significant and complex component of predicting behavior and intention (Sheeran et al., 2016). Within the context of *health behavior theories* (HBTs), intention is “a mediator of the influence of attitudes, social norms, and self-efficacy on health behavior, and evidence indicates that intention has a causal impact on behavior” (Sheeran, 2016, p. 1179). The authors acknowledge gaps exist in identifying successful interventions of attitudes, norms, and self-efficacy in eliciting intentions that promote health behavior changes (Sheeran et al., 2016). That being said, Bandura (2006) suggested, “self-efficacy items should be phrased in terms of *can* or *could do* rather than *will do* statements, ensuring that a person’s *intention* to carry out a behaviour and their *perceived capability* to carry out a behavior remain separate both conceptually and empirically” (Burrell et al., 2018, p. 598).

Health Self-Efficacy/Health-Related Self Efficacy (HRSE). It has been shown that interventions made on attitudes, societal norms, and self-efficacy can result in changes in

intention and positive health behavior modification – to a moderate or medium magnitude (Sheeran, 2016). Intention can be motivated externally through intervention initiatives (ICT supported, and other) and programs that teach, motivate, and support behaviors that build self-efficacy in the accomplishment of health-related activities (Linge et al., 2021). Studies confirm that high self-efficacy consistently results in improved and/or desired health outcomes (Marks, Allegrante, & Lorig, 2005). Across numerous studies that included patients suffering chronic conditions such as arthritis, asthma, heart disease, hypertension, and lupus, self-efficacy support programs were shown effective in producing positive outcomes when contrasted against pre-existing statistics or control groups (Marks et al., 2005). These programs used various approaches utilizing concepts identified in Bandura’s self-efficacy development (Marks et al., 2005). High self-efficacy further associates with improved overall personal health management, mental health, and motivation of persistent healthy behaviors, and psychological function (Dadipoor, Alavi, Ghaffari, & Safari Moradabadi, 2021; Marks et al., 2005; Isaac et al., 2018).

Despite the positive influences of various interventions, the discussion of health-related self-efficacy is often conducted in the literature in ways that overlook intention and further assume compliance expectations between patient and provider (Freyman-Fontenot, 2014; Kwong, 2017). There is a quantifiable gap between what providers and patients perceive during interactions (Wagner, 2021). Societal norms and/or interventions may not conform with a patient’s attitudes or behaviors. Desires of patient behavior or cooperation by providers or healthcare systems may be confounded by the complexity of evolving societal norms. Patient cognitions may conflict with commonly accepted standards of healthcare delivery or health practice (Kwong, 2017; Busetto, Sbraccia, & Vettor, 2021). For example, a survey in 2000 by the *American Dietetics Association* revealed 40 percent of overweight people were not interested

in giving up their unhealthy lifestyle in pursuit of healthy living despite most wanting to lose weight (Cochrane, 2008). The great variance of interpretation and employment of individual cognitions creates dilemmas for patients, providers, and healthcare system. The issues of patient non-compliance become much more complex when hitched to the sophisticated issues of personal psychology (attitudes and self-efficacy) and broader society (social norms, issues, stigmas) (Freyman-Fontenot, 2014; Kwong, 2017; Busetto et al., 2021).

Literacy plays an important part in self-efficacy and patient compliance. This includes conventional views of literacy, as well as digital (technological) literacy and health (medical) literacy. Patients tend to under-report issues of literacy with their providers (Stock et al., 2021). If literacy is not assessed correctly, the tailoring of patient-provider interactions and interventions may not occur, and healthcare may not be optimized or may suffer - which proliferates self-efficacy issues (Stock et al., 2021).

Provider approaches to patient HRSE can also be problematic, especially if assumptions are made during interactions. Omitting consideration of unique dynamics affecting each patient's individual approach of HRSE can generate less productive or beneficial interactions and treatment plans (Cochrane, 2008). Such dynamics include overall health and socioeconomic capacities, capabilities, influences, and perceptions. Clinician evaluation of self-efficacy and other personal and social considerations in the development of intervention and management plans is important (Ji, Sereika, Dunbar-Jacob, & Erlen, 2021). While providers may be sensitive to the unique variances of HRSE across populations, there are logistical and time constraints that can restrict or impede patient-provider interactions and sensitivities. As digital health records (and patient access portals) have become increasingly available, the hope of better-informed, capable, and healthier patients has not necessarily materialized (Freyman-Fontenot, 2014).

Outside the healthcare system, deficiencies in the patient-provider relationship can be both mitigated or exploited when health-related activities are pursued in the broader ICT ecosystem.

ICT & Self-Efficacy. As an ecosystem, ICT comprises typical digital devices like smartphones, smartwatches, tablets, computers, and other mobile and stationary devices that provide digital access to communications, information, and multi-media content. These devices increasingly function passively when not actively manipulated by users. Perhaps more importantly, ICT includes the immense communications, computer, and data infrastructures that enable and host the capacity and capability of global connectivity and information dynamics. Computing and database networks and centers connected via communication conduits of copper, fiber, cellular, and wireless provide access to near infinite streams of multi-media Internet access through systems, programs, and applications engaged through digital devices. Information, social media, entertainment, influence, and perception is experienced through the digital innervations and interaction of an interconnected ecosystem – not a singular device or application.

In terms of general SE, ICT can enable and improve an endless array of life management and enhancement activities. From accessing knowledge, information, and education to managing daily calendars and reminder events to communicating with family, friends, and colleagues, ICT can integrate into and facilitate an entire day's activity with greater fidelity, accuracy, and efficiency. In support of HRSE, ICT can help empower and manage health-related activities such as diet, fitness and activity, medications, treatments and therapies, or other formal health care, education, and research initiatives.

The ICT ecosystem is enabled by a diverse array of corporations that control availability, accessibility, and content. Everything in and tangible to the ICT ecosystem can be exploited and commoditized by controlling corporations. Entities utilizing the ICT ecosystem can platform a

wide range of content. Though formal healthcare and health-related ICT areas represent microcosms of a much larger ecosystem, their digital proximities to collective ICT ecosystem machinations and use can create concerns. People are likely to be primarily or initially engaged with ICT for reasons other than health. The cross-pollination of application, content, influence, and perception in the ICT ecosystem can complicate a person's HRSE views and behaviors, or subject them to externalized interactions of questionable benefit.

One concern is that ICT infused healthcare, mandated by federally subsidized Medicare healthcare structure, has created a digitized and transactional system, managed by, and profitable to healthcare systems, which has removed some power from patients and providers and altered healthcare delivery (Dorrance & Clement, 2021). The environment and inefficiency created by this dilemma have elevated reactive fee-for-services while diminishing primary and preventive care services (Dorrance & Clement, 2021) – preventative healthcare interactions that are associated with positive HRSE. This approach contributes to some well-insured patients (via Medicare and third-party insurers) being more reactive to health issues as they are less motivated by cost, thus a detriment to personal health self-efficacy and some beneficial proactive behaviors.

An interesting interpretation of the technological ICT impact on self-efficacy is the *Passive–Interactive–Proactive (PIP)* framework (Letheren, Russell-Bennett, McAndrew, & Mulcahy, 2019; Bocking, 2021). Conceptualized in the evaluation of technologies implemented in the home, the PIP framework provides a view of how people rely on, leverage, and sometimes abdicate or delegate to ICT. As technologies evolve from passive to interactive to proactive, people exhibit strong and increasing affinity for adoption as they are able to craft personalized experiences that are potentially anticipatory and autonomous (Bocking, 2021). A concern in this

vein is the granting of personal autonomy to a digital tool or service to act on one's behalf. Being reminded to do something or enabling the completion of a predesignated request is one thing – authorizing a device or application to make independent “digital” autonomous decisions is different (Letheren et al, 2019).

The loss of interpersonal connections and hands-on/face-to-face medicine is a growing concern due to transformative healthcare delivery ICT facilitated patient portals, messaging, remote monitoring, and telemedicine/telehealth (Holland et al., 2018; Gordon, Solanki, Bokhour, & Gopal, 2020; Hong et al., 2020). The automation of messaging and reminders are often viewed as impersonal and can further be inopportune or even distressing (Brooks et al., 2020). As healthcare becomes more digital, it could change the perception of personal health as something less tangible and more vicarious because it transposes it into the digital ICT sphere of interactions.

With the explosion of technology, there are arguments that the productivity and efficiency gains are being displaced with the accretion of additional interventions identified by the automation of healthcare delivery (Wagner, 2021). Patients are evolving a personal reliance on digital medicine to identify and guide a reactive relationship of personal health, as opposed to a proactive health based self-efficacy inspired by preventative health. Some automations are replacing active self-determinism (autonomy) and threatening the internal motivators of self-efficacy (Dotolo, Petros, & Berridge, 2018). Many are simply interventions of convenience like glucose monitors that wirelessly connect to mobile devices and warn patients of acute concerns or reach back to healthcare providers, who can then positively engage with patients and their behaviors (Dugas, 2017). ICT is employed to manage a myriad of chronic conditions via patient portals, messaging, mobile devices, and more (Brooks et al., 2020; Bao et al., 2020; de Jong,

Ros, & Schrijvers, 2014). As ICT facilitates an empowering of the patient-consumer, it also creates a potential for “democratizing” effect that can lead to expanding accessibility (Ross, 2020) and reliance. This could evolve into an over-reliance of ICT to facilitate and complete healthcare interactions and desired outcomes.

While not specifically citing ICT as means to generate social support, social support along with self-efficacy was noted as a significant contributing factor to problem-solving and self-management of medical conditions (Ji et al., 2021). Some gravitate to social support platforms voluntarily for auxiliary support and others out of limited resources. ICTs, especially social media platforms, are utilized in greater reliance by some ethnic and disadvantaged groups for accessing public domain or free medical information - groups that may have additional literacy concerns (Goulbourne & Yanovitzky, 2021). These groups often have limited participation in managed healthcare and rely on open-sourced information which can be unreliable or exploitive (Andrade, 2020).

Within the context of the literature and introduction to the key concepts, this analysis seeks to answer the following research questions.

RQ1: What enables and constrains health-related self-efficacy in/by the ICT ecosystem?

RQ2: How is the ICT ecosystem moderating cultivation of health-related behaviors?

Chapter 3: Methodology

Researcher Positionality. From early adolescence to present I had significant access to, education, and immersion with ICT that built a diverse technological foundation that continued through decades of military service. During nearly three decades of active-duty military service as a special operations medic and state and Nationally Registered Paramedic, I had extensive experience in rescue, pre-hospital, emergency, trauma, and combat medicine. I practiced across

civilian and military domains of medicine in major cities, metropolitan and university trauma centers, and global humanitarian and combat operations.

I was a contributor to and user of many of the medical and health technology transformations and evolutions that occurred over past decades. During and post military career, I would participate in numerous military, research, and commercial working groups developing medical technologies and protocols to expand the growing fusion of health and technology. These technological innovations enhance provider medical capabilities and efficiencies, which directly contribute to lives saved and improved patient care - leading to broader healthcare improvements and commercialization opportunities. At the same time, it conversely increased provider reliance on technology and elevated patient expectations of interventions, treatments, and survivability.

Over time I observed some concerns about over-reliance on technology and complications of patient-provider interactions. I have seen the multi-dimensional exploitive capacity and capability of ICT. Over decades I experienced growing patient behavior resistance or expectations cultivated in aspects of misrepresented or misunderstood medical information or technologies. Despite the abundance, propagation, and accessibility of health information, I was routinely surprised at some patients' expectations of medical intervention or pharmacological outcomes not tempered in the reality of contemporary healthcare capabilities or a person's individually unique health condition and behavior. Though I have always been interested in how technology improves patient-consumer quality of life, health outcomes, and self-efficacy, I am more concerned about technology and its use as a facilitating tool to influence and manipulate people and their perceptions, beliefs, and behaviors related to health. Where were some patients' ignorance, misinformation, motivations, disinterests, and/or resistance in relation to health-

related self-efficacy coming from? What were the overt and covert mechanisms driving inaccurate or misleading information and/or behavior influence? My concerns were not unique, as other more experienced providers anecdotally conveyed in recurring conversations over the years. I felt concern that as ICT grew and evolved in positive reach and value for health-related endeavors and outcomes, it would conversely generate negative, exploitative, and destructive applications and influences. These concerns would collectively form the impetus of a qualitative view of this intersection of disciplines.

Systematic Literature Review. This study is a qualitative, semi-systematic literature review (Snyder, 2019; Rother, 2007). The reasons for this approach are multifold. First, this thesis explores HRSE modulated by and through ICT ecosystem use and exposure, further cradled in the dynamics and narratives of the social fabric. Second, the topic of this thesis is interdisciplinary in nature, thus requiring a synthesis of diverse sources. The literature review spans interrelated disciplines and topics of healthcare and medicine, psychology, sociology, and information and communications technologies. Finally, the research questions guiding this study are broad due to the interdisciplinary nature and approach. This approach is appropriate because it allows for the synthesis of disparate data, contained within multiple disciplines, to assemble a more comprehensive view of a broad scope ICT effect on matters of HRSE in the social context.

Data Collection. Utilizing electronic database queries, the majority research was executed within the domain of journal and related peer-reviewed scholarly and scientific articles and research. Reflecting the multidisciplinary nature of this study identified above, an array of databases were queried, including: Communication & Mass Media Complete (CMMC), APA PsycARTICLES & PsycINFO, SocINDEX, CINAHL Plus, JSTOR, Proquest Databases, Sage

Journals, SCOPUS, Statista, PubMed Central, AccessMedicine, MEDLINE (Ovid, EBSCOhost), and Elsevier.

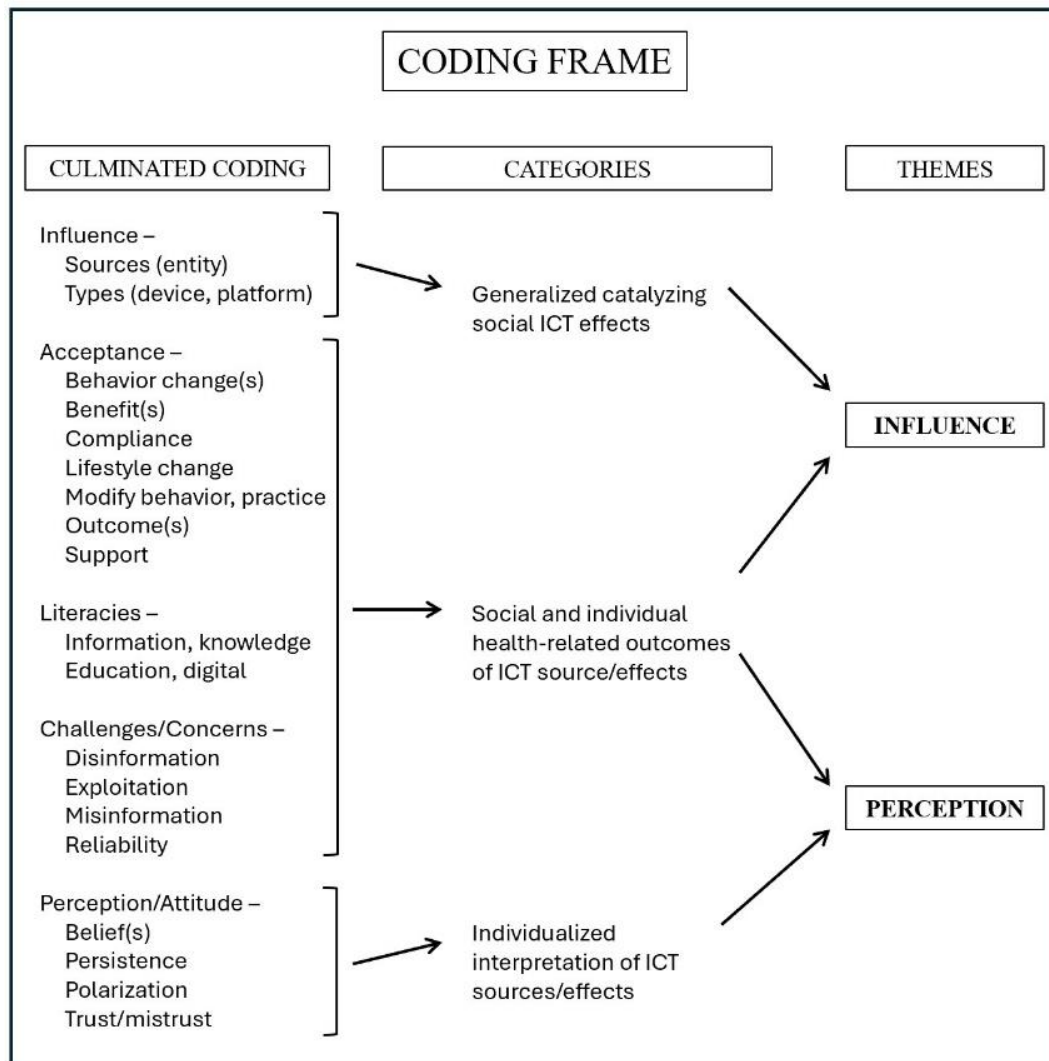
Articles were searched utilizing the IU Library online database access engine. Employing advanced search methods, the following inclusion parameters were applied. Article selection was set from 2015 to present, though most articles selected for this research ranged from 2020-2022. Further parameters included scholarly, peer reviewed, and academic journals, further filtered by discipline area (i.e., healthcare and medicine, psychology, sociology, communications, and technology). Three to five levels of search fields were applied to keyword search criteria to extract thematic relationships among disciplines. Some primary keywords included: self-efficacy, health-related, healthcare, health, outcomes, patient, provider, system(s), information, communications, technology, media, social media, digital devices, influence, and impact. The above criteria produced search results of literature that was abundant, multi-disciplinary, and intuitive to the direction of this research. As a note, the beneficial aspects of self-efficacy and ICT are well documented and numerous, therefore application of keywords with a more negative or derogatory connotation were applied to ensure a diverse spectrum and balance of research data and narratives were extracted for analysis.

Search results were scanned for titles that contained relevant associations and then those article abstracts were reviewed for content that had applicability to the research questions. Articles reflecting at least two, preferably three or more, discipline domains encompassing Westernized medicine and healthcare, psychology, sociology, and ICTs were further evaluated for selection. Articles reflecting broad and diverse scopes of demographics were sought but rare. Additionally, articles addressing a variety of health and ICT concerns or interests at the health and ICT intersection were valued more highly. A fusion of broad demographics, health concerns,

and ICT applications was sought to best visualize the most evident and generalized implications of this thesis across Western society. In total, 50 articles were included in this analysis.

Data Analysis. To unpack the interdisciplinary and diverse literature, a summative qualitative content analysis was used to answer the research questions and reveal recurring themes of the impact of ICT on HRSE. Croucher & Cronn-Mills (2019, p. 162-163) describe this method as an interpretive analysis supported with a pseudo-quantitative approach. While some codes were identified at onset, codes and framework emerged and grew as they were extracted during the research process. The codes evolved into categories that would reveal and support the general themes of this review – an evolving pathway of developing analysis. As certain coding and grouping numerically multiplied, they represented a tracked quantitative significance of the data in both content and context. Figure 1 below provides a succinct view of this process. This approach supported a “latent analysis” of the collective literature that was more deeply interpretive than the individual literature titles might suggest. A phronetic iterative approach was also utilized in this analysis. The iterative approach is ideal in a qualitative inquiry such as this research effort of an interdisciplinary problem with broad influences and evolving social phenomenon and interactions (Tracy, 2018). This approach better enables shift between inductive and deductive paths, while utilizing broad research questions, applying existing theories and frameworks, and allowing recent and emerging commentary on the analysis (Tracy, 2018).

Figure 1
Coding Frame for Literature Analysis



Data analysis of selected articles was conducted through multiple steps. The first step comprised full article review with in-document notation that was then summarized into an annotated bibliography that helped in the generation of deductive first-level codes. The next step was coding using *NVivo*, a qualitative analysis and research databasing software program. First level coding cycle included pre-set codes and inductively-identified codes that applied to the research questions. A few examples of first-level codes included: self-efficacy (SE), health-related self-efficacy (HRSE), health technology self-efficacy (HTSE), technology, device(s),

Internet, behavior, useful, enable, support, promote, benefit, limit, impede, constrain, and concern. Second-level coding is when analysis of the “how, why, or effect” begins to emerge and reveal common themes and relationships that can help formulate potential responses to research questions. This progression narrows the coding into noteworthy segments that support a synthesis of data. These codes included: agency, knowledge, information, expectancy, acceptance, belief, support (social, emotional, informational, material), modified behavior, behavior change, prevention, and outcome. These codes were grouped and used to identify the themes presented in the analysis. Codes with significant recurring frequency along multiple themes included: literacy (educational, medical/health, technology, etc.), influence, social influence, perception, misinformation, trust, trustworthy, mistrust, and social media. The following examples illustrate some progressions from first level to culminating coding that produced groupings and categories that supported themes - also reflecting how similar progressions (with varying factors) could evolve into different themes:

- technology (device) + social media + health information → general social observations/behavior (generalized catalyzing social effects) → influence
- social media + health information → literacy + health behavior → celebrity endorsement → compliance (non-committed/transitory) → social and individual health-related outcomes of ICT source/effects → influence
- social media + health information → literacy + health behavior → belief + lifestyle change (commitment) or reliability (analysis) → social and individual health-related outcomes of ICT source /effects → perception
- HRSE (high) + HTSE (high) + health information → trust or belief → individualized interpretation of ICT sources/effects → perception

Because there are volume limits of collecting such a diverse array of literature for this review, *NVivo* has the added benefit of helping to confirm the selected literature as generally reflective of the various topic domains – in avoidance of anomalous data.

Chapter 4: Findings

Introduction. The goal of this analysis is to explore how ICT, as an integrated and multi-directional ecosystem, is affecting and influencing health-related self-efficacy (HRSE) with generally related beliefs, behaviors, and outcomes. This findings section is presented thematically, to answer the research questions:

RQ1: What enables and constrains health-related self-efficacy in/by the ICT ecosystem?

RQ2: How is the ICT ecosystem moderating cultivation of health-related behaviors?

The first theme *influence* is one of the overarching individual, societal, and information interactions facilitated by ICT in the realm of HRSE and associated behaviors. Influence is the direct, indirect, active, or passive external force or capacity that drives a person to exercise individual effect(s) of thought, belief, action, or behavior. Simply, influence is a catalyst. The influence and impact of ICT and related technologies across society already contribute to variable and impactful outcomes in the general realm of individual psychology, self-efficacy (SE), and resultant behaviors associated with health. The power of ICT facilitated influence is its omnipresence, persistence, pervasiveness, accessibility, applicability, tailorability, and diversity - it innervates virtually every aspect of society. Influence can be subconsciously effectual even when people believe they ignore or reject it.

The second theme of *perception* is a personal view created by a complex interplay and interpretation of an individual's unique dynamics, including personal background and experiences, education, vocation, relationships, and information and media consumed in the

public domain. Perception exists within a context of fluid social norms, manipulated and built by influences – further facilitated by the ICT ecosystem. Perception is the personalized observation and interpretation of information and/or experience that is in contrast with the broader population. Simply, perception is the framework used to process influence. How influence of messaging or information is interpreted, processed, and utilized is dependent on perceptions at the individual level – a perception that also weighs the value and impact of influence that might affect change and incorporation into perception itself. An exploration of these effects that enhance and/or confound perception are essential in understanding the motivation to behaviors that affect HRSE.

There are other extractable themes to this research, but *influence* and *perception* represent key elements and territory that drive health-related behaviors of SE/HRSE. They are notable facilitators of behaviors related to SE and health in the modern technological and digitally connected society. Additionally, considerations of influence and perception permeate and are expressed in multifarious ways across the constructs and factors reflected in existing theories and models discussed herein. The constructs and factors are individually informed, utilized, or rejected through filters of influence and/or perception. The impact of this persistent and omnipresent cosmos of ICT infrastructure, devices, and services follows. First is a presentation of common theories and models addressing the primary subjects. Following that are the two themes of influence and perception and their extractions from the literature.

Setting the Stage: Theories and Models

Throughout the literature, many theories and models are applied to research, reviews, surveys, and assessments. This section will provide an abbreviated review of these theoretical and conceptual models most prominent in this research, to collectively illustrate how researchers

have commonly approached information in this domain. Often referred to as *technology acceptance*, motivations to utilize technologies related to health in this research revealed eleven (11) theories and (5) conceptual models of discussion in the literature. Of these, the Technology Acceptance Model (TAM & TAM2), Unified Theory of Acceptance and Use of Technology (UTAUT), Theory of Planned Behavior (TPB), and Social Cognitive Theory (SCT) were most prominent and robustly represented in the literature. In a statistical analysis of 142 studies, TAM and UTAUT were found to dominate theories for technology acceptance (AlQudah, Al-Emran, & Shaalan, 2021). Table 1 provides an overview of the similarities and differences of the primary factors utilized in these commonly applied theories and models.

Table 1
Theories and Models Applied in Technology Acceptance Research

Constructs / Factors	Theories					
	TAM	TAM2	UTAUT	UTAUT2	TPB	SCT
Perceived usefulness (PU)	X	X	X	X		
Perceived ease of use (PEOU)	X	X	X	X		
Self-efficacy (SE)	X	X	X	X		X
Attitude to use	X	X	X	X	X	
Intention to use	X	X	X	X		
Facilitating conditions	X	X	X*	X*		
Social influences (inc. social norms)		X	X*	X*	X	
Cognitive instrumental processes		X	X	X		
Demographics			X	X		
Consumer variables				X		
Behavioral intentions					X	
Perceived behavioral control(s)					X	X ¹
* = expanding variables of constructs/factors						
¹ = factors included by default in theory						

TAM. TAM theory is used to predict individual technology behavior intention and adoption and comprises evaluative elements such as compatibility, *perceived usefulness (PU)*, *perceived ease of use (PEOU)*, *self-efficacy*, *attitude to use*, *intention to use* (Garavand, Aslani,

Nadri, Abedini, & Dehghan, 2022; Nayak, Bhattacharyya, Kumar, & Jumrani, 2021; Son et al., 2021), and facilitating conditions such as availability and ease of access, speed, and reliability (Garavand et al., 2022; Nayak et al., 2021). General attitude, a component of TAM, is the strongest predictor to the motivation to use various healthcare related ICTs and is a mix of qualities such as expected, realized, and desired outcomes of use, *perceived ease of use*, and *perceived usefulness* (AlQudah et al., 2021; Garavand et al., 2022; Khan, Saleh, Quazi, & Johns, 2021; Tetri & Juujärvi, 2022). TAM2 theory expands the relevance to include criteria for social influence like subjective norms and cognitive considerations (Nayak et al., 2021; AlQudah et al., 2021; Son et al., 2021).

Perceived usefulness and *perceived ease of use* are core to this theory and various studies attribute approximately 40 percent of acceptance and intent of technology use to these constructs (AlQudah et al., 2021; Dutta, Peng, & Sun, 2018). Internet self-efficacy is a typical determinant of *perceived ease of use* and bolsters health information technology (HIT) self-efficacy – aka health technology self-efficacy (HTSE) - which is predictive of ICT usage (Tetri & Juujärvi, 2022). On the other hand, some studies have found TAMs *attitude to use* ICT to be superseded by specific attributes like *perceived ease of use*, *perceived usefulness*, and focused HTSE (Dutta et al., 2018). The authors suggest that despite the ease of which these services might be accessed and utilized, an *intent to use* might be hampered by trust issues that include security and privacy (Dutta et al., 2018; Son et al., 2021) – a concern frequently associated with social media usage.

Social media is an ICT that TAM falls short in analyzing, and Hossain, Yusof, Hussin, A.-lahad, & Sadiq (2021) noted criteria like social influence, information quality, and privacy threats influence social media behavior, as well as traits such as gender, age, and use frequency. Further, Hossain et al. (2021) suggests that scholars do not always agree on the effects of

perceived usefulness and *perceived ease of use* regarding social media. Khan et al. (2021) also found *perceived usefulness* to be negligible in influencing social media adoption behaviors. Despite limitations, TAM/TAM2 theories apply across a broad spectrum of users – patient, medical professional, or otherwise (AlQudah et al., 2021).

UTAUT. Though AlQudah et al. (2021) cited TAM as a “gold standard model” of behavior criteria across many technology domains in an analysis of 142 studies, this recognition is likely due to its numerical frequency of use, as theories like UTAUT appear more fruitful for health-related ICT concerns. UTAUT was found to expand factors of acceptance and intent upwards of 70 percent beyond TAM theories and is the most applied model in the healthcare ICT domain (AlQudah et al., 2021). With similarities to TAM2, UTAUT expands on the manipulating influence of technology use facilitating conditions (i.e., environment, ICT), social influences, demographics, and certain behaviors (AlQudah et al., 2021). This theory has extensively correlated social influences, including social groups and beliefs, organizational/industry work climates, to effecting behaviors and perceptions of ICT use and expectations of use (AlQudah et al., 2021; Son et al., 2021). An evolution to UTAUT2 added criteria to expand consumer driven influences of ICT adoption (Khan et al., 2021). This is an acknowledgement of the increasing influences across media and internet that drive social pressures and influences of corporate inspired consumerism that migrate into the calculus of individual behavior.

TPB. TRB has origins in other theories: the Theory of Reasoned Action (TRA), the Expectation Confirmation Model (ECM) (Khan et al., 2021), and the Theory of Reasoned Behavior (TRB) which extends TRA with behavioral intentions (controls) (Nayak et al., 2021). As an evolved blending of theories, TPB illustrates the ongoing impetus to cast wider nets of

behavior analysis to better identify influential variables and the dynamics affecting outcomes of technological influences and facilitations. The behavioral intentions expressed through attitude are distinctive in influencing adoption of (new) ICT (Hossain et al., 2021). TPB proposes attitude, subjective norms, and perceived behavioral contracts as key elements of expressed individual behavior, and it has been successfully applied in analysis of health-related, consumerist, and other behaviors and intentions (Nayak et al., 2021).

SCT. Social Cognitive Theory is Bandura's framework for self-efficacy previously discussed in the literature review section. Regarding ICT associations, SCT comprises concerns that include technology related anxieties and self-efficacies, both of which are frequently cited variables of ICT adoption and use (AlQudah et al., 2021; Rahman, Ko, Warren, & Carpenter, 2016). High self-efficacy correlates with positive perceptions and high aptitude to navigate and complete challenging situations, which is inclusive of and critical to various technology adoptions and use (Rahman et al., 2016; Choi, 2020).

In assessing the complexity of selecting theories and models in the evaluation of telemedicine adoption, Garavand et al. (2022) cited concern of the multitude of variables that can complicate and confound such a process. These concerns, and more, might include such factors as country, culture, contemporary events, types of technology and context, socioeconomic considerations, and the overwhelming variability of individual psychology and behavior (Garavand et al., 2022). This is of particular concern in a nation such as the U.S. with broad and often extreme demographic diversities of culture, ethnicities, religious beliefs, and multifarious socioeconomic considerations and regional variances. It suggests research and studies could be limited in fully identifying the complex interactions, increasingly inclusive of ICT ecosystem

influence and facilitation, that effect health-related behaviors and outcomes driven by individual self-efficacy.

Amalgamations of Theoretical Models. Combination, integration, expansion, and rich customization of existing theories and models is essential in approaching contemporary issues of evolving and growing diversity of social affects. Throughout these findings, many researchers were found to conduct studies through combined approaches. For example, Hossain et al. (2021) referenced TPB, TAM, TRA, and Self-Efficacy theory (SE-theory) for their study of glucose monitors. Dutta et al. (2018) applied TAM, HTSE, and select demographics to better assess user acceptance of health-related ICT. AlQudah et al. (2021) noted integration of Social Cognitive Theory attributes in studies utilizing TAM and UTAUT and encouraged widening theory and model integration for healthcare-related ICT studies.

The diverse use and application of theories and models reveals a broad complexity of interpretations regarding ICT in the realm of health and user. Combinations of these and other theories and models have been used to extract beneficial findings of health-related ICT research (Hossain et al., 2021). There is no one-size-fits-all approach to evaluating the universe of ICT in the context of healthcare and the individual. As illustrated above, there is much interwoven and interconnected influence that drives human behavior in today's highly connected and media driven world, and inconsistencies and contradictions of applied theories emerge throughout the literature. Further, interpretations and/or outcomes over time may be fluid in terms of acute and unique social contexts at the time they are observed or assessed. With expanding inclusion of social contexts and consumerist factors revealing complexity of effectors and influence, AlQudah et al. (2021) and Garavand et al. (2021) echoed advice of accommodating numerous acceptance/adoption models to better craft expectations and identify research gaps. ICT has

helped enable and perpetuate an ecosystem of ever expanding and evolving complexity of social norms and individual behavior, thus complicating the application of theories and/or models that fail to account for a complex calculus of period influence, behavior, and outcome.

Influence

The ICT ecosystem has changed the paradigm of influence. Influence has evolved to new levels of propagation, exposure, and impact. Influence that was previously and mostly restrained to deliberate and voluntary engagement of the recipient is no longer essential. Influence that was previously confined to time restraints, location, environment, and delivery methods such as broadcast radio, television, newspapers, or the water cooler, now has no boundaries. Influence that was previously restrained by limited or expensive technologies or resources is now more easily accessible, cheap, and routinely free. The ICT ecosystem is omni-present, omni-persistent, without borders, uncensored, and individually customizable. The ICT ecosystem is analytical, intuitive, and deliberate in the power to curate and present influence desirable to the recipient. This capacity to enable the patient-customer-user is of significant personal and social utility. This ability to cater to or enable engagement and isolation with preferred and agreeable influences can present both benefits or detriments to HRSE or any other individual SE. Likewise, the patronization of desirable influence does not isolate the user from exposure or the effects of the broader and persistent noise of ICT ecosystem influences. This section illuminates influence in regard to health-related concerns tangible to the ICT ecosystem.

ICT Enablers of HRSE. The ICT ecosystem is a compelling, and sometimes overwhelming, innervation of technology, people, society, and information that creates, engineers, and impels influence. Populations embrace new and evolving ICTs with high interest and increasing reliance. This is increasingly true for younger generations such as Generation Z

(Gen Z) individuals born from 1995 to 2010, and subsequent generations who are sometimes referred to as “digital natives” (Nayak et al., 2021; Cozma & Muturi, 2021) – a term that clearly acknowledges the prominence and reliance of technology integration in the conduct and management of daily living. Even among depressed socioeconomic demographics, studies report high accessibility of mobile communications technologies (Faujdar, Kaur, Singh, Sahay, & Kumar, 2022). Technology helps people navigate and overcome various limitations and while mobile devices contribute particularly and significantly to healthcare delivery (Balapour, Reyhchav, Sabherwal, & Azuri, 2019), nearly any digital device and/or software platform or application that helps manage or enhance lifestyle choice or experience is readily embraced and utilized. Influence is facilitated by ICT through enabling attributes such as connectivity, awareness, management, motivation, and support. This also includes individual and social gains of health-related literacy and knowledge. The analysis of direct, obvious, and overt health-related influences and outcomes cultivated in the ICT ecosystem are important, but equally important are simultaneous tangible effects that are unintended, deliberately covert, and cumulative, that may contribute to misinformation, disinformation, mistrust, habituation(s), or other beliefs and behaviors averse to good health and health-related outcomes.

As with most segments of technology application, the integration of ICT into health and healthcare endeavors revolve around similar attributes such as improving service, experience, accuracy, and safety (Baudier, Kondrateva, Ammi, Chang, & Schiavone, 2022). Much of the vast diversity of digital equipment, devices, platforms, and software used in the ICT ecosystem translates into health-related spaces. Health technologies are defined “as any devices that are used to diagnose, monitor, or treat health or any medical conditions” (Rahman et al., 2016, p. 14) and when integrated with concerns of self-efficacy, they are referred to as HTSE (Rahman et al.,

2016). These include and are in no way limited to computers, tablets, smartphones, smart watches, smart glasses, and other smart wearables imbedded with a variety of sensors and actuators that provide biometric and medical monitoring (i.e. heart activity, blood oximetry, respiration), fitness, activity, sleep, location tracking (Immonen & Koivuniemi, 2018; Obro et al., 2021; Kim, Shin, and Yoon, 2017; Nayak et al., 2021; Iqbal, Johnson, Chambers, & Johnson, 2021), and interactive speech recognition (Nayak et al., 2021). Wearable technologies can be worn externally or implanted inside the body (Hossain et al., 2021) and are referred to as smart wearables if they provide monitoring, analytics, data logging, communication capabilities, or appliance type medical interventions (Hossain et al., 2021). Health-related environmental technologies can include smart homes, smart appliances (Immonen & Koivuniemi, 2018), and interactive smart-speakers with digital assistants (Nayak et al., 2021). The array of digital ICT devices provides users access to a universe of health-related information, monitoring, interventions, and management via interactive capabilities to include voice, text messaging, email, mobile applications, and Internet web-based platforms (Widmer et al, 2015; Obro et al., 2021; Iqbal et al., 2021).

Formal healthcare providers and systems capitalize on the ICT ecosystem that provides connectivity and accessibility to devices and services that support healthcare management via telehealth/telemedicine, remote health monitoring (Immonen & Koivuniemi, 2018; Iqbal et al., 2021; Hossain et al., 2021; Reyhav et al., 2019), and other web-based and communications strategies like email, text-messaging/SMS (Short Message/Messaging Service), automated messages, electronic health records/electronic medical records (EHRs/EMRs), and information access (Iqbal et al., 2021; AlQudah et al., 2021; Faujdar et al., 2022). This includes integration of wearable devices that can remotely monitor patients, manage treatments, and enable disease

detection across a broad spectrum of medical concerns that include cardiovascular, respiratory, and blood glucose/diabetes (Hossain et al., 2021). Technologies that facilitate formal health-related workspace and management via the Internet are often referred to as *eHealth* and typically encompass tools like healthcare software suites that include health services management, scheduling, information distribution (Choi, 2020), and integrate functions such as patient portals (PPs) (Son et al., 2021), EHR/EMRs, and telemedicine. Patient use of PPs reflect personal healthcare management enhancements that enhance HRSE via improved satisfaction with patient-provider communications, appointment keeping, medication adherence, and overall health outcomes (Son et al., 2021). *eHealth* PPs provide healthcare systems a direct venue of patient-consumer information and behavior effects (via influence) – effects that can be beneficial, adverse, misleading, ethically or fiscally motivated. Various ICT devices, such as mobile smartphones, that integrate and facilitate individual access into the *eHealth* and health-related continuum are referred to as *mHealth* (Choi, 2020; Faujdar et al., 2022).

mHealth facilitates self-service technologies (SSTs) for patient-consumers that can improve accessibility, convenience, safety, and precision and fidelity of health management (Immonen & Koivuniemi, 2018; Baudier et al., 2022). For example, the spectrum of previously mentioned ICT devices, platforms, and systems enable patient-consumer health participation and management with provider connectivity, information seeking, personal data access (EHR/EMR, PPs), and telemedicine (Widmer et al., 2015; Immonen & Koiveniemo, 2018). Multi-media accessibility helps improve public health through information, awareness, and related promotions (Hong et al., 2021) and is inclusive of integrative broadcast media, health websites, and social media (Hong, Myung, & Kim, 2021) that is dispensed via the Internet and airwaves. Increasing mobile technology accessibility is further growing interest, participation, and access of *mHealth*

in underserved populations (Faujdar et al., 2022). Digital health interventions (Widmer et al., 2015) and SSTs are a part of global shift in patient-consumer centered and enabled health services (Immonen & Koivuniemi, 2018; Baudier et al., 2022) and span preventative, collaborative, and prescribed healthcare as well as expanded accessibility to populations.

There are hundreds of thousands of *mHealth* specific and health-related downloadable applications that integrate with ICT devices spanning formal healthcare to individual/consumer interests that include categories of activity and fitness, chronic disease management, and behavior modification and/or support (Balapour et al., 2019). These digital tools evolve beyond simple vitals and activity monitoring capabilities into data collection, analysis, and management that can help with such concerns as weight management, substance abuse, and smoking cessation (Balapour et al., 2019). ICT-enabled active and long-term monitoring can contribute to beneficial lifestyle behavior modifications, physical activity motivation, predictive or early diagnosis of disease processes, and management of treatments or interventions (Nayak et al., 2021). *mHealth* is recognized as an effective interactive tool to cultivate positive health behavior change, particularly in the realm of self-management activities (Obro et al., 2021) and many of these devices and tools interact or synchronize with each other to provide a greater range of accessibility and capability in this effort (Nayak et al., 2021). ICT-enabled continuous glucose monitoring systems (CGMs) may reduce glucose monitoring related complications by 35 percent (Hossain et al., 2021) and digital health interventions have led to significant reductions in negative outcomes related to cardiovascular disease (CVD) (Widmer et al., 2015). Studies have shown that a customized approach to health-monitoring utilizing wearable ICT devices can drive increased “self-preservation” (Kim et al., 2017; Hossain et al., 2021). The same study also confirms that those who tend to be early adopters of technologies have greater SE and are more

likely to explore and adopt evolving ICT as compared to the general consumer population. Nayak et al. (2021) echoes similar findings that the feedback and interaction of health wearables not only empower, motivate, and sustain positive health behaviors but can help perpetuate positive HRSE behaviors and discontinue unhealthy behaviors which collectively lead to positive individual outcomes. ICT can clearly benefit patient-consumer HRSE and outcomes, but it also provides a bridge between patient and healthcare providers.

Helping to bridge the patient-provider relationship, messaging capabilities occupy *eHealth* and *mHealth* realms. Positive health outcomes are associated with efficient and effective patient-provider communications (Garavand et al., 2022; Iqbal et al., 2021) effected through ICT-enabled *eHealth* and *mHealth* devices and services (Garavand et al., 2022; Baudier et al., 2022; Iqbal et al., 2021), that further correlate with positive SE effects (Baudier et al., 2022). Faujdar et al. (2022), citing systematic reviews, indicated ICT-related patient communication tools, text/SMS messaging in particular, were associated with improved patient physiological outcomes and adoption of health behaviors such as self-care, treatment adherence and management, and risk mitigation – findings echoed by Iqbal et al. (2021). As a supplement to in-person and conventional telecommunications, ICT can facilitate (automated) health coaching activities via email, text/SMS, and smart applications that help develop and sustain healthy behavior changes (Obro et al., 2021). A connectivity routine with healthcare providers can help develop and encourage positive patient behaviors, lifestyle changes, and health management. Success in remote monitoring and coaching is directly associated with a patient assuming or perceiving a provider or coach is actively engaged (Obro et al., 2021). *mHealth* has elevated and maximized opportunities and outcomes of patient-consumer health management, particularly

when fostered with direct health provider interactions (Obro et al., 2021) and ICT conduits of accessibility and collaboration enable these relationships and outcomes.

Telemedicine, also known as telehealth, is another patient-provider *eHealth/mHealth* communication bridge and the recent COVID-19 pandemic has contributed considerably to its growing relevance and use (Baudier et al., 2022; Garavand et al., 2022) with online consultations doubling to 1.8 million interactions from March 2019 to March 2020 (Iqbal et al., 2021). Telehealth has enabled greater patient healthcare participation, decision making, individual autonomy, and patient education (Garavand et al., 2022). As an adjunct to clinical/in-person traditional healthcare, telehealth supports continuing care, education, prevention, and treatment activities (Garavand et al., 2022; Obro et al., 2021; Nayak et al., 2021) and as an effective patient-provider communications adjunct has been associated with hospital admission reductions and improved mortality for patients with heart failure and diabetes (Iqbal et al., 2021). Online telehealth services can be provided to treat mental health concerns such as depression and anxiety disorders (Tetri & Juujärvi, 2022). Additionally, telemedicine has high potential of addressing health inequalities with accessibility for disadvantaged populations (Iqbal et al., 2021; Garavand et al., 2022), to include mobility and affordability challenged (Terrasse, Gorin, & Sisti, 2019), and to reach those with transportation challenges and/or in remote locations (Iqbal et al., 2021; AlQudah et al., 2021; Garavand et al., 2022, Terrasse et al., 2019). Overall, telemedicine is observed as contributing to patient resilience across society (Baudier et al., 2022) with a multitude of HRSE benefits.

Social media is a major center of gravity within the ICT ecosystem and health-related concerns are featured throughout those digital spaces. Second to *YouTube*, *Facebook* has 2.3 billion active users with nearly 75 percent of users in the U.S. visiting daily and reporting it as a

source for health information and support (Rivera, Moran, Thrul, Joshu, & Smith, 2022). Social media contributes cultural engineering and community building that can drive strong relationships, memberships, and partisan-type alliances that craft influence and perceptions that range from single subjects to worldviews (Marcos-García, Alonso-Muñoz, & López-Meri, 2020) and that further extend into health-related information and behaviors (Hong et al., 2021) particularly through public health communications and promotion (Cozma & Muturi, 2021).

HRSE Outcomes of ICT Enablement. Generalized outcomes of ICT-enabled health-related activities include patient-consumer empowerment that improve healthcare behaviors, healthcare system participation, and vaccine and testing compliance (Faujdar et al., 2022). *mHealth* applications were found to positively contribute to “physical activity, diet change, adherence to medication or therapy, and knowledge enhancement related to clinical procedures” (p. 224), resulting in improved clinical health outcomes (Han & Lee, 2018). Digital health interventions help improve (lifestyle) management and diminish negative outcomes related to hypertension, CVD, heart failure, and type 2 diabetes, with correlations of reduced hospitalizations and improved mortality (Iqbal et al., 2021). Geriatric populations benefit from online health information access and behavior motivation that help them age-in-place (Choi, 2020) and these information and enablement tools promote improved health outcomes (Wang, Song, Zhu, Ji, & Wang, 2022). Older populations can also benefit from a variety of ICTs that enable or enhance independence, companionship, and safety, further empowering populations to age-in-place for longer (Corbett et al., 2021) - to include digital monitoring of people with concerns of cognition, memory, communication difficulties, or incapacitation (Bartlett, Balmer, & Brannelly, 2017). Again, each ICT infused capability contributes to improved HRSE potential.

Acquisition of health-related knowledge directly associates with positive health behaviors and compliance and further helps to manage media use in those endeavors (Cozma & Muturi, 2021). Perceptions of self-efficacy can be elevated through health behaviors such as exercise and avoiding substance abuse (Rahman et al., 2016), along with similar lifestyle choices and management activities that further contribute to HRSE. Many ICT infrastructures and devices did not originate or initially evolve with health-related intention or implementation in mind. Time, need, creativity, and commercialization opened the possibility of most any technology to be adaptive to health-related domains in some capacity. These benefits can collectively help improve HRSE by increasing knowledge and enhancing or changing behaviors and/or perceptions that result in improved or optimum outcomes of health. Digital literacy is seen as critical for health outcomes going forward (Wang et al., 2022) and ICT and social media help contribute to the health literacy that will support those outcomes (Cozma & Kuturi, 2021).

Individual agency (self-efficacy) is enhanced through gained medical knowledge and health literacy – enabled through access to personal medical data such as physician notes, charts, images, laboratory results (Bartlett et al., 2017) or health information internet searches (Wang et al., 2022). This health literacy is further recognized to translate to embracing health-promoting behaviors and self-care indicative of high HRSE (Choi, 2020; Wang et al., 2022). Improving health and science literacy enhances HRSE and helps build individual resilience to and/or investigative inquiry into false or misleading health information or rumor that has potential of negative outcome (He et al., 2021). Through online *eHealth* PPs, patients engage in a variety of actions that include viewing personal medical records (EHR/EMR) and communicating with health providers (Son et al., 2021). EHR accessibility is acknowledged to improve patient-provider relationships, improve healthcare delivery, and empower patients (Dutta et al., 2018).

Though EHR usage is still growing slowly, accessibility reveals people's climbing interest in utilizing PPs and EHRs and related management tools in pursuit of better informing themselves of their conditions and improving quality and outcome of health behaviors (Dutta et al., 2018). This includes lifestyle management practices relating to diet, medication, exercise, and the interplay of practices with health conditions, especially chronic conditions. While intent to use were the same between genders, women's HTSE-motivated attitudes to use and learn EHR systems were higher (Dutta, 2018), a finding similar in other health-related technology platforms and devices.

Utilizing mobile devices and wireless infrastructure, *mHealth* tools enable and contribute to patient-consumer health education, awareness, and promotion, public health advisories, personal healthcare access management and reminders, patient monitoring and treatment compliance, and medical staff support features ranging health records management to decision support to enhance diagnosis and treatment (Faujdar et al., 2022). While *mHealth* is seen as a mechanism to help encourage healthier lifestyle choices through promotion of positive health behaviors and risk reduction (Faujdar et al., 2022), the merging of mobile digital devices, applications, remote monitoring, and interactive health-coaching support (Obro et al., 2021) has correlated with a positive nexus of individual perceptions related to mobile technology identity, overall IT experience, and SE promotion (Balapour et al., 2019).

Popular digital assistants such as *Alexa* (Amazon), *Google Assistant* (Google), and *Siri* (Apple) and associated fixed and mobile devices can interact hands-free with users, operate inside and outside the home, perform user queried internet searches, provide entertainment, run home appliances, and a multitude of other functions that contribute to personal healthcare management such as providing medication or treatment reminders and dietary information (Iqbal

et al., 2021; Beaney, Kalirai, & Chambers, 2020; Corbett et al., 2021). Healthcare professionals and patients have cited improvements to medication and treatment adherence and positive behavior adaption through digital assistant/device use (Beaney et al., 2020; Corbett et al., 2021; Iqbal et al., 2021). Some of these and similar devices can integrate with cameras that can enable remote viewing of a room to see if a person has become incapacitated (Corbett et al., 2021). Added benefits also include quality of life and SE enhancements that include counteracting isolation, companionship with interactive digital “company,” management and reminders of daily activities, entertainment cultivated by assistant connected devices (music, podcasts, videos, etc.), and imparting feelings of safety and security – in part through emergency services integration (Corbett et al., 2021). These device capabilities can contribute to HRSE by facilitating autonomy, independence, and control.

Exposures to the vast array of health-related information and media messaging within the ICT ecosystem inspires individual interest, interaction, and discussion concerning health topics, which drives interest in other health-related behaviors which in turn can influence adoption of positive health beliefs and behaviors (Hong et al., 2021). Vast quantities of health-related information once delivered via television and print magazines have been digitized for on-demand multi-platform Internet access and exert a discernable impact on health-related behaviors (Hong et al., 2021). Direct human interaction and discussion of information is often observed as essential to developing informed perceptions and decision making. While direct interpersonal interactions can displace effects of health-related ICT media influences, the ICT ecosystem can be a helpful substitute for that lack of human interaction and discourse (Hong et al., 2021).

Almost half of surveyed adults reported social media influence on individual health conduct (Schillinger et al., 2020). A multitude of studies show social media is used to promote

individual and public health services and advocacy, dispense health information, drive health behaviors, promote overall wellbeing (Petkovic et al., 2021; Zhang, Zhou, & Lim, 2020) and support health-related motivations (Cozma & Muturi, 2021; Zhang et al., 2020). Social media can contribute to better informed patients and health consumers (Khan et al., 2021) and help increase public awareness and fight health misinformation (Rivera et al., 2022; Schillinger et al., 2020). Part of this is due to the democratized, creative, and engaging aspect of the medium (Schillinger et al., 2020). Social media has played a part in various public health crises, including the recent COVID-19 pandemic (Cozma & Muturi, 2021), and higher social media exposure associates with increased health-related protective behaviors and SE (Choi & Fox, 2022; Choi, 2020). Social media groups and communities hosted COVID-19 interest, discussion, and support activities (Petkovic et al., 2021; Schillinger et al., 2020) - which can be especially crucial for people with physical or mental health challenges, chronic or permanent conditions, addictions, or who lack supportive or accepting family, friends, or environments. Social media software infrastructure and artificial intelligence (AI) enhanced data analytics can contribute to real-time analysis of demographics, language use, and social context to develop infomatics that support statistics, and predictive modeling of public health trends, crisis response, policy, or mental-health concerns (Schillinger et al., 2020; Zhang et al., 2020). This same level of analysis and demographic data are applied to consumer and marketing analysis. Social media enables immediacy of speed, access, global reach, and volume for messaging, information, education, and promotions in numerous visual and/or auditory media formats that can create great impact and interest (Cozma & Muturi, 2021; Petkovic et al., 2021) – which can be of added benefit to those with processing or literacy issues (Cozma & Muturi, 2021) and other communication challenges.

YouTube is a platform utilized for medical information seeking and discussion (Calvo, Cano-Orón, & Llorca-Abad, 2022; Hong et al., 2021), particularly during the COVID-19 pandemic where general knowledge, preventative and protective behaviors, testing, and treatment actions were sought (Shi et al., 2022; Calvo et al., 2022; Zhang et al., 2020). One study noticed that users readily accessed cancer screening and prevention information on Facebook (Rivera et al., 2022). A large meta-analysis of 88 studies involving over 871,000 participants found that social media initiatives to motivate physical activity could positively increase individual activity, with some improvements in body weight and/or heart rate (Petkovic et al., 2021). Additionally, social media can provide access to like-minded people or communities that offer information or resources that may be difficult to find or access locally or online. Because various forums enable sharing, venting, advice, information exchange, and individual/group social support, social media is used by people with mental health issues who are emotionally reluctant (Zhang et al., 2020) or fiscally constrained from seeking professional help. While social media can both combat and exacerbate health-related literacy, health professionals can advance legitimacy by linking formal *eHealth/mHealth* conduits to ensure propagation and confirmation of accurate information (He et al., 2021).

Constraints to Influence. The challenges that encompass the intersection of ICT, health, and SE/HRSE are numerous and include a range of constraints and negative attributes. While technology can help people overcome an array of personal and lifestyle limitations or enhance or improve life in general, it can conversely create individual and social concerns, fuel overreliance or addiction, and open floodgates for mechanisms and avenues of misinformation, disinformation, risk, abuse, and exploitation. The sheer volume of information available over the Internet can be overwhelming, especially if digital and/or educational literacy is absent or low –

resulting in confusion or disincentive to seek health-related information (Khan et al., 2021) or ability to identify disinformation (Calvo et al., 2022). Misinformation and disinformation were propagated throughout online media during the COVID-19 pandemic (Calvo et al., 2022; Dan & Dixon, 2021; Zhang et al., 2020; Cozma & Muturi, 2021) – results that can contribute to mistrust, paranoia, anxiety, panic, non-compliance, and negative outcomes. Misinformation pertains to inaccurate, sometimes incomplete or false, information that is typically advanced through unintentional, careless, or accidental means. Disinformation is the intentional advancement of inaccurate or false information, usually for the purpose of misleading. Individuals with low health and ICT literacy are at higher risk of misinformation (Rivera et al., 2022). As an example, studies have found upwards of 40 percent of skin cancer prevention practices and over 50 percent of some reproductive health choices found online to contain misleading information or commentary (Terrasse et al., 2019). Misinformation has been used to manipulate political attitudes, inspire past anti-vaccine movements, and suggest microchip imbedding or instant-death COVID-19 vaccine conspiracies (Sadiq & Saji, 2022).

People can be exposed to questionable health-related information that elevates personal risk and adverse outcomes while using some *eHealth* applications (Choi, 2020). *eHealth* applications, utilized by patient and provider alike, could use biased algorithms and data sets that provide erroneous or biased decision-making support (Terrasse et al., 2019). Mobile internet and social media users, as opposed to “traditional” computer users, may be more susceptible to misinformation because of emotional attachment to the combination of device and application format (Sadiq & Saji, 2022). Device and media attachments are more prevalent in younger populations who also have an increasing reliance on social media (Cozma & Muturi, 2021) and

though they are at as much risk as older populations, they are generally more digitally literate and savvy to avoiding risks.

Access to ICT devices and tools do not necessarily equate to digital literacy (Iqbal et al., 2021). Not everyone is eager to engage with ICT facilitated health-related services, participation can be involuntarily obligatory or coerced (Bartlett et al., 2017), and assumptions of healthcare improvement and efficiencies may not be realized. Despite advantages of improving patient-provider communications and personal outcomes of health and health-management, Dutta et al. (2018) noted that EHR/EMR utilization by patient-consumers was slow. Digital health is an evolving and essential catalyst for improving geriatric health (Wang et al., 2022) and older patient populations note a need for intuitive and articulate digital assistants (Corbett et al., 2021), but digital literacy and technology evolutions can present steep learning curves that take time to learn and navigate, or outright inhibit adoption (Corbett et al., 2021; Son et al., 2021). Training and competency can be problematic and overwhelm providers with time-consuming training of patients in adoption and use (Garavand et al., 2022). SSTs can create challenges in optimizing health outcomes when responsibilities of health-related activities shift to the patient, particularly when provider contact is diminished or lost (Immonen & Koivuniemi, 2018). Self-reporting, versus supervised remote monitoring, could result in patient biased reporting (Reychav et al., 2019) that confound diagnosis, treatment, and/or outcome. Persistent messaging can contribute to attention fatigue (Shi et al., 2022) that push users away from using *eHealth/mHealth*. Age, education, economic circumstances, location, culture, religious issues, and technological savviness can contribute to the “digital divides” of digital literacy and accessibility that impede successful participation in digital healthcare and desired health outcomes (Choi, 2020; Petkovic et al., 2021; Iqbal et al., 2021; Garavand et al., 2022). These demographic concerns can

exacerbate an inequality of ICT-facilitated healthcare delivery if there is a shortage or absence of technology access and resources, digital literacy is unaddressed (Petkovic et al., 2021; Terrasse et al., 2019; Son et al., 2021), and/or the healthcare is focused on cost savings versus quality and reach of services (Terrasse et al., 2019). ICT implementation can unintentionally sabotage HRSE despite good intentions and efforts of the healthcare system, or the individual themselves.

Telemedicine raises concerns that can inhibit health delivery and HRSE. Despite advantages that include healthcare efficiencies and cost-savings, in-person care is still the preferred method of healthcare delivery for providers and patients alike, and telemedicine is still often viewed as a stop-gap or supplement to in-person clinical visits (Terrasse et al., 2019; Tetri & Juujärvi, 2022). Even though online therapy for depression and anxiety disorder treatment has been reported as effective as in-person treatment in some cases, there are many remote treatment limitations based upon unique individual cases that can include such considerations as developmental, cognitive, relation building concerns, and complex mental health therapies (Tetri & Juujärvi, 2022). Further, therapeutic relationships may erode over time or not be established at all, in-person presentation and body language cues may be missed, and other cultural misunderstandings or discriminatory acts could occur (Terrasse et al., 2019). Even with successful implementation of telemedicine, conventional clinical approaches and interactive human support systems are still seen as important components in facilitating patient motivation and SE in complementary health technology adoption and use (Tetri & Juujärvi, 2022).

Social media is a highly contentious medium to both conduct healthcare related activities and access health related information and opinion (Cozma & Muturi, 2021). While allowing cross-pollination of information (Ferguson, 2021), social media also enables omni-directional and unrestricted flow and exploitation of information for legitimate and illegitimate uses. With a

high capacity to help revolutionize healthcare and delivery, social media can adversely impact public health and induce crisis (Terrasse et al., 2019), due in part to many concerns of messaging and information legitimacy and/or accuracy (Shin, Wang, & Lu, 2022) or loss of filtering (Marcos-García et al., 2020). Information reliability is often questionable when information fidelity is constrained by platform character limits, promoted by fiscally motivated influencers, or pushed in aggressive marketing schemes (Shin et al., 2022; Terrasse et al., 2019). Social media venues that host health positive messaging also advertise marketing campaigns that can contribute to harmful health behaviors by promoting behaviors or industry products like alcohol (Petkovic et al., 2021), tobacco and e-cigarettes, dietary practices contributing to obesity, type 2 diabetes, CVD (Schillinger et al., 2020), or risky sex behaviors – campaign influences with impactful and lasting HRSE effects. Because of reach and speed, social media can assert a very acute and immediate impact on health (Terrasse et al., 2019) – this applies to both beneficial and detrimental influences. Social media can propagate messaging that conflicts with public health authority guidance and creates individual and community risk (Shi et al., 2022).

The Internet and social media can contribute to compromises in health due to the speed at which health and medical information can be promulgated before sources and content veracity can be validated, corrected if required, and re-distributed (Petkovic et al., 2021; Sadiq & Saji, 2022) – a concern that revolves around concerns of misinformation, disinformation, incompleteness, rumor, pseudoscience (Sadiq & Saji, 2022; Heyland et al., 2022), and conspiracy (theories) (Sadiq & Saji, 2022; Schafer, Mahl, Fuchslin, Metag, & Zeng, 2022; Heyland et al., 2022). The immediacy of misleading information can lead to public panic and anxiety (Ferguson, 2021) that delay implementation of behaviors, interventions, or compliance which result in adverse individual and/or public health outcomes (Sadiq & Saji, 2022; Schafer et

al., 2022; Shi et al., 2022), including casualties (Sadiq & Saji, 2022; Schafer et al., 2022).

Misleading information can gain traction, legitimacy, and power when propagated by trusted sources such as family, friends, or celebrities (Sadiq & Saji, 2022; Shin et al., 2022), erroneously sway public opinion (Sadiq & Saji, 2022), and low income, limited education, and elderly populations are at higher risk of deception (He et al., 2021). Health-related misinformation is long-lasting, propagates across media domains, is globally virulent, and government cannot control its presence in the ICT ecosystem – though it may be able to help coordinate mitigation efforts (Sadiq & Saji, 2022).

Research studies have shown social media to negatively contribute to mental health concerns (Bradman & Gustafson, 2021). Negative mental health effects caused by excessive social media use (Ferguson et al., 2021) or social media manipulations intended to mislead, exploit, or damage (Zhang et al., 2020; Gao et al., 2020) are particularly concerning. Social media, applications, and Internet sites employ “nudging” tactics that apply digital persistence methods to wear down user resistance to engaging in persistent online media activity or other behaviors (Terrasse et al., 2019). Analytic algorithms perpetually cultivate user profiles of online activity to continually stimulate influences and attention (Quiring et al., 2021; Sadiq & Saji, 2022) that drive behavior(s). These techniques and tactics could be used in the healthcare space to shift patient-centered health objectives to consumer driven profit objectives or complicate or mislead issues of medical choice and consent (Terrasse et al., 2019). Negative fear-inducing or risk-amplifying language is often used to frame social media messaging (Price et al., 2022) and post-traumatic stress disorder (PTSD) can be induced via media presentations of traumatic events (Gao et al., 2020). Further, doomscrolling, a persistent viewing of social media that elevates negative mentation, can contribute to depression and PTSD (Price et al., 2022). With great

variety of fidelity and findings in studies, social media is associated with concerns of social isolation, depression, anxiety, aggression, and cyberbullying (Petkovic et al., 2021). Social media can contribute to body dysmorphic disorders leading to low self-esteem, addictions, anxieties, and depression already associated with elevated consumption (Bradman & Gustafson, 2021). Fear of Missing Out (FoMO) has become a significant mental health crisis with compulsions of around-the-clock social media engagement (Price et al., 2022; Lee, Lin, Tsao, & Hsieh, 2020) that can lead to symptoms of depression and anxiety (Lee et al., 2020). While not clearly the causal impetus of general social aggression (Ferguson, 2021), the distortive capacity of social media contributes to greater problems of societal perspective, angst, mental health, and achievement of optimum HRSE.

Other concerns and challenges relevant to ICT influence and effect include safety, security, and ethics. Negative influences of health-related SST adoption include privacy, data security, exploitation or theft of personal identity and data, and general cyber-threats (Immonen & Koivuniemi, 2018; Petkovic et al., 2021; Son et al., 2021). Users are concerned with the safety and security of smart speakers, but many reluctantly utilize them out of the sense of security they can provide over other concerns (Corbett et al., 2021). Technology used to assist or enable cognitively affected persons could create concerns of “technological agency” by exercising superiority or authority through influence and manipulation of self-agency, to the point of displacing, discrediting, and replacing autonomy (Bartlett et al., 2017). The exploitive capacity of the ICT ecosystem cannot be underestimated in potential to undermine HRSE.

Research Gaps. Despite the rich amount of information related to ICT integrated into the health domain, data are still scarce and/or subjectively inconclusive when looking at its effect on HRSE and health outcomes. In a systematic review on *mHealth* spanning 18 years, Han & Lee

(2018) cited much concern that consumer use of *mHealth* applications was growing at a tremendous rate, yet there was scant and inconclusive information regarding quantitative effectiveness or potential harm. Four years later, Faujdar et al. (2022) continued to echo Han & Lee's (2018) concern that *mHealth* remains inadequately studied and requires urgent research. Obro et al. (2021) also calls for additional research in this area but suggests that a patient-provider connectivity component deserves special focus. Medical and health-related discourse is a ubiquitous and growing concern in the ICT ecosystem, but particularly within social media, and the assessed impact of health technology, media, and information is limited.

Social media utilized for health-related management or information seeking is risky due to its digital proximity to vast inaccuracy, distraction, discourse, commercialization, and mental health concerns. HRSE and health outcomes are impacted by social media influence, but current literature is scant and identifying variables and effects of individual and social impact is a monumental undertaking. Quantitative data confirms the abundance of misinformation throughout social media with calls for more studies, but authors note data are becoming more difficult to collect and lack variable and contextual details needed to clearly analyze and associate misinformation with resultant behavior linked to adverse health outcomes (Rivera et al., 2022; Price et al., 2022). Particular attention is suggested for studies on social media impact on children and youth (Terrasse et al., 2019), analysis of social media effect on public health communications outcomes (Schillinger et al., 2020), and elevating fidelity of variables of exposure, intensity, persistence, and cross-pollinating effects on health influence and outcomes (Petkovic et al., 2021). This endeavor is further complicated by inferior efforts to integrate attributes of social media in numerous ways across models, theories, and studies mentioned herein: "No conceptual model exists for examining the roles that social media can play with

respect to population health.” (Schillinger et al., 2020, p. 1393). In a testament to this challenge, Ferguson (2021) noted in an analysis of literature that various researchers drew “vastly” differing conclusions of identical datasets concerning issues of mental health and youth suicide tangible to social media.

How one accesses and utilizes ICT is unlikely to change the embedded perpetual persistence of influence – whether for health, fitness, general information, education, entertainment, or other. The ICT ecosystem can propagate influence that encourages adoption and support of beliefs and behaviors that contribute positively to individual HRSE and outcomes of health. Conversely, various aspects of influence can overtly and covertly impact HRSE and health outcomes in adverse or less than ideal ways – deliberately or unintentionally. The cumulative exposure to and volume of ICT-facilitated influence can contribute to the broader manipulation of the individual and a re-engineering of the individual’s framework of perception – with both beneficial and detrimental effects to personal agency and HRSE.

Perception

Like influence, ideas of perception have experienced perhaps an even greater paradigm shift because of the ICT ecosystem. ICT has opened the floodgates of accessibility to a universe of multi-media, news, and information. A person can “engage” on-demand, passively or actively, with hundreds and thousands of influential people, entities, organizations, and forums every day - all offering different views, opinions, or narratives on identical or dissimilar topics. This previously unachievable degree of individually accessible public discourse has evolved a society where perceptions can be extremely fluid and malleable – by the day, hour, or minute. Further, personal perceptions that may endure critical public views or an unsupportive circle of friends can now find affirmation and support via online associations of like-minded people. People who

embrace the fluidity of perceptions not tempered with critical thinking, discussion, and evaluation may expose themselves to personal risk. Excluding a cornucopia of deliberate misrepresentation and misinformation online, AI has evolved the manipulation of perception to astronomical heights and social dangers with nudging tactics and completely fabricated (often false) narratives, images, audio, and video. Society has entered a new paradigm that could threaten the social stability of health-related truths and accepted canon that both influence people and contribute to HRSE.

ICT Enablers of Health-Related Perceptions. None of the sources of this research focused specifically on perception(s) – it emerged collectively as a unifying theme. The idea of one's life, sense of control, and SE/HRSE is based on individual perception. The sense of control people unilaterally exert for themselves and within society is operating in a complex nexus of personal genetics, biology, and physical and mental capability and capacity operating in an environment of personal relationships, societal elements, and other influences. As previously discussed, an individual's perception is framed in a complex background of self, experiences, relationships, and cultivated information, which is further informed with influences and interactions that dominate the person's environments and interpretation of the social spaces. A person's perception or vision and participation within the greater social context is uniquely variable in terms of social activities, acceptances, expectations, and outcomes. Further, perceptions enable a framework of internally validated processes that can guide cognition and behaviors of predictability and consistency – to include the acceptance or rejection of influences. Enabling, complicating, and constraining individual perception is the ICT ecosystem that cradles and facilitates a multiverse of systems, devices, and software that provide connectivity, access, information, and influence in the social environment. Of high interest is how the ICT ecosystem

is manipulating individual perceptions of health-related concerns that further elicit behavioral changes that affect HRSE.

Bartlett et al. (2017) said that human agency within the scope of healthcare is not just represented by the *priori selfhood* but is enabled “through a heterogeneous and ontologically complex network of actors” that includes “sociotechnical networks” (p. 1,3). This alludes to the *eHealth/mHealth* resources of patient medical data, information, and provider connectivity, but is especially inclusive of the broader dynamics and implications of the ICT ecosystem and media operating in and outside health domains. In this digital space, the ICT ecosystem can facilitate individuals with infinite possibilities and identities via social media engagement and personas (Bradman & Gustafson, 2021). How one might navigate between these perspectives and express SE/HRSE is an immense dilemma to be explored here.

Pre-existing self-efficacy (Tetri & Juujärvi, 2022; Immonen & Koivuniemi, 2018) and facilitating conditions are key dynamics of health-related ICT adoption (Immonen & Koivuniemi, 2018). The facilitating conditions center around ICT accessibility as well as self-perceived capabilities to engage in the health-related ICT synergy. The ICT ecosystem can facilitate and support an environment that promotes Bandura’s (1977) ideas of self-capacity, optimism, expectations, and related perceptions that enable SE. These findings confirmed Rahman et al.’s (2016) conclusions of ICT use associated with high SE, attitude, and cultivated personal perspective, formulated into a HTSE. Personal perception, often linked with normative perception, is frequently noted as key in the cascade of criteria that motivate use of SSTs for health-related behaviors (Immonen & Koivuniemi, 2018; Hong et al., 2021). This criteria include attitude, willingness to use ICTs, gauging social value, and internal motivation of effort and engagement. Findings on PPs use credit education, literacy, and strong SE as well as PEOU and

PU (Son et al., 2021). Dutta et al. (2018) previously cited similar findings of SE and the cascading effects of PEOU, PU, and attitude, with PEOU being the dominant catalyst of intention and subsequent effects. A person's SE guided by perception of health risk or vulnerability and evaluations of potential outcomes is key to engaging in self-protective or behaviors of desired outcome(s) that motivate health-related ICT and social media use (Cozma & Mururi, 2021).

Motivation to use technology is strongly rooted in the belief it will produce expected results and benefits (AlQudah et al., 2021; Immonen & Koivuniemi, 2018). Attitude can be a barrier to adoption (Son et al., 2021) since it is a primary predictor of intention to use health-related technology and it is informed through PEOU and PU (AlQudah et al., 2021). With near identical findings as Khan et al. (2021) regarding healthcare centered social media, Garavand et al.'s (2022) evaluation of telemedicine acceptance and adoption also identified the key roles of attitude, PEOU, PU, expanded with subjective norms and other previous referenced considerations. Subjective norms are individual perceptions of social acceptance. When faced with a selection of competing options and PU is confirmed, a further perception of value is applied to selecting an option worthwhile of effort investment (Immonen & Koivuniemi, 2018). Evaluation of perceptions and expectations indicate engagement beyond casual or passive influence. People adopting wearable technologies to assist daily fitness activities and diet management make made additional efforts to increase device literacy, lifestyle analysis, and beneficial behaviors (Nayak et al., 2021), illustrating an evolution of perception that enhances SE/HRSE via empowerment and control. On the other hand, a patient could perceive PPs as a dilution of the patient-provider relationship (Son et al., 2021) or telemedicine interactions as

trivial or dehumanizing due to the loss of in-person interaction, thus potentially inhibiting HRSE, healthcare participation, and health outcomes.

The nature of the ICT ecosystem enables and contributes to the ubiquitous discourse of health-related narratives (Schillinger et al., 2020) which shapes and manipulates perceptions. Legacy (news) media reporting or promotion of health-related information can exploit population biases of accepted authoritative information sources perpetuating de facto social norms, thus crafting and perpetuating normative perceptions that motivate individual and social views and behaviors (Hong et al., 2021). Erroneously manipulated perceptions can motivate behaviors with negative outcomes if based on artificial, inaccurate, or incomplete information or ideas. In the past, “opinion leaders” served as information filters, passing the “vetted” information on to the masses (Marcos-García et al., 2020). The ICT ecosystem has transformed this dated mechanism, and information is now available through unlimited venues that may or may not authenticate information or sources. Influencers, with no medical education, expertise, or training, can promote health-related information, products, and services (Montez, 2020), bypassing vetting and editorial processes with other celebrities and everyday people. The dialogue and discourse of interpersonal relationships and communications play an important part in navigating authenticity and value of health-related messaging (Hong et al., 2021) and surrogating that trust to ICT-facilitated sources can add distortion to perceptions that put HRSE and outcomes at risk.

A person’s view (perception) of media influence that is embraced by others is more inclined to be embraced by that person (Hong et al., 2021). Some research finds the motivation and intent to use health-related technologies is strongly impacted by an individual’s family, social groups, and social environmental influences (Choi, 2020; Nayak et al., 2021; AlQudah et

al., 2021). Other research expands the social influence to most all technology, social media in particular, and highlights PEOU, quality, privacy, and SE in adoption of technology (Khan et al., 2021). Though Baudier et al. (2022) acknowledged the effect of general social influence, their research in UTAUT2 criteria and technology adoption found that social interaction and facilitating conditions (environment) were not as strong as effort or performance expectancies that are framed more in personal perceptions that weigh personal health-related outcomes. This suggests a demand for greater fidelity of data that expresses personal perceptions on the gravity of personal health behaviors and potential outcomes.

Social Media Perception. Social media provides a conduit for both positive and negative perception cultivation via Bandura's (1977) vicarious experience and persuasion (Rahman et al., 2016). Social media can promote or change social norms, behaviors (Petkovic et al., 2021), and perceptions (Shin et al., 2022). For example, social media platforms can foster user discussion and exchange of media that contribute to information sharing activities that help challenge and correct effects of misinformation (Rivera et al., 2022). Conversely, they can also instigate and contribute to false narratives and perceptions. People are more prone to accepting media provided health-related information if they do not regularly discuss it with others; conversely, media influence is less impactful in people who routinely discuss health-related topics with others (Hong et al., 2021). If people perceive that others are highly receptive to media influence, they are much more inclined to accept conformity, change beliefs, and/or adopt behaviors (Hong et al., 2021). Young people (digital natives) and the well-educated with medical literacies have a more positive association with social media promoted compliance that advance protective behaviors; an association that can persist as social media propagation of public, mass media, and even misinformation narratives multiply – especially if there is perceived personal vulnerability

(Cozma & Muturi, 2021). Though they can substitute for each other, routine interpersonal communications of health-related information cultivate perceptions of health-related social norms which can diminish the effect of media-exclusive influence on health behaviors (Hong et al., 2021).

During public health crises, perceptions of health behaviors crafted by traditional and social media mediated in the ICT ecosystem can confound and impede scientifically vetted government guidance (Shi et al., 2022; Hong et al., 2021). Though higher education and science literacy correlate with increased resistance to health rumor and misinformation (He et al., 2021), people can still contribute to their own negative perceptions by doomscrolling (Price et al., 2022) or embracing polarizing views or activity (Dan & Dixon, 2021) – behaviors enabled by social media. Though social media use for COVID-19 knowledge was generally viewed negatively in terms of protective measures compliance, individual perceptions of infection vulnerability and exposure severity risks, combined with strong SE, were key in navigating and interpreting negative social media information and producing compliance (Cozma & Muturi, 2021), confirming social media can positively contribute to risk perceptions (Gao et al., 2020) that inspire appropriate responses. Alternately, research on *YouTube* viewing has shown that content reflecting discord and controversy has high search presence and subsequent recommendations (Calvo et al., 2022) that can derail beneficial behavior. The online digital environment can diminish the power and messaging of authorities and enable influencers, bloggers, and activists of unknown expertise and intention to disrupt the social spaces of information exchange (Marcos-García et al., 2020; Schillinger et al., 2020) – an outcome that heavily manipulates perceptions for individuals and society at large. Long-term cumulative usage of social media may manifest as FoMO (Lee et al., 2020) - an emotional behavioral addiction (sometimes

anxiety) that can contribute to distortions of perception. In studying the effects and concerns of users' online health-related information protection, privacy, and trust in those systems, individual emotions and perceptions play an important and pivotal role in those health-related decisions (Bansal, Zahedi, & Gefen, 2010). Dutta et al. (2018) would go on to cite Bansal et al. (2010) in their study to acknowledge acute health condition emotional factors affecting perceptions in the cascade of decision making that would predict technology use/adoption applied to HTSE. Social media elicits significant emotional responses, be it confusion, doomscrolling, polarizing politics, public crisis, or FoMO. The sum of social media effects can exert significant modification of individual perceptions - perceptions that regulate further consumption and analysis of additional external influences, or perceptions that compromise beneficial behaviors of HRSE.

SE/HRSE/HTSE Perceptions. ICT devices and ecosystem provide many benefits that can create distortions to perception(s) – some minor, some significant. These perceptions can alter views of personal HRSE that further affect behaviors contributing to or impeding it. Studies suggest that good SE appears to be a precursor or component of successful adoption of *mHealth/eHealth* tools and applications and can also be expressed as a mobile technology identity (MTI) (Khan et al., 2021; Balapour et al, 2019; Reychav et al., 2019; Tetri & Juujärvi, 2022). Information literacy gained from online experience improves knowledge which further bolsters SE (Wang et al., 2022). On the other hand, if computer literacy and SE is low, people may distance themselves from technology (Reychav et al., 2019) and healthcare participation tools. Higher education positively influences higher SE which are both associated with *eHealth* literacy and increased perception of value and capability in utilizing *eHealth* tools such as patient portals (Son et al., 2021). On the other hand, at some levels, higher education is associated

negatively with a patient's perceived intention to use and adopt *mHealth* applications (Balapour, 2019).

Just because one has good general SE or HRSE, does not mean that positive efficacy is represented across all domains resulting in beneficial behavior (Rahman, 2016). For example, a person could eat a healthy and well-balanced diet, engage in fitness, manage stress, and obtain optimum sleep, but then smoke cigarettes, or engage in recreational drug use or risky sex behaviors. This can also occur with the hope that some behaviors can mitigate the risks of other less desirable or harmful behaviors (aka compensatory health beliefs) (Fleig et al., 2015). Additionally, people who otherwise display high levels of SE/HRSE may deliberately avoid certain aspects of personal health information such as higher cancer risks, skin damage, or STDs by engaging in information avoidance (Hong et al., 2021).

A person's general and computer SE are typically personified evaluations built over time through perceptions of capability measured through multiple direct and tangible experiences over time (Dutta et al., 2018). Different from general SEs that are more trait-oriented and cultivated over time, Dutta et al. (2018) concluded that a person's HTSE is fluid, based on present and fluid perceptions of acute health, thus behaviors may be more reactionary, emotionally inspired, and motivated by acute events. This concern of reactive acute cognitive conditions of emotion is inclusive of social factors promulgated in the ICT ecosystem that could alter perceptions that drive behaviors adverse to HRSE and health outcome. Further, emotions derived from health circumstances can impact decision making processes that drive health-related ICT usage and acceptance (Dutta et al., 2018) and contribute to problematic health behavior and outcome.

The ubiquity and use of the ICT ecosystem and content has an impact on mental health – particularly with youth (Price et al., 2022). Because people can manipulate their identities online,

people who primarily cultivate online friendships generally have poorer mental health with associated concerns (Bradman & Gustafson, 2021). The remote and faceless environment of social media and many online venues can promote feelings of anonymity and safety that contribute to the *online disinhibition effect*. This effect can motivate people to act and communicate in ways that are aggressive, bullying, and violent, inflicting mental anguish and anxiety on victims. Anxiety is an influential factor in health ICT use (AlQudah et al., 2021) and it can contribute to a variety of mental and emotional states that impact individual perception(s) that diminish HRSE and health positive activities.

The online and social media environments of the ICT ecosystem expose individuals to narratives and images that are often idealized and perfected to present often false, distorted, unrealistic, unobtainable, and/or depressing perceptions of daily life or the world (Bradman & Gustafson, 2021). A critical self-comparison behavior can create or exacerbate mental health issues, stress, or inspire actions that may be contrary to good behaviors, health, or HRSE. In an effort to fit in or replicate an influential narrative, behaviors such as manipulating personal images or portraying and posting a false reality can be employed (Bradman & Gustafson, 2021). Seeking external approval via distorted online perceptions of the world can supplant selfhood and manipulate SE/HRSE negatively by engaging in acceptance and accommodation of misleading external perception(s).

Though beyond the scope of this thesis in focus and complexity, it is noteworthy to mention the growing concurrent intersection of politics into the ICT ecosystem and health-related areas that may impact HRSE. Separate and combined, ICT and health are socially contentious subjects and quoting Barnard (2016), “technology is political” (Barlett et al., 2016, p. 6), thus extending health-related affairs into a political discourse. Social media is used to

“accelerate sociopolitical movements” (Sadiq & Saji, 2022, p. 272) and its intersection with health and polarization is complex (Ferguson, 2021). With Fraser et al. (2022) finding “significant associations between polarization and health outcomes” (p. 1), the power of politically determined health-related perceptions is very concerning when weighing HRSE. Political biases and partisanship were shown to affect perceptions of the pandemic, personal HRSE, social distancing, and mask wearing activity during COVID-19 (Fullerton, Rabb, Mamidipaka, Ungar, & Sloman, 2022). The ICT ecosystem can facilitate influence of partisan affiliations that create individual divergence from previously trusted sources (Hegland, Zhang, Zichettella, & Pasek et al., 2022).

There is an obvious connection between trust and partisanship (Hegland et al., 2022) and political/partisan influence can establish trust that motivates beneficial health behaviors (Fullerton et al., 2022). While there were many factors at play in the case of COVID-19, political affiliation strongly correlated with virus concern, engagement in protective behaviors, and uptake of the vaccine (Hegland et al., 2022). The outcomes of partisanship and polarization can move beyond politics and can translate into opposing splits of trust and mistrust regarding health-related information, beliefs, and behavior that directly impact SE/HRSE.

Trust. Trust is necessary in the formulation of perception(s). Trustworthy people, institutions, systems, and information provide critical input to perception interpretation, analysis, and beliefs that translate into action and behavior. Assessing trustworthiness can be a circular evaluation of perception and new information complicating the path to truth, validity, and accuracy. Beyond and inclusive of TAM and UTAUT components - computer self-efficacy, anxiety, and trust are among the most influential factors regarding health ICT (AlQudah et al., 2021). Trust transforms influence into acceptance, perception, behavior, and action. In parallel

with SE, trust is a key component in effecting components of UTAUT2, specifically the expectancies of performance and effort that correlate to medical technology adoption for such devices and services as wearable monitors (Hossain et al., 2021; Baudier et al, 2002) and telehealth (Baudier et al, 2002). Additionally, physician trust is an important variable in the collaborative ICT *eHealth/mHealth* relationship (Garavand et al., 2022) and better patient adherence and health outcomes (Tetri & Juujärvi, 2022). Perceptions of trustworthiness in sources and officials are associated with compliance of health guidance (Choi & Fox, 2022). Without the perception of trust in health-related content and service in the ICT ecosystem, HRSE can diminish or collapse, and health outcomes can suffer.

Trust in the context of this research can be associated with trust of ICT infrastructure and devices as safe, dependable, and secure and trust in the information, data, sources, and influences as legitimate and accurate within that ecosystem. As highlighted previously, trust is essential in user acceptance of health technologies – trust includes privacy, confidentiality, security, and low risks associated with use and misuse (AlQudah et al., 2021; Khan et al., 2021). Trust, as well as safety and security concerns, can be a barrier to telemedicine (Baudier et al., 2022). Son et al. (2021) reports that concerns of data privacy and security are adverse to PEOU, SE, and ICT *eHealth/mHealth* use. If patients do not have trust and high expectations in *mHealth* platforms utilized for self-reporting, patient reporting may be inaccurate or absent which could impede effective remote provider guidance and/or treatment (Reychav et al., 2019). Patient-consumers who lack clarity in evaluation of SST risks may avoid devices and platforms altogether, especially if interactions appear to lack user control (Kim et al., 2017).

The sheer volume of information and sources within the ICT ecosystem immediately present a credibility, reliability, and trustworthiness problem. Trust considerations tied to health-

related social media adoption and use include such considerations as information reliability and quality, quality accreditation, and social acceptance (Khan et al., 2021). The circulation of misinformation and disinformation during COVID-19 (Shi et al., 2022; Calvo et al., 2022; Cozma & Muturi, 2021; Dan & Dixon, 2021; Zhang et al., 2020) contributed to mistrust, distrust, and defiance when engaging with online information and sources, with potential outcomes detrimental to individuals, health systems, and society (Calvo et al., 2022). The embrace of and credibility given to social media and information it houses is strongly aligned with the degree of relationship and/or influence associated in close personal relationships or those who are chosen as trusted moderators of information (Shin et al., 2022; Khan et al., 2021) - this includes family, friends, celebrities, influencers, or news reporters. Infodemics erode the public trust since most are associated with efforts of disinformation or misinformation (Schillinger et al., 2020; Shin et al., 2022; He et al., 2021) and can create negative perceptions of persons and institutions typically seen as trustworthy (He et al., 2021). Sharing misinformation or rumor can elevate individual perception and acceptance of false information's trustworthiness while further discrediting the trustworthiness of competing accurate information or authorities (Sadiq & Saji, 2022).

Health-related concerns intersect significantly with powerful corporations, political, and government entities that direct ICT content and distribution for influence and perception manipulation (Montez, 2020; Schillinger et al., 2020; Sadiq & Saji, 2022). Social media simultaneously platforms competing narratives of health information, often with conflicts of interests, between clinical and public health guidelines, peer-reviewed research, and commerce (Schillinger et al., 2020). For example, companies promote products that contribute to disease, addiction, and obesity; while competing entities and organizations provide education and

counter-messaging to those products and behaviors that contribute to health-related epidemics (Schillinger et al., 2020). Persistent exposure to ICT media sources can perpetuate echo-chambers that promote confirmation bias (Sadiq & Saji, 2022; Schillinger et al., 2020) that further craft and reinforce perceptions. Research shows a complex nexus of social media replacing traditional news media with hostile political polarization that reinforce echo-chamber preferred influences that solidify perceptions (Ferguson, 2021; Schillinger et al., 2020). Additionally, the rise in conspiracy beliefs during public crisis (Schafer et al., 2022) have a direct effect on trust and perception and social media can negatively exacerbate the tenuous balance of contexts and trustworthiness in the space of health-related information, sources, science, and public officials (Schillinger et al., 2020). The bewildering conflicts and contradictions in the ICT ecosphere undermine trust, skew perception, and present challenges HRSE.

Research Gaps. Much research on the ICT, health, and SE/HRSE intersection noted limited data evaluating perception(s) and tangible components like trust, relegated simply to noting its relevance. There is limited research on the sources of information and the delivery mechanisms in the ICT ecosystem and how those relationships craft perceptions that ultimately affect health outcomes (Cozma & Muturi, 2021). Research is limited regarding self-efficacy perceptions and how it effects attitudes in health-related ICT adoption (Rahman et al., 2016). Not everyone perceives health-related messaging the same way due to perceived risks and outcomes of behavior which can distort research findings if assumptions are made concerning queries regarding disease processes, prevention, or promotions (Hong et al., 2021). There is interesting divergence in findings related to trust perceptions of science information and health-related authorities when impacted by information misinformation, disinformation, and polarization (Choi & Fox, 2022; He et al., 2021; Hegland et al., 2022; Schillinger et al., 2020; Shi et al.,

2022). Data, context, and fidelity of misinformation are difficult to obtain (Rivera et al., 2022) yet are of great concern to perception manipulation and outcomes of health. Summing up research on the complex nexus of internet and social media effects entrenched in the global context of current events, history, and socio-economics, Ferguson (2021, p. 131) said, “It can be very difficult to disentangle one factor such as the internet, from these many other systems and issues...considering the internet or social media may simply be the wrong question and we’ll be best served by understanding the internet as one piece of a larger, more complex system.” Perceptions of information and influence are part of a complex calculus motivating individual behaviors, informed and enabled by a vast ICT ecosystem homogenizing the corporeal and digital worlds into an understudied area that is manipulating HRSE.

The scope of influence and perception and associated variables is immense. These two closely associated themes of influence and perception manipulated in the ICT ecosystem can evoke vast differences and complications in interpretation, belief, behavior, and outcome. Most researchers cited both positive and negative attributes of ICT-related aspects in their findings, with many narrating common themes, similar gaps, caveats, and calls for much greater depth and fidelity of research. The *Theories and Models* section provides an interesting view of approaches cultivating valuable data, but researchers echo recurring sentiments of limitations, loss of fidelity, or unmet alibis in exploring and evaluating the ICT and HRSE intersection. Within the themes, issues of trust were the most prolific concerns cited of ICT and related services, devices, sources, and information within the ecosystem. Trust was referenced directly in approximately 70 percent of the literature and implicitly extracted from about 90 percent of the literature – a prominence that might suggest its own theme. However, the separation of trust and perception was not pursued here because findings suggest (mis)trust is a constituent and outcome of

perception in the individualized and often complex information analysis process. Trust is a variable in the homogenizing algorithm of perception. Also, within the themes, narrative and commentary on generalized and negative media and social media influence were nearly as prolific. Overall, most research addressed HRSE and ICT in less holistic ways, focusing on (a few) singular aspects of the ICT ecosystem, often omitting the relevance, inclusion, and synergy of multi-dimensional digital and social influence and effects, and how people process the sum into perceptions that fuel SE and health-related beliefs and behaviors. This literature review was able to reveal the great nuance and depth of ICT effect in the health-related space and its effect on HRSE. The findings and researcher testimony collectively suggest future research on the HRSE and ICT intersection requiring much greater depth of fidelity on variables of influence and clarity of individual or group perceptions.

Chapter 5: Discussion

The focus of this analysis was the intersection of literature on HRSE and ICT. The literature reviewed was a diverse selection that revealed comparable and tangible innervations of ICT and concerns relative to HRSE. On surface and interpreted, the similar themes and concerns, as well as parallel gaps and limitations in research, suggest effects and complexities of an omni-directional and omni-sourced array of ICT fueled influence with an underlying probability of perception manipulation that is under-researched and limited in scope.

ICT and related ecosystems are very beneficial and impactful health-related resources, facilitators, and tools. In many cases they significantly promote, enhance, or enable various health-related tasks, behaviors, and qualities of life that contribute to HRSE (Garavand et al., 2022; Baudier et al., 2022, Nayak et al., 2021; Balapour et al., 2019). These qualities can positively impact issues that include health knowledge, preventive behaviors, medical treatment

and recovery, therapy, diet, exercise, and mental health. In some profound cases it is an essential component integrated into the quality and/or preservation of life itself. In contrast, the ICT ecosystem can produce negatively opposite health-related effects, or an amalgamation of both positive and negative manipulations and outcomes, some of which can compete in terms of health status and outcomes (Calvo et al., 2022; Sadiq & Saji, 2022; Petkovic et al., 2021; Zhang et al., 2020; Terrasse et al., 2019). What appears unknown currently is how much and how significantly the ICT ecosystem contributes to manipulation in terms of individual health-related knowledge, beliefs, behaviors, and outcomes.

The findings reveal that ICT is often discussed in the literature in narrow and discrete ways when attributed to marked influence and/or outcome in specific health-related concerns. Broader or collective ICT ecosystem contributive effects are either omitted, disregarded, or cited as limitations that deserve greater study. Often, research related to ICT and health does not specifically cite or target HRSE as an objective, though a HRSE association may become evident in the data and/or findings and then discussed briefly if acknowledged. When considering the multitudes of research looking at ICT effect or use in the health domain in numerous veins (general health, mental health and support, health management, exercise, diet, disease, information seeking, etc.), a holistic and critical focus on ICT effect related to HRSE is generally scant. This oversight is compelling, as any specific area of personal health that may suffer because of misleading or adverse ICT propagated influence, may indicate a broader level of negative ICT influence on personal health-related beliefs or behaviors that result in other undesirable outcomes. A person exhibiting an adverse health outcome caused by ICT influence in one area may manifest and compound health adversity across multiple areas.

As evidenced in the analysis, ICT impact occupies a broad spectrum of individual and societal influence across ranges of extremes of positivity and negativity. There is great magnitude of impact this influence wields across many aspects of physical and mental health considerations that directly affect HRSE and behaviors. While this discussion centers on Western-style developed nations with advanced and propagated digital communications infrastructures and devices, the concerns here will transcend geography and culture in similar and dissimilar ways as ICT globally evolves and propagates.

A question woven throughout this research process was, “What is self-efficacy, as it relates to health?” The complexity of this question generates many considerations from the preceding and following material. Individual perceptions of HRSE are variable in views and behaviors of personal health, health beliefs, or health management that may not align with that of their family, peers, health providers, or the American Medical Association. In general terms of healthcare providers, the expectations of HRSE are generally represented in decades and centuries of cumulative medical canon when contrasted with the general expectations of patients and consumers directly engaged with the healthcare system. These include such generalized expectations and behaviors as healthy balanced diets, good routine hygiene, avoiding tobacco products, responsible alcohol consumption, protected sex when appropriate, using or wearing safety equipment when appropriate, or patient compliance of treatment, therapy, or medication protocols. When answered by the contemporary non-medical individual, the response is likely informed by an increasingly complex and sometimes fluid constellation of personal perceptions that drive health-related beliefs, behaviors, and outcomes manipulated by the influence of preferred sources, preferred information, and other active and passive forces accessed and sustained by the ICT cosmos that include mainstream news media and social media. This

influence can greatly complicate otherwise simple questions like, “What is a good health decision?” Cooperation or refusal may be irrespective of medical doctrine or sources. The delineation between influence and perception can become difficult to segregate as they can homogenize in shared spaces of mutual circular affirmation and motivation.

The ICT ecosystem is arguably ground zero for accessing contemporary society’s social condition, shaping perceptions, and as a metaphor collectively serves as an expansive “town square.” The information acquired from the digital macrocosm of the social condition cultivates influence and develops perceptions that perpetuate beliefs that inform behaviors that people perform on behalf of their own health – ideal or not. Furthermore, as a conduit for the social condition, the ICT ecosystem is not altruistic or necessarily trustworthy, dependable, or safe, and is increasingly misleading, polarizing, and corporately metric driven.

On the Theories and Models

The overview of the theoretical models that have defined development of this area of study serves to orient the reader and provide context for their reference in the central themes and this discussion. While the theories and models explored in this literature review have no doubt been beneficial up to this point in identifying how technologies have been useful and how people have adapted them to health, they are dated in some regards and significantly constrained in addressing broader effects that inspire, guide, or compel ICT ecosystem use, content consumption, and effect. They are narrow in considerations of present-day ubiquity, omnipresence, compounding, and tangible effects of devices and collective ICT ecosystem. Simplified measures of *intent or attitude to use*, *perceived ease of use*, or *perceived usefulness* are limited in revelation when omitting inclusion of complex variables of individual perception(s) that frame the broader motivating influences, effects, and contexts of usage. These

theories lack necessary analytical depth to show how they manifest in a digitally robust contemporary population. This is further complicated in a social environment of pervasive, mindless, and often compulsive ICT engagement that also includes usage because of reluctant adoption and/or compulsion. The ICT ecosystem is not just made up of casually interrelated digital components within contemporary society – it is contemporary society. In the escalating progression of theories discussed, the nets of inquiry that were cast with broadening variables seemed to elicit data of increased fidelity, but authors conversely noted concerns of growing unknowns and unaddressed variables or confounding factors. The greater individual and social effects of widespread ICT usage, expanse of information and multi-media, consumer marketing pressures, and other social influences, filtered through greater analysis of individual behavioral components in the social context yield better clarity of ICT effects, but most are not looking at how these synergistic dynamics are impacting SE/HRSE and the resultant range of health-related beliefs, behaviors, and outcomes. These theories and models fail to appropriately capture the collective homogenizing and synergizing ICT ecosystem effects. Despite this, they have provided helpful components for constructing an amalgamated approach to a more comprehensive inquiry model development. Table 2 reflects influence and perception as effects that inform, enable, and motivate the individual and social constructs that comprise these theories and models. It also intends to impart the deficiencies of the theories to account for the collective ICT ecosystem and the universal presence of perpetual and cyclical influence and perception manifesting corporally and digitally in the individual to greater society.

Table 2
Theory and Model Constructs and Factors Expressing Influence and Perception

Constructs / Factors	Theories						Themes	
	TAM	TAM2	UTAUT	UTAUT2	TPB	SCT	Influence	Perception
Perceived usefulness (PU)	X	X	X	X			X	X
Perceived ease of use (PEOU)	X	X	X	X			X	X
Self-efficacy (SE)	X	X	X	X		X	X	X
Attitude to use	X	X	X	X	X		X	X
Intention to use	X	X	X	X			X	X
Facilitating conditions	X	X	X*	X*			X	X
Social influences (inc. social norms)		X	X*	X*	X		X	X
Cognitive instrumental processes		X	X	X			X	X
Demographics			X	X			X	X
Consumer variables				X			X	X
Behavioral intentions					X		X	X
Perceived behavioral control(s)					X	X ¹	X	X
* = expanding variables of constructs/factors								
¹ = factors included by default								

ICT Enablements and Constraints of HRSE

HRSE Enablements. While the following enablements contribute to concepts of SE/HRSE and a framework utilized in this intersection and interpretation – ICT facilitations are tangible to a multitude of uncited researchers, literature, and theory operating in analogous areas of human agency. ICT is ubiquitous and generally well received and utilized across wide demographics. The ICT ecosystem contributes to HRSE via health-related knowledge, influence and persuasion, social observation, support, and access to and participation in health-related activities and healthcare that can collectively contribute to beneficial health outcomes. HRSE is cultivated by individual effort of applied ICT ecosystem information, resources, and influence, and some is cultivated through access to established external resources of perceived benefit that are accessed via the ICT ecosystem.

Raising health literacy is a primary contribution of ICT, and gained health literacy and medical knowledge is strongly associated to HRSE, health-promoting behaviors, and outcomes (Wang et al., 2022; Cozma & Kuturi, 2021; Choi, 2020). Much of the collective literature cited

digital literacy as an important factor in ICT adoption, but high self-efficacy with discriminating social literacies were the defining characteristics that translated those health-related applications into beneficial outcomes. ICT provides additional and enhanced opportunities to engage in formal healthcare (Son et al., 2021; Bartlett et al., 2017). Expanding healthcare engagement enhances individual capacity and independence that furthers HRSE enablement that builds confidence in execution and outcome (He et al., 2021; Balapour et al., 2019; Dutta et al., 2018), further confirmed in the research clinical outcomes and studies. The ICT ecosystem enhances a myriad of activities and interventions related to health. Activity, fitness, and related metrics and goals can be supported and managed with ICT (Iqbal et al., 2021; Corbett et al., 2021; Beaney et al., 2020). Health-related resources do not necessarily need to be formalized to be immensely important or impactful for the HRSE or outcomes of individuals. Empowerment of control over beneficial health decisions and outcomes enhances and strengthens HRSE.

Externalized benefits of the ICT ecosystem are numerous. Overall, ICT and related ecosystems can improve formal health-related services, efficiencies, safety, and communications, which then contributes to improved patient outcomes and HRSE (Petkovic et al., 2021; Zhang et al., 2020). Public health trends and metrics can be monitored and analyzed in near real-time with ecosystem data driven metrics that can help speed and target public responses and resources (Schillinger et al., 2020; Zhang et al., 2020) – elevating public confidence and trust. The ICT ecosystem enables broadened interpersonal communication dynamics which supports the essential deliberation, value, and application of health-related information; a crucial resource and supplement during diminished face-to-face interactions such as of the COVID-19 pandemic (Choi & Fox, 2022; Petkovic et al., 2021; Schillinger et al., 2020). These enhanced

communications also extend to direct communication with professionals, experts, public officials, businesses, and private citizens for information and/or support.

HRSE Constraints. There are also numerous constraints to HRSE affected by and through ICT. Information integrity and intention are paramount concerns that include misinformation, disinformation, misdirection, perception manipulations, and exploitation. These concerns and other ICT effects, independently and combined, can contribute to physical, mental, and emotional changes that produce adverse physiological and mental health behaviors and outcomes. While the literature reveals little condemnation of ICT, it does provide a litany of caveats, exploitations, and other concerns.

One of the primary constraints is rampant misinformation and disinformation that can contribute to misleading influence, perceptions, and beliefs that further generate adverse or risky behaviors, non-compliance, anxiety, paranoia, panic, and mistrust (Sadiq & Saji, 2022; Calvo et al., 2022; Heyland et al., 2022; Khan et al., 2021). Identity and privacy concerns that include personal and financial data increasingly contribute to paranoia (Son et al., 2021; Petkovic et al., 2021; Dutta et al., 2018). ICT ecosystem use can directly contribute to adverse health-related concerns that impact physical and mental health (Lee et al., 2020) such as overuse, compulsive use (Ferguson et al., 2021), addiction, FoMO (Price et al., 2022), social comparison (Bradman & Gustafson, 2021), cyberbullying, aggression (Ferguson, 2021; Petkovic et al., 2021), isolation, physical inactivity, and other online exploitations. The open and accessible nature of the ICT ecosystem creates opportunities for exploitation, abuse, excessive influence, and manipulation of perceptions. These hazards can occur in parallel, tandem, and in addition to the previously mentioned constraints. These perils, including the concerns of misinformation, disinformation, polarization, identity, privacy, and abuses, collectively contribute to increasing mistrust in the

ICT ecosystem. The growing lack of trust in ICT devices and ecosystem sources and information can inhibit technology use, information dissemination, information acceptance, behavior change, or exacerbate conditions that negatively impact HRSE and health outcomes.

ICT Moderation of Health-Related Behaviors

ICT ecosystem moderation of health-related behaviors is only partly answered in the reviewed literature. There are some generalized findings, but there are far more questions than answers. Unanswered questions of moderating ICT ecosystem effects on HRSE and health-related behaviors have serious acute and long-term consequences that need clarity. On surface, ICT can contribute generously to motivating and informing positive HRSE, behaviors, and outcomes. Conversely, it is recognized to contribute to beliefs, practices, and behaviors that may result in adverse HRSE and/or health-related outcomes. Despite inclusion of the noted constraints previously mentioned, the tangible and expansive subsurface effects of influence and perception manipulation is relatively unknown and limited in scope with unilateral and narrow-scope academic research, but extremely contentious and active in news stories, journalistic exposés, and anecdotal commentaries from experts and technology insiders.

The challenge of informing personal HRSE and the cascade of beliefs, behaviors, and outcomes is an individual journey advised with pivotal and often questionable influence permeating from the ICT ecosystem. First, the immense growth, reach, complexity, and proliferation of ICT has created exponential social conflicts in the duality of benefits and challenges that can confuse and mislead. Second, the immediacy of information propagation often limits opportunity for authentication, contemplation, and measured social commentary before acceptance and action. Lastly, the environment facilitated by ICT enables cultivation of individually preferred influences that speed assimilation in support of personally ordained

perceptions, beliefs, and behaviors. A person can exert strong and logically based HRSE on their own perceptions yet suffer adverse outcomes due to inaccurate or misleading influence and information. Navigating the ICT ecosystem and content to determine legitimacy and veracity is a complicated individual and social endeavor guided by influence and perception.

Influence Moderation. This research shows an omni-present and persistent ICT ecosystem that hosts a compelling gravity of media, information, digital tools, commerce and marketing, interactions, expectations, and discourse in a complex social context that exerts various forms of influence. These technological interactions and content influences, and devices that enable them, are active, passive, voluntary, involuntary, overt, covert, and even forced. The aggregate of ICT ecosystem exposures and interactions are likely manipulating societal and individual influence as a powerful contemporary digital “homogenizing collective consciousness” (Bandura, 1997, p. 523), but the literature reviewed here is not accounting for this collective and confounding effect. Generally, most research and studies are not looking at broader ecosystem effects and instead focus on narrower topical applications of ICT in the health space with more predictable surface elements and effects; omitting more difficult to obtain and confounding individual variables that likely offer better clarity of influences, motivations, and outcomes. Exploring the effects of the torrent of collective ICT influences and how they manifest in decision and behavior processes unique to an individual and HRSE better clarify the pathways to health outcomes. As of now, this concern is understudied in the literature. While some influences can be temporary and transient, the persistence, potency, and appeal of influence can contribute to cultivation and crystallization of perceptions that also inform beliefs, perceptions, and behaviors – beneficial or not to HRSE and health-related outcomes.

Perception Moderation. The ICT ecosystem has increasingly become an essential resource for constructing individual perceptions of the components of society – particularly if surrogating for social relationships, or accommodating solitude or isolation. Perception is more easily manipulated as sources of influence narrow and diminish – as in the case of solitary behaviors with ICT patronage of preferred sources. This research has shown that while perception is a palpable theme at the ICT, health, and SE/HRSE junction, it is relatively unknown and understudied in the context of HRSE impact, health behaviors, and outcomes. Usually presented as a simple perception assessment of *usefulness or ease of use* for example, the deeper contexts of what informs perception and how it expresses in the cascade of health-related beliefs and behaviors is a recurring omission that requires clarity. How information and influence is analyzed and assigned trust in the perception continuum for the streams of online dialogues, social and news media, and other information sources is important in the chain of behaviors resulting in health outcomes. The manipulating ICT effects on perceptions of trust can inhibit or motivate behaviors related to HRSE. Understanding if and how ICT digital manipulations are complicating, corrupting, or displacing human cognitive analysis is also important. If interpersonal discussion and deliberation are key to developing individual interpretations of health-related information, and face-to-face interactions diminish as ICT facilitated digitally navigated interactions increase, risk of intrusive ICT cultivated influence may be distorting perceptions of HRSE and health-related behaviors. More than 25 years ago, before the smart phone and ubiquity of mobile Internet access, Bandura (1997, p. viii, 521) said of technology (tools), “The very technologies that people create to alter and control their environment can, paradoxically, become a constraining force that in turn controls how they think

and behave.” This research can affirm, in part, Bandura’s more than 25-year-old assertion – an assertion that is far more compelling in today’s overwhelming digital cosmos.

HRSE Moderated in the ICT Ecosystem & Why It Matters

How one individually views and exercises SE/HRSE is increasingly cultivated in a perception manipulating atmosphere of vast information and media influences enabled in the environment of an expanding, evolving, analytical, increasingly autonomous, intrusive, and commercially motivated ICT ecosystem of growing human manipulation and dependency. This suggests individual HRSE is less an autonomously developed capacity and increasingly more a product of social and corporate influences. This is not a new or novel assertion, but the immense power and insidious nature of the ICT ecosystem has monumentally changed the claim. It also proposes that ICT as an ecosystem is not in synchronicity with the best outcomes of people and may be contributing to health adversity and harm. Overt, covert, conscious, and subconscious individual and social engineering manipulated in the ICT ecosystem likely contributes to cultivated individual perceptions, beliefs, behaviors, and outcomes that are less organically inspired.

SE/HRSE and resultant behavior, while individually unique in expression, are by-products of increasing exposure and pressures to perception and behavior motivating influences delivered by an increasingly manipulative ICT ecosystem environment – beneficially and adversely. HRSE managed in the ICT ecosystem is at best the optimized realization of one’s health and outcomes cultivated in an altruistic environment of accurate and timely information, excellent advice and guidance, respect, and privacy. At worst, HRSE navigated in the ICT ecosystem is exposed to detrimental and crippling misinformation, disinformation, misleading influence and narratives, exploitation, commercialism, and ulterior motivations that can create or

exacerbate health-related issues. What becomes overwhelming and deafening for HRSE, and health-related outcomes are the numerous and socially strained discourses and issues frantically circulating in the ICT ecosystem.

Technology Corporations, Consumer Driven Humanity, and The Digitized Human as Currency. The digital noise of the ICT ecosystem keeps users saturated with consumer driven marketing, attention grabbing visuals, captivating auditory soundtracks, and addictive interactions driven and monitored by interpretive analytics. Entities that control aspects of the ICT ecosystem – access, content, extensive databases, complex algorithms, AI, and analytics – also control a fiscally transactional digital currency represented by the commoditization of users and their digital behaviors, which enables manipulation of influence and perception. Online bots and AI scour and entice user engagement in a range of health-related consumer interests including food, diet, fitness, elective medical procedures, and pharmaceuticals.

The origins of companies like *Apple*, *Microsoft*, and *Amazon* had nothing to do with health. Now, each of these trillion-dollar companies have considerable stakes in health-related interests. Further, they exercise powerful control and infrastructure for mobile computing, communications platforms, application development, hardware development, data storage, and integrative AI. The monumental impact of current and emerging AI cannot be understated. The ICT ecosystem is already complicated – AI is making it astronomically so. As AI continues to evolve capabilities, it will fundamentally transform most aspects of civilization and society where it is integrated. Though beyond the scope of this research thesis, the vast complexities of AI will innervate all concerns discussed above and deliver amazing life and health benefits and enhancements as well as insidious exploitations and perils.

Recommendations

The ICT and HRSE intersection should be approached with a holistic interdisciplinary socio-technological lens. Singular and component topic research usually fails to account for the symbiosis of ICT ecosystem effects and usually lacks depth of individual demographics that may impact influence and perception effects. Research also tends to omit social contexts that may influence period data collection. For example, singular component research of health-related ICT such as smartphones, application platforms, or social media often lack consideration of their greater integrative and manipulative attributes of active, passive, and non-health-related ICT effects and influence. Segregating these components from the broader effects of the much larger and influential ICT ecosystem is problematic when trying to assess effects of someone engaged in “screen time exposure,” smartphone use, or social media participation. The sum effects of ICT devices, platforms, and content use, framed in broader social contexts further framed in individual demographics and behaviors is the calculus that better reveals ICT ecosystem influence and perception manipulation. These effects also better capture “why is a person using technology?” and those tangible influences that cultivate, inform, or confound its health-related applications - important investigative factors that should accompany the “how” in evaluation of ICT participation and effects. This represents an immense range of difficulty ICT can exert on any research designed to identify source, strength, persistence, and veracity of influence effecting individual perceptions, beliefs, motivations, and behaviors. The synergy of devices, platforms, and content access and usage across the vast ICT ecosystem has a high probability of influence and perception manipulations with little known in terms of overall HRSE effects and cascading outcomes. While casting narrow nets of inquiry may seem desirable to manage process complexity, previous researchers have criticized this approach by identifying multiple gaps and limitations in their findings. Without extensive demographics, social contexts, technological

adaptation and environments, commercial interests, and associated concerns, research data collected from unilateral efforts and singular lenses will expose gaps, require assumptions, and leave more questions than answers. This suggests a breadth of experts encompassing such specialties as sociology, psychology, communications, computer science, marketing, and healthcare. This intersection of mass variables and effects requires a fusion of quantitative and qualitative methodology that acknowledges the dynamics of interrelated and confounding variables.

Demographics and ICT variables that modulate individual and group perceptions and responses to information and influence can be vast. Key demographics include general education, medical literacy, digital literacies, ethnicity, religion, political persuasions, economics, and existing medical diagnosis, particularly mental health concerns. ICT variables would include ICT device(s) usage, online patronization behaviors and preferences, preferred news sources and consumption, information and media accessed, cumulative and compounding exposures, and personal data exploitability risks. Patronization behaviors include such criteria as participation in social-media applications, general surfing activities, subscription services preferences, and echo-chamber(s) associations. Perceptions, preferences, and patronization criteria also highlight variables of trust and biases. Targeted areas of health-related inquiry should explore and identify potential competitive distractors or counter-narratives in the ICT ecosystem that can account for unexplained or unaddressed quantitative variations of research pools. Accounting for broader demographic and ICT variables better illuminate if and how HRSE is being manipulated in, by, and through the ICT ecosystem, and if those manipulations are beneficial or detrimental.

Implications and Areas of Future Research

The ICT cosmos is vast, easily accessible, generally unregulated, highly manipulative, and monetized throughout. This fiscally motivated capacity to exert enormous influence and manipulation of perceptions represents both immense benefit and threat to people, their SE/HRSE, and health-related outcomes. The ICT ecosystem may be contributing to social perceptions that encourage more cavalier and risky health behaviors, to include consumption overindulgences and addictions, with reliance on medical interventions and pharmacology to mitigate undesirable health outcomes. Individual HRSE could be experiencing social manipulations via ICT ecosystem influences that present profit driven medical interventions, elective medicine, and designer pharmacology as healthful options of lifestyle choices. For example, future research could evaluate patient-consumer willingness to participate in less healthy behaviors today in exchange for future mitigating solutions promoted via ICT ecosystem interactions – activity that can highlight the risk of profit motivated influences.

A constant barrage of external information and influence overload facilitated by ICT may be contributing to evolving and fluid real-time social perceptions that can manipulate individual thought, decision, and behavior processes. It is unknown how much these perceptions may contribute to fluid health-related personal beliefs and behaviors. There is potential danger of adverse health behaviors and outcomes if susceptibility to ICT engaged influence translates to high malleability of perception. A person's autonomous perception of individual HRSE may not be so organic, may be ill informed, or externally engineered and cultivated. HRSE could manifest in the surrogated personal digital preferences of ICT sources and resources. Future studies could investigate if ICT ecosystem facilitations are motivating preferences of pharmaceutical interventions over behavior changes, lifestyle modifications, or less invasive therapies. Further, studies that examine the influential power of celebrities or online personalities

with ICT platforms in supplanting established medical information or guidance to their followers can reveal ICT ecosystem effect.

Complicating these matters is AI. As AI evolves in complexity and integration into ICT infrastructure, it will become more deductive, inductive, interpretive, and creative. It will independently craft and introduce engineered ideas and norms of society in our digital pathways and social spaces, curating choices and options for citizens that seem logical and desirable. As technology entities exercise control over the management, access, and flow of information in the digital domains, the potential of digital surrogacies emulating a façade of individual autonomy, free will, and HRSE could become a living reality. As this area explodes, future studies will need to investigate how human agency manifests in a new reality of an ICT ecosystem further manipulated with an AI augmented homogenization of digital and physical environments. Living breathing people lie at the end of these digital pathways, with SE/HRSE and the chain of perceptions, beliefs, behaviors, and outcomes in the balance.

While HRSE for many is likely to expand and strengthen with ICT, many could experience diminished HRSE, especially those who are socially and economically vulnerable, or literacy challenged. Digital exploitations are likely to grow exponentially, exposing substantial numbers of individuals to the health-repercussions of those events. Trust and legitimacy may diminish in public health officials, health-related experts and academics, and previously reputable sources. This all translates to diminished outcomes of health for many people. Technology is inconsiderate and emotionless. Future research also must account for observations of vulnerable and disadvantaged populations at elevated risk, as well as trust-agents of health-related information and establishments. People who are technologically savvy today may become at risk with the impairments of age and future technological evolutions.

Limitations

Study of the ICT ecosystem and HRSE intersection is an expansive undertaking. Constructing a framework of literature necessary to better reveal assertions of this thesis and the research questions of moderating effects is a formidable effort of intensive multi-discipline material research and analysis.

Limitations of this research revolve mostly around the scope and fidelity of acquired literature. The subject matter is exceptionally broad, especially when attempting to explore a vastly nebulous ICT ecosystem and its health-related social effects all the way down to individual SE/HRSE and documented outcomes. Selected word combinations used for database searches may have limited visibility on results. Predominate use of medical databases may have also limited valuable selections of research in these combined domains. Expanded database use would have greatly opened research material, but narrowing parameters was essential for the logistics of this effort. This restriction may have omitted recently published studies across disciplines that amplify the dynamics of the ICT ecosystem and HRSE elucidated here.

There are some limitations of this research that hinge very specifically on the content of the literature. For example, the general focus on narrow topics of singular devices, applications, or interventions that address specific medical conditions, treatment, local, or age omit the effects of a broader ICT ecosystem. Further, limited application of social contexts, technology use contexts, extensive demographics, compounding and cumulative ICT effects, and limited longevity studies diminish the ability to identify moderating ICT effects. Additionally, research reflecting adolescents in this area was limited. While parents may exercise great control over adolescent health choices and behaviors, this is an influential period of life for this demographic, and adolescents are prolific devotees of ICT devices, environments, and platforms.

Conclusion

This literature review has revealed a dichotomy of ICT in relation to HRSE. Though the diversity, reach, accessibility, and depth of ICT is generally commended as highly beneficial to people in informing and managing health-related concerns, it contrarily hosts a plethora of disadvantages. The benefits can enhance individual HRSE through information, education, observation, and management of healthcare and related behaviors. Conversely, it has been noted to have detrimental effects on physical, mental, and emotional health in various capacities among other effects. Additional disadvantages range misinformation, disinformation, exploitation, overuse, abuse, addiction, and overwhelming influences that can contribute to and motivate perceptions, beliefs, and behaviors that negatively impact HRSE and manifest in physiological and/or psychological adversity. Many of the disadvantages cited and/or cautioned against were noted as areas of much needed or continuing research. The complexity of this dilemma requires an interdisciplinary approach of scope and depth that grounds HRSE in the broader effects of the ICT ecosystem with consideration of comprehensive demographics, social contexts, and health-related information, narratives, and discourse in the social spaces.

HRSE is not just about feeling confident in one's ability to successfully manage one's healthcare but being confident in the information and sources that support those health-related perceptions, beliefs, and behaviors. The literature indirectly suggests that aspects of the ICT ecosystem could behave as an interconnected tool of human behavioral engineering or manipulation with capacity to harm the very users it enables. The probability of harm likely correlates with individual attributes of education, digital and medial literacies, and pre-existing SE/HRSE. As technology evolves and migrates deeper into the digitized social spaces that physically segregate humans, the ICT ecosystem with AI will increasingly and autonomously

manipulate influence and perceptions. If the ICT ecosystem, in concert with entities with ulterior motives, emerges as a primary architect of the social fabric, then the human condition, to include HRSE, becomes corrupted. The moderating effects that the ICT ecosystem produces in the health and healthcare-related spaces exerts considerable influence on the pliability of human health experience and outcomes. Determining the level of ICT intrusion and affect into the manipulation of individual SE/HRSE is essential.

As medical science, treatment advances, and pharmacology progress over time with increased longevity complicated with chronic multi-system health conditions, these and related quality of life concerns, to include mental health, will evolve in parallel with the ICT ecosystem and its tangible effects. A person's idea of SE/HRSE is a complex individualized composition that will increasingly be moderated through the ICT ecosystem. SE/HRSE can be manipulated in the fluidity of information exchange and social dynamics playing out in the unregulated, exploitive, polarizing, and often misleading environment of the ICT ecosystem. HRSE may evolve into whatever preferred media sources tell a person it should be at that moment. Behaviors and expectations are usually driven by whatever metrics the contemporary social fabric suggest, and those metrics are increasingly fabricated and accessed via the ICT ecosystem. Knowing the diversity of health-related risks associated with utilizing the ICT ecosystem and content is as important as knowing any other health-related risk to body and mind.

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cross-genre study on perception and validation of health information online. *International Journal of Data Science and Analytics*, 1–16. <https://doi-org.proxyse.uits.iu.edu/10.1007/s41060-022-00310-7>

Todd Swartz

Abbreviated Résumé for Thesis

COLLEGIATE EDUCATION

1987-2002 Tulsa Community College, University of Oklahoma, University of Maryland

2007 A.A.S. Pararescue (Personnel Recovery), Community College of the Air Force

2018 B.S. Criminal Justice, Troy University

2025 May Master of Interdisciplinary Studies Health Humanities, Indiana University

TECHNICAL CERTIFICATIONS

1993-2017 National Registry of Emergency Medical Technicians - Paramedic / National Paramedic, State Paramedic

PROFESSIONAL EXPERIENCE

1989-2016 United States Air Force, Chief Master Sergeant, Pararescue, Retired

2016-present Consultant

CONTACT

oktswartz@gmail.com

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