UNDERSTANDING AND IMPROVING PATIENT PORTALS FOR OLDER ADULTS

EVALUATING AND IMPROVING THE USE, INCLUSIVITY, AND ACCESSIBILITY OF PATIENT PORTALS FOR OLDER ADULTS

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A Thesis Submitted to the School of Graduate Studies in Partial Fulfilment of the Requirements for the Degree Master of Science in eHealth.

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Lay Abstract:

This thesis examines how older adults use patient portals, the factors which promote and prevent patient portal use amongst older adults, as well as frameworks and tools that can be used to ensure that patient portals are designed with everyone, regardless of background, in mind. This thesis provides recommendations for improving patient portal access and adoption revealed through a systematic review (support and engage portal users, simplify patient portal design, build health literacy and digital literacy capacities in older adults, and to build trust and value in a patient portal, all while considering equity), frameworks to assist in the design and/or implementation of equitable patient portals for older adults, and how anyone engaging in portal design or implementation can identify, select, combine and adapt, use, and finally assess these frameworks in their own patient portal project.

Abstract

As technology advances, we see the digitization of many crucial services, including healthcare. Patient portals provide patients with quick access to their personal health information, the ability to perform health management tasks, educational materials, and more. Patient portals are rapidly increasing in adoption, and becoming a core part of the healthcare experience. Although patient portals show promise in improving healthcare outcomes and experiences, these solutions are not equally accessible to all.

Older adults face unique barriers to using patient portal including limited digital literacy, physical and cognitive limitations, and issues arising from a lack of consideration of older adults in patient portal design. This thesis examined the state of patient portal use amongst older adults, facilitators and barriers to portal use and adoption, frameworks and strategies to improve the adoption and use of patient portals, and roadmaps for selecting and including these frameworks into patient portal development and implementation.

Chapter 2 employed a systematic review to examine the use of patient portals by older adults, the features most frequently accessed by older adults, and the facilitators and barriers to older adults’ use and adoption of patient portals. The systematic review revealed lower use of patient portals amongst older, low socioeconomic status, low education, non-English speaking older adults, amongst other factors. Patient portals were most frequently used to access personal health information, or perform health management tasks such as booking appointments or renewing prescriptions. The barriers and facilitators revealed pathways forward; building trust and value, supporting and engaging portal use, advancing community capacities, and simplifying patient portals. These pathways surrounded by a focus on EDI can serve to make patient portals more accessible for older adults of all walks of life.

Chapter 3 employed a multi-modal search of databases and gray literature to provide a list of 11 frameworks, 6 of which can be used to ensure equity is promoted, 3 of which are focused specifically on pathways to improving use and adoption of technologies, and 2 of which are focused on ensuring the protection and control of sensitive data by minority groups.

Chapter 4 brings the findings of earlier sections together by exploring actionable pathways to implementing the suggestions made in Chapter 2 and Chapter 3. Chapter 4 lays out roadmaps for incorporating frameworks for the improvement of equity within development and implementation projects and lays out liberatory design as a potential pathway for developers to consider EDI throughout the design process.

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List of all Abbreviations and Symbols

Abbreviation	Full term
D&I	Dissemination and Implementation
DDoH / DDOH	Digital Determinants of Health
DHEF	Digital Health Equity Framework
EDI	Equity, Diversity, and Inclusion
EGAP	Engagement, Governance, Access, and Protection
EHR	Electronic Health Record
eHEF	eHealth Equity Framework
HCP / HCPs	Health(care) Provider(s)
HEIF	Health Equity Implementation Framework
i-PARIHS	integrated Promoting Action on Research Implementation in Health Services
LGBT	Lesbian, Gay, Bisexual, and Transgender
NIMHD	National Institute on Minority Health and Health Disparities
OCAP®	Ownership, Control, Access, and Possession
PHR	Personal Health Record
PROGRESS-Plus	Place of residence; Race/ethnicity/culture/language; Occupation; Gender/sex; Religion; Education; Socioeconomic status; Social capital; Plus: age, disability, sexual orientation, and other context-specific factors
SDoH / SDOH	Social Determinants of Health
TAM	Technology Acceptance Model
T-CaST	Theory, Model, and Framework Comparison and Selection Tool
UTAUT	Unified Theory of Acceptance and Use of Technology
WHO	World Health Organization
ICT / ICTs	Information and Communication Technology / Technologies
RCT / RCTs	Randomized Controlled Trial(s)
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PRISMA-P	Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols
CINAHL	Cumulative Index to Nursing and Allied Health Literature
SLUMS	Saint Louis University Mental Status Exam
2FA / 2-FA	Two-Factor Authentication
ZWIP	Zorg en Welzijns Informatie Portaal
COVID-19	Coronavirus Disease 2019
SES	Socioeconomic Status
DEI	Diversity, Equity, and Inclusion

Declaration of Academic Achievement

This thesis proves its academic achievement through several key areas of contribution. This thesis builds upon and deepens the understanding of patient portals for older adults through secondary research, explores relevant and applicable frameworks for patient portal implementation and development, and provides developers and implementation focused groups with roadmaps and potential tools to be used to ensure the principles of equity, diversity, and inclusion are upheld while bringing quality solutions to users.

This thesis is uniquely applicable as it focuses not only on secondary research and literature, but is grounded in application, with a focus on being usable to ensure EDI in the implementation and development of patient portals. Patient portal developers and groups interested in patient portal implementation are encouraged to apply the findings and processes outlined by this thesis, specifically in Chapter 3 and 4. Furthermore, this thesis makes considerations for the various sizes of organization or project scopes which may be involved in patient portal projects. The table of frameworks and methodologies in Chapter 3 describes levels of application, as well as specific synergies and contexts in which frameworks are most applicable.

Chapter 1

Introduction

As Canada’s life expectancy has increased, so have the number of older adults (individuals aged 65 and above), and proportion of the population who are older adults. Older adults represented nearly one fifth of Canada’s population as of 2022, and projections estimate this proportion will continue rising (Government of Canada & Canada, 2022). While age alone does not serve as an indicator of health status, the prevalence of adverse health outcomes and disability increase as populations age (Jaul & Barron, 2017).

Digital health tools are a promising solution to addressing the increased demand for healthcare services associated with an aging population (Chen et al., 2023). Digital health tools broadly refer to information and communication technologies (ICTs) used to manage and promote health and wellness in their users (Ronquillo et al., 2023). Digital health tools encompass a number of physical and virtual ICTs such as wearable devices, telemedicine platforms, mobile health apps, electronic health records, and more (Ronquillo et al., 2023). Among these ICTs, patient portals have emerged as a tool for patient care.

Patient portals, often referred to as personal health records, are digital health tools that employ the web to provide patients with access to health-related information, media, and communications (A. Griffin et al., 2016). Patient portals often vary in the breadth of features and customization provided, as some may perform simple tasks, while others act as a platform for patients to receive and monitor their health care. Simple patient portals allow patients to interface with aspects of their healthcare by viewing and potentially updating portions of their electronic health records (EHR), such as lab tests, medications, immunizations, discharge summaries, and allergies (Alturkistani et al., 2020). More complex patient portals may offer additional features or customization such as appointment management, adjustable font/text size, secure communication with their healthcare providers (HCPs), and/or access educational materials that are related to their health (Norouzi Aval et al., 2025). Patient portals may act as facilitators for patient-provider communication, promote patient engagement and encourage informed decision-making in patients (Norouzi Aval et al., 2025). They have been associated with increased satisfaction with care, improved healthcare outcomes, and an increase in treatment adherence (Carini et al., 2021; Choudhury et al., 2022; Wade-Vuturo et al., 2013).

1.0.1 Research Motivation

Despite the potential of patient portals to improve healthcare delivery, their usage among older adults remains low relative to younger counterparts (Carini et al., 2021). The limited adoption of patient portals by older adults is, in part due to, a lack of consideration for the needs of older adults when designing portals (Turner et al., 2015). Other age-related factors such as cognitive decline and lower comfort levels with technology may make patient portals inaccessible for some older adults (Nahm, Zhu, et al., 2020; Taha et al., 2013). Health inequities are often exacerbated amongst people at the intersections of marginalized identities (Kelly et al., 2022). This idea is supported by intersectionality, and addressed by the principles of Equity, Diversity, and Inclusion (EDI), which aim to address underrepresentation or discrimination in institutional contexts (Kelly et al., 2022) Given that there are significant disparities in portal use amongst older adults and the working-age population, it is important to understand how and why these disparities exist, how they may intersect with other factors affecting portal use, and how EDI as well as other tools and programs may be leveraged to overcome these inequalities, and ensure patient portals are suitable for all users.

1.0.2 Overarching objective:

To assess the inclusivity and accessibility of patient portals used by older adults and make recommendations that could improve access and use of such portals for all older adults.

1.0.3 Research questions:

Having developed the overarching objective, the following 3 research questions were developed to accomplish it.

1. How do older adults use and perceive patient portals in healthcare settings?

a) How are patient portals being used by older adults?
b) What are the characteristics of portals that promote or discourage portal use?
c) What are the facilitators and barriers to use of portals?

This research question is addressed in chapter 2, a systematic review of the use and perceptions of patient portals by older adults. The chapter synthesizes observations from 36 studies and provides a list of recommendations or "keys" to the successful adoption of patient portals for older adults.

2. To better support the needs of differently-abled and culturally diverse older adults, what frameworks or tools that consider EDI principles can be applied to patient portals to enhance their usefulness?

This research question will be addressed in chapter 3 of the thesis, an exploration of EDI frameworks and other methodologies which can be employed to improve access, use, and understanding of patient portals for diverse and differently-abled older adults.

3. How might we apply the findings from the review and frameworks to existing or future patient portals to best support older adults with diverse

needs?

Chapter 4 brings together the findings from chapter 2 and chapter 3 to present a refined list of recommendations and tools to support successful patient portal development, adaptation, implementation, and adoption by older adults, with emphasis on mitigating the disparities experienced by diverse and differently-abled older adults.

1.1 Background

1.1.1 Patient Portals

Patient portals are secure online platforms that permit individuals to access personal health records and perform a variety of tasks related to the management of their health (Carini et al., 2021). Patient portals were developed in the late 1990s alongside a greater boom in health information technology (Halamka et al., 2007). Patient portals enable their users, the patient, to complete health management tasks such as scheduling appointments, requesting prescription refills, viewing medical records (e.g., test results, medications, etc.) and communicating with their care providers in a safe and secure manner (Carini et al., 2021). Early portals, including the Children's Hospital Boston's online personal health record (PHR), the CHIP system, and Epic Systems' MyChart, were revolutionary in providing patients direct electronic access to their health information (Halamka et al., 2007).

Adoption of patient portals followed a similar trend in Canada. Alberta health authorities embraced Epic's clinical information system in 2006, initiating a MyChart proof-of-concept in 2014 and full rollout in 2019 (Avdagovska et al., 2020). Sunnybrook Health Sciences Centre in Toronto similarly began implementation of their own patient portal as a research tool in 2006, later expanding it to be system wide. Sunnybrook's adoption made it evident that to achieve meaningful portal use, there was need for patient centered design, ongoing evaluation, and consistent stakeholder engagement (Curtis et al., 2011). Accounting for this and important considerations such as equitable access, privacy, and usability, has permitted portals to evolve from limited pilot programs to integral parts of digital health infrastructure across North America.

As patient portals proliferate, there is a growing body of research, some of which suggests that portals may improve the engagement and, in some cases, the clinical outcomes of patients. A systematic review on the health outcomes of patient portals found that portal users reported better monitoring of chronic conditions, improved patient-doctor communication, and perceived higher quality of care (Carini et al., 2021). While there is some evidence that portals may lead to improved health outcomes, the evidence is mixed. Some studies do show better control of disease and appointment attendance, but others do not observe any effect (Carini et al., 2021).

1.1.2 Health Inequities

Although patient portals may be beneficial for patient care journeys, their benefits are not enjoyed universally. They may be disproportionately adopted; characteristics such as lower socio-economic status (SES) (e.g., income, education, employment, occupation status), membership in a racial minority group (e.g., Black, Latino), Indigenous background, rural dwelling, and male sex are associated with lower likelihood of accessing a patient portal (J. M. Griffin et al., 2023; Perzynski et al., 2017). These inequities are generally mirrored in the broader Canadian context, as a report by the Public Health Agency of Canada observed significant health inequalities among immigrants, and those who were Indigenous, functionally limited, and having lower SES (Public Health Agency of Canada & Pan-Canadian Public Health Network, 2018).

Older adults face many inequities in their day-to-day life, as they navigate an increasingly digital world which is often not designed for them. Such inequities are evident in patient portal access, as older adults are significantly less likely to access and use patient portals (Cajita et al., 2021). This may be due to a variety of reasons including disparities in access to technology or broadband, low digital or health literacy, or physical and/or cognitive impairments (Taha et al., 2013) Older adults generally report having lower levels of familiarity and exposure to technology which can result in low confidence and comfort in using technology (Vroman et al., 2014).

Studies in the U.S. have observed disparities in patient portal access among racial minorities, particularly amongst Black and Latino patients (Arcury et al., 2017). Interestingly, after adjusting for the effect of education, income, and health literacy, it was observed that the disparities may be structural rather than due to race (Arcury et al., 2017). In the Canadian context, we observe significant digital barriers such as a lack of access to reliable broadband for the Indigenous communities (Ali-Hassan et al., 2020). Racialized groups may also face additional barriers arising from difference in language, and a mistrust of healthcare institutions caused by historic prejudice and discrimination (Antonio et al., 2019).

Patients with lower-income are less likely to own smartphones or have access to reliable internet and may lack digital skills needed to use health portals effectively (Arcury et al., 2017).. This is reflected in research, with individuals below the poverty line shown to be significantly less likely to register for a patient portal (Arcury et al., 2017).. Patients with lower health literacy due to limited reading or numeracy skills may additionally find portal interfaces confusing or inaccessible (Taha et al., 2013). A lack of education (non-completion of high school) is another factor that can be a barrier among older adults, possibly intersecting with socioeconomic status and health or technology literacy to impact portal use (El-Toukhy et al., 2020).

These factors rarely act in isolation. An older adult who is low-income and from a racialized background will face compounding disadvantages in accessing and using digital health tools (Antonio et al., 2019). It thus becomes important to not only address patient portal access as a technical issue, but rather within a larger conversation of digital health equity.

1.1.3 EDI Principles

EDI are principles that aim to remove barriers and encourage meaningful inclusion across a variety of disciplines. Equity emphasizes giving people a fair opportunity to experience opportunities and be included by reducing or removing the barriers to participation. Diversity refers to the layers or differences of a community, representing the various sociocultural identities within groups. Inclusion emphasizes a sense of belonging and dignity for all, reinforcing ideas from equity, that all should have an equal chance at opportunities (McMaster University, 2020). The combination of these ideas can promote curiosity, creativity, innovation, and introduce novelty and quality to our environments (McMaster University, 2020).

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Inequalities in health are often approached from a lens which aims to mitigate or reverse the effects of negative social determinants of health (SDOH) (Koh et al., 2010). Programs worldwide are seeking to mitigate the negative effects of factors that relate to populations, diseases, geography, or other risk factors. PROGRESS-Plus is a framework which concretely attempts to address SDOH by defining dimensions of social stratification. The PROGRESS-Plus categories are Place of residence, Race/ethnicity, Occupation, Gender, Religion, Education, Socioeconomic status, and Social capital, in addition to personal characteristics associated with discrimination (i.e., age and disability), features of relationships (i.e., smoking parents, caregiver), and time-dependent relationships (i.e., hospital discharge, hospice care, or other situations in which a person is at a temporary disadvantage) (The Cochrane Collaboration, 2025). PROGRESS-Plus characteristics are not necessarily a disadvantage but can serve as prompts for deeper exploration and understanding. Considering a person's PROGRESS-Plus characteristics can serve to view equity beyond the typical lens, where considerations are limited to a single social stratifier (O'Neill et al., 2014). PROGRESS-Plus is widely used in health equity projects, and is the predominant framework employed in systematic reviews examining effects of numerous characteristics on health interventions (Hollands et al., 2024). Although PROGRESS-Plus can provide a good overview of health equity factors, it fails to consider the deeper interactions of these factors, as well as complex pathways and contextual factors that would make it more practical in application (Hollands et al., 2024). For these reasons, PROGRESS-Plus will be used as a guiding framework for recognizing the important dimensions of health equity but also supplemented by frameworks in Chapter 3 which examine the interaction of these factors, and the relation of these factors to the use of patient portals (or technologies more broadly).

Throughout this thesis, PROGRESS-Plus will inform the multidimensional characteristics of older adults affecting their equitable access and use of patient portals. PROGRESS-Plus characteristics were used to identify participant characteristics in included studies in Chapter 2, to score the relevance of frameworks to EDI in Chapter 3, and to produce recommendations for the improvement of portals in Chapter 4.

Chapter 2

Older Adults' perceptions and use of patient portals: A Systematic Review

Patient portals, which provide an online electronic way to access personal health information, communicate with providers, renew medications, schedule appointments, and engage with educational materials (Turner et al., 2015), continue to gain popularity worldwide (Carini et al., 2021). Patient portals have the ability to support the relationship between physicians and patients, increase patient autonomy and involvement in care, and improve the adherence to and usage of healthcare interventions (Carini et al., 2021; Nahm, Son, et al., 2020).

The rise in health care research and improvement of health technology has been accompanied by a growth in the older adult population (Nahm, Son, et al., 2020). Though older adults, who often manage comorbid and chronic conditions, can experience similar benefits in using patient portals, a number of barriers make this a challenging feat for many in this population. These barriers include a lack of computer proficiency, low health literacy, security concerns, physical/cognitive limitations, and high financial cost of the internet (E.-H. Kim et al., 2009; Sakaguchi-Tang et al., 2017; Turner et al., 2015). Patient portals have not been created with these factors in mind, and this can make it difficult for older adults to feel capable or supported in using these new technologies to manage their care (Turner et al., 2015).

Older adults are also often assumed to be completely non-technology users, though many utilize the internet and own smart phones (Nahm, Son, et al., 2020). If equipped with the tools and guidance to navigate new online platforms like patient portals, the factors that do limit affect older adults' use can be improved (Nahm, Son, et al., 2020; Turner et al., 2015). The limited percentage of older adults who do use patient portals cite easy access to personal health information, ease of booking appointments, and improved communication with providers as valuable to their experience (Turner et al., 2015). By building upon and refining these important features, and providing adequate levels of training to individual patients, it becomes possible for the benefits of patient portals to become accessible to the larger older adult population (Sakaguchi-Tang et al., 2017; Son & Nahm, 2019).

This systematic review aims to evaluate the current evidence on older adults' use and satisfaction with patient portals, the portal features most accessed by older adults, the barriers and facilitators impacting portal use, as well as suggestions to improve patient portal use among older adults.

The primary research question of this systematic review, as defined in chapter 1 of the thesis, was: "How do older adults use and perceive patient portals in healthcare settings?"

2.1 Methods

This systematic review was conducted in accordance with The Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols (PRISMA-P) 2020 guidelines (Page et al., 2021).

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2.1.1 Information Sources

Medline, Embase, and CINAHL were searched on July 25th, 2024. The database selection and search strategies (Table 2-1) were developed through consultation with a health sciences librarian. Searches were restricted to 2010 onwards.

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Table 2-1. Search strategy concepts used when searching the various databases.

Term	Term Description
1	((aged [MeSH]) OR (older adult*) OR (older people) OR (elder*) OR (aged) OR (ageing) OR (aging) OR (elder*) OR (geriatric) OR (old age) OR (senior*) OR (older))
2	((patient portals [MeSH]) OR (patient portal*) OR (online portal) OR (online platform) OR (personal health record [MeSH]))
3	((patient preference [MeSH]) OR (patient satisfaction [MeSH]) OR (perception*) OR (adopt*) OR (accept*) OR (satisfaction) OR (usage*) OR (utilization*) OR (usability) OR (preference*))
Search	1&2&3

2.1.2 Inclusion Criteria

We considered studies that include participants with a mean age >55 years that examined participant perception, preferences, use, and adoption of digital health tools which integrate the patient’s electronic health record. Randomized controlled trials, cohort studies, cross-sectional studies, mixed-method, and qualitative studies were considered. The outcomes of interest included measures of portal usage, patient satisfaction, perceived portal usability, and barriers/facilitators to portal adoption. Studies not published in English or published prior to 2010 were excluded.

2.1.3 Study Selection

Two reviewers independently screened all titles and abstracts yielded by the search against the eligibility criteria. We used a two-stage screening process in Covidence. In the first stage, irrelevant or clearly ineligible studies were excluded based on title/abstract. In the second stage, we retrieved full-text of the remaining articles and assessed each in detail for inclusion. Any disagreements between reviewers were resolved through discussion or by consulting a third reviewer.

2.1.4 Data Extraction

For each included study, two reviewers independently extracted relevant data using a standardized form that was piloted by the reviewers on a sample of 5

Commented [GL4]: I think you also piloted the forms....this should be mentioned included articles. Extracted data included: study bibliographic details (first author, year, country), study design (retrospective vs. prospective, etc.), setting and population, participant characteristics according to PROGRESS-PLUS (The Cochrane Collaboration, 2025), the name and aim of the digital patient portal, condition which the portal intended to treat/support, portal features, the care environment (e.g. primary care, inpatient), recruitment methods, quantitative outcomes of use, qualitative outcome of use, perspectives gathered, facilitators & barriers to portal use, description of the acceptance of portal features, the author's overall impression of portal efficacy, and any recommendations to improve older adults' adoption and use of patient portals. The extraction template is available in Appendix A.3

2.1.5 Analysis

Following the extraction of features, facilitators, and barriers, reviewers convened to categorize the extracted features into 6 or fewer categories. Features were grouped into 6 categories, with an extra category to accommodate any other features. Facilitators and Barriers were initially grouped into 6 and 5 categories respectively, however, after consideration, it was determined that the overlap between 2 facilitator categories was sufficient to combine them in order to yield 5 facilitators and 5 barriers.

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2.2 Results

The search yielded 8699 articles, of which 7559 remained after deduplication (Figure 2-1). Initial title and abstract screening were performed on these 7559 articles, of which 7390 were deemed to be irrelevant. We were able to retrieve full text of 158 of the 169 remaining studies. Following full text review, 36 were included.

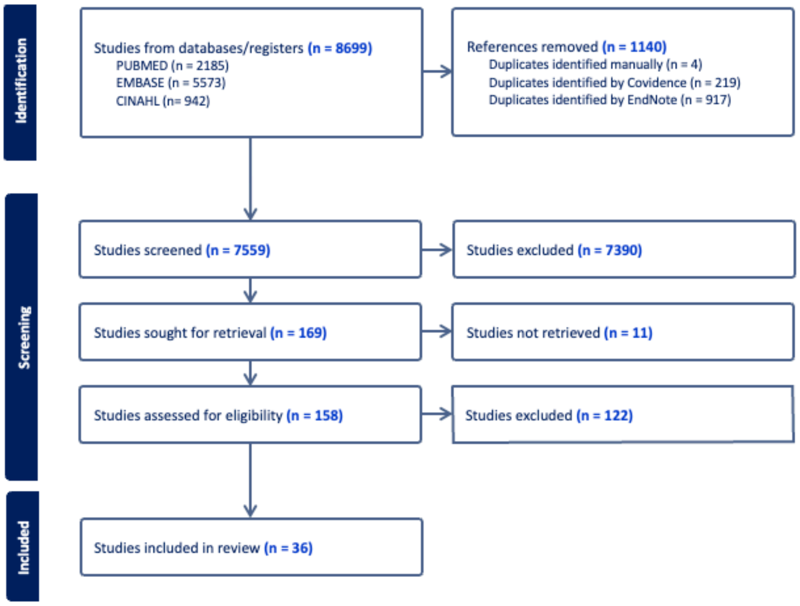


Figure 2-1. PRISMA diagram showing study selection process for systematic review on portals.

The included studies employed a variety of study designs; 19 used quantitative-only study designs that included cross-sectional surveys, retrospective cohort analyses, and analysis of secondary data to explore older adults' experiences with patient portals. Qualitative only methodology, through focus groups, interviews, and other user-centred design approaches, was employed by 7 of the included studies. Ten of the included studies combined quantitative and qualitative methods to explore older adult experience with patient portals using mixed methods. Three mixed methods studies and 1 quantitative only study were randomized controlled trials (RCTs).

Twenty studies focused on a single portal comprising 10 unique portals. The most prevalent portals were EPIC MyChart (7 studies, 2 of which are simulations of MyChart), Zorg en Welzijns Informatie Portaal (ZWIP) (3 studies) and My Health Manager (3 studies).

2.2.1 Participant Characteristics

Details of the included participants are in Table A-1 in Appendix A. Sample sizes ranged from 17 (S. Kim & Fadem, 2018) to 183,092 (Gordon & Hornbrook, 2016) participants. Fourteen studies had fewer than 100 participants, 11 included 100-500 participants, 10 had 500-5000 participants, and 3 of the studies exceeded 5000 participants.

The included studies focused on older adults and their experiences, but this was not defined uniformly throughout the included studies. Specifically, 31 studies had a population of older adults defined as adults aged 65 or older. The other 7 included studies had broader age ranges, often starting at 50 or 55 years of age, or had an adult population which was skewed towards older adults. In addition, 7 studies included the perspectives of caregivers, and 5 included the perspectives of healthcare professionals (most often primary care physicians).

The studies focused on older adults dwelling within the community, accessing primary care services, with some studies having patients across primary, secondary, and tertiary care environments.

2.2.2 Portal Features

138 portal features were mentioned in the articles. To determine the importance and frequency of these features, those that were analogous or similar were grouped into 6 overarching categories and 27 unique features (Table 2-2). Some articles did not report the features of the patient portal(s) as they considered a variety of patient portals or portal features were beyond the scope of their study.

Table 2-2. Features of patient portals described in included studies.

Feature	Number of articles
Health Management Tasks	
• Viewing and/or managing medical record (test	26
• Manage/order/refill prescriptions and/or medications	14
• Appointment management	14
• Discharge sheets and visit summaries	7
• View (only) medications and/or set reminders for	7

• Action plans and/or goal setting	3
• Appointment information and/or reminders	2
• Access and manage Advanced Directives	1
Educational and Informational support materials	
• Information on health and other educational	8
• Community/local services, care providers’ links	3
• Billing and insurance	4
Healthcare Provider Communication	
• Secure messaging/emailing	27
• eVisits or check ins	3
• Doctor visit preparation	2
Services	
• External service or care provider booking/scheduling	2
• File organ donation testament	1
• Merchant coupons	1
• Emergency call	1
Care Network	
• Shared access for caregivers	4
• View or customize care network	1
Portal Architecture	
• Secure login (username, password, SMS	1
• Portal access via laptop/desktop	1
Other features	
• Calendar	1
• Clock	1
• (Video) contacts	1
• News	1
• Games	1

The most prevalent features observed were a form of secure message/email to communicate with the healthcare provider and the ability to access and view (potentially manage) health records including test results, immunizations, ongoing concerns, care plans, and/or clinical notes. The ability to view or manage prescriptions and medications, and to track or manage/schedule appointments were also common.

Feature Usage

Eight articles reported usage statistics and found that older adults most frequently used portals for healthcare management tasks and healthcare provider communications.

Under healthcare management tasks the most used features were viewing laboratory results, managing medications, and accessing other medical records. Four articles reported health management tasks such as viewing lab results as the most used portal features in their studies (Burgdorf et al., 2024; Cross et al., 2021; Lafata et al., 2018; Son et al., 2022). Appointment related functions were also highly used, with both Lafata et al. (2018) and Burgdorf et al. (2024) finding 77.x% of patients using patient portals for appointment management. Other healthcare management tasks which were commonly used included medication management and viewing visit summaries.

Four included articles reported communication features, specifically messaging between the patient and provider, to be the most commonly used feature by older adults (Finkelstein et al., 2011; S. Kim & Fadem, 2018; Makai et al., 2014a; Portz et al., 2021). This is supported by patient-provider communication also being used by over half of the participants in all other studies that reported the usage of features (Burgdorf et al., 2024; Cross et al., 2021; Lafata et al., 2018; Son et al., 2022).

Other notable features included educational content and goal setting tools, which each reported respectable usage in single articles, however usage of these features varied greatly between studies, with others reporting minimal use. The studies reported little use of goal setting (Makai et al., 2014b) billing tools (Burgdorf et al., 2024; Portz et al., 2021), and coupon book features (Finkelstein et al., 2011).

2.2.3 Portal Adoption and Use

Portal adoption varied across studies, with rates of adoption among study participants ranging from 32.6% (Lafata et al., 2018) to 71.2% (Gleason et al., 2023). Among those registered, the majority used the portal at least once, although their frequency of engagement varied considerably, ranging from single logins (Nahm, Zhu, et al., 2020; Robben et al., 2012) to use multiple times per month (Finkelstein et al., 2011; Nahm, Son, et al., 2020; Portz et al., 2021; Son et al., 2022; Willard et al., 2018; Yoon et al., 2024).

Lower portal use was associated with older age (Huang & Ye, 2024; Lafata et al., 2018; Portz et al., 2021; Yoon et al., 2024), preference for a non-English language (Lafata et al., 2018), and identifying as African American (Burgdorf et al., 2024; Lafata et al., 2018; Portz et al., 2021; Yoon et al., 2024), Hispanic (Lafata et al., 2018; Yoon et al., 2024), or Asian (Portz et al., 2021).

Higher portal usage was associated with being white (Burgdorf et al., 2024; Lafata et al., 2018; Portz et al., 2021; Yoon et al., 2024), married/partnered (Burgdorf et al., 2024; Cajita et al., 2021), having achieved a higher level of education (Huang & Ye, 2024; Turner et al., 2015) and greater income (Huang & Ye, 2024). Patients with more chronic conditions (Lafata et al., 2018; Son et al., 2022; Yoon et al., 2024), greater health literacy (Yoon et al., 2024), or self-efficacy (Son et al., 2022), were also more likely to use portals. Having an informal/unpaid caregiver was more common among non-users (Turner et al., 2015).

Shared access and proxy use of portals was common (Burgdorf et al., 2024; Cajita et al., 2021; Gleason et al., 2023). Shared portal access may also affect engagement, with one study reporting that patients with a shared access user were more likely to be portal users and demonstrated greater portal activity compared to those without shared access (Gleason et al., 2023).

Across multiple studies, the most frequently used features were viewing test results (Burgdorf et al., 2024; Cross et al., 2021; Nahm, Zhu, et al., 2020; Son et al., 2022; Yoon et al., 2024), and messaging with providers (Finkelstein et al., 2011; Lafata et al., 2018; Makai et al., 2014b; Nahm, Son, et al., 2020; Son et al., 2022; Willard et al., 2018). Use of appointment scheduling/management (Burgdorf et al., 2024; Lafata et al., 2018; Portz et al., 2021), medication management (Burgdorf et al., 2024; Nahm, Zhu, et al., 2020), and visit summary features (Lafata et al., 2018; Nahm, Zhu, et al., 2020) were also common, although somewhat less frequently used.

2.2.3 Facilitators and barriers

Numerous facilitators and barriers to older adult patient portal use were identified in the included articles. These were categorized and tabulated in Table 2-3.

Table 2-3. Key facilitators and barriers to portal use by older adults identified from includes studies.

Facilitators	Frequency (# articles)	Barriers	Frequency (# articles)
Support and Engagement	18	Lack of Support	13
Ease of Use	13	Difficulty of Use	14
Perceived Value	7	Lack of Trust	11
Familiarity with Technology	4	Age / Socio Economic Factors	14
Health Literacy	6	Low Literacy	12

2.2.3A Facilitators

Commented [JD6]: Check numbers for facial and barriers

Commented [GL7]: Since many of the barriers and facilitators are related to the same constructs, I wonder if you should summarize the information on facilitators and barriers in one section instead of two. If this is a big job, it can be done after the defense.

The facilitators observed in the included studies were listed, discussed by 2 of the authors, and then categorized into 5 distinct groups, representing the types of actions, features, or devices required to support and promote the use of a patient portal among older adults. These categories are support & engagement, ease of use, perceived value, access to technology, and health literacy.

Support and Engagement

Support and engagement was the most widely reported facilitator category with 18 articles describing its role in promoting portal use for older adults. This category encompassed several ideas such as provider engagement, caregiver and peer support, technical training and support, effective communication, and patient engagement.

Provider engagement was referenced in 7 of the included studies. Cross et al., (2021), Kim & Fadem (2018), and Son et al., (2022) found that when healthcare providers offered guidance, support, and interactions with the portal to patients, the patients significantly increased their use and satisfaction with the portal. Portz et al., (2020) and Lafata et al., (2018) reinforce this finding, as they found portal engagement improved with stronger patient-provider relationships. In addition, Nahm, Zhu, et al., (2020) and Wildenbos et al., (2018) both found that timely response and engagement with the patient portal from HCPs encouraged users to engage with the portal and improved portal trust.

Caregiver support improved patient portal use and engagement amongst older adults in 4 of the included articles. Burgdorf et al., (2023), Gleason et al., (2023), and Makai et al., (2014a) found that the involvement of informal caregivers had a positive effect on the navigability and/or engagement with patient portals for older adults. These findings were echoed in Zoorob & Hasbini (2023), which extending the umbrella of support beyond caregivers to informal familial and peer support.

Technical training such as onboarding support was observed to be a facilitator in 4 of the included articles. Taha et al., (2014) and Son & Nahm (2019) emphasized the impact and importance of hands-on demonstrations when signing up, as well as assistance in registration. Willard et al., (2018), Portz et al., (2020), and Gordon & Hornbrook (2016) found that tailored training materials such as paper guidebooks were more effective than online training programs for older adults. This was contrasted by the findings of Robben et al., (2012), which found that in-person coaching was preferred to guidebooks in the onboarding phase.

Kim & Fadem (2018) and Cross et al., (2021) emphasized the importance of communication strategies in supporting patient portal users. These studies expressed that tailored communication strategies such as screen sharing or using the portal in patient discussions encouraged participants to engage with the system more frequently, and with improved confidence.

Lastly, a perception of engagement from the portal itself was identified as a facilitator in 2 of the included articles. Alignment between the participant’s goals, and portal features, combined with perceived engagement with providers due to portal features were observed to be a facilitator in both Steele Gray et al., (2021) and Makai et al., (2014b).

Ease of Use

The other most reported facilitator was the ease of portal use. Older adults expressed that simpler and more intuitive portal designs had positive effects on their experience and use of portals. Elements contributing to the ease of use were clear and intuitive interfaces, simplified login and authentication processes, and ease of completing desired user tasks.

Having clear and intuitive platform design and user interfaces was commonly mentioned. Barron et al., (2014), Willard et al., (2018), and Siek et al., (2010) all found that user-friendly layouts that employ large icons/images and low clutter allowed older adult users to better navigate the portals. Siek et al., (2010) went a step further, and found that the ability to simplify the interface to remove unnecessary features was a facilitator to older adult's experience with portals. Cross et al., (2021) and Son et al., (2022) found that simplified interfaces and clearly labelled functions were promotors to portal use, Portz et al., (2020) echoed these findings, listing the ease of navigation and ability to find desired features as a facilitator. User friendly design was also promoted as a facilitator in one of the included articles (Nahm, Son, et al., 2020).

Simple login and authentication features were described to be a facilitator in Wildenbos et al., (2018) and Son & Nahm (2019), noting that the ability to save login credentials, and have a simple login process improved usage for older adults.

The last facilitator under the category of ease of use, was the ease of completing desired tasks using the portal. Willard et al., (2018), and Siek et al., (2010) found that medication lists that were simple and linear made improved older adult experiences accessing these lists. Eriksson-Backa et al., (2021) echoed similar ideas, suggesting that simplifying tasks related to health management or accessing health data improved portal experiences for older adults.

General comments relating to the ease of use being a facilitator to portal experience were also observed in Steele Gray et al., (2021), Finkelstein et al., (2011), and Makai et al., (2014b).

Perceived Value

The perceived value of the patient portal helps promote portal use in older adults. This was observed in 7 of the included studies, where portals or features that enhance care relationships, align with personal goals, or generally enhance the perception of portal value can improve portal use or positive perception for older adults.

Cross et al., (2021) reported that older adults who believed that use of the portal by both them and their HCPs improved their relationship were also more satisfied with and likely to engage with patient portals. Furthermore, they found that non-users were significantly less likely to have high EHR value perception and had lower perceived health care quality in general. Participants with high EHR value perception and study participants that were extensive portal users demonstrated higher perceived quality of health care.

Portals were also reported to empower older adult users to have better perceived control or management of their health by aligning with the care goals and routines of older adult users. Zoorob & Hasbini (2023) and Logue & Effkin (2012) reported that users were more likely to be engaged and interacting with the portal when it supported their care needs and allowed them to participate in health decisions in a more active capacity. Steele Gray et al., (2021) echoed these findings, suggesting that patients were more likely to use an electronic patient reported outcome tool and portal when they felt that use of the portal was supporting their care needs. Portz et al., (2021) found that older adults facing more serious health issues were more likely to use the portal, suggesting that portal use may increase due to a decline in health, perhaps arising from an increased perception of value of health management tasks.

More generally, Finkelstein et al., (2011) discussed how effective support through orientation can positively impact the perceived value and ease of use of portals, resulting in higher satisfaction rates and prolonged use. Eriksson-Backa et al., (2021) found that portals, especially those that are designed to be accessible, improve the overall accessibility of health information. This empowered patients to use features such as reminders and interact with their portals.

Familiarity with Technology

Familiarity with technology appeared in 4 of the included articles. Cajita et al., (2021) and Huang & Ye (2024) found overlap between individuals with high income, education, health literacy, and portal use. Individuals with higher incomes are often more capable of accessing infrastructure such as the internet, resulting in such disparities. Taha et al., (2014) also found overlap between past internet experience and the openness of older adults to using portals. Participants' openness and interest in engaging with a patient portal was lower when they had less internet experience (Taha et al., 2014). Evans et al., (2018) found an association between higher computer competency and proficiency with use of electronic personal health records. Although the physical availability of an internet-accessible devise is essential to using portals, concern with technology can go beyond to address internet access and experience.

Health Literacy

Health literacy was identified as a facilitator to portal use in 6 of the included studies. The importance of health literacy, and ability to perform health related tasks was reported to have a positive impact on portal use and/or experience for older adults.

Both Cajita et al., (2021) and Yoon et al., (2024) found that older adults with higher/adequate health literacy were enabled to use their portal more actively and consistently. Son & Nahm (2019) and Son et al., (2022) found that older adults who had the health literacy to interpret medical information and navigate portal interfaces had greater confidence and success in completing tasks using their patient portal. Health related internet and social media use were also found to promotors of portal adoption and use amongst older adults (Huang & Ye, 2024). Lastly, Makai et al., (2014b) found that older adults who possessed the necessary computer skills and comfort communicating about healthcare topics were more engaged and active in their use of patient portals.

2.2.3B Barriers

The barriers observed in the included articles were grouped into 5 categories: age & socioeconomic factors, digital & health illiteracy, difficulty of use, a lack of trust, and a lack of support (Table 2.3).

Lack of Support

Thirteen of the included studies mentioned a lack of support hindering older adults’ usage and experience with patient portals. The lack of support was identified to stem from a lack of initial onboarding and training, insufficient ongoing support, and low involvement from caregivers and/or family.

Inadequate onboarding and training were referenced as a barrier in 5 of the included articles. Cajita et al., (2021) and Nahm, Son, et al., (2020) reported an absence of structured training that left users confused on how to operate basic portal features. Makai et al., (2014a), Makai et al., (2014b) and Son & Nahm (2019) reported that older adults had a difficult time getting started with patient portals when they did not have access to onboarding or other technical support. These findings were further demonstrated by Zoorob & Hasbini (2023) reporting that although onboarding training can improve understanding, it is not consistently made available to those who need it.

Other articles discuss the impact of not having access to ongoing support to assist with the day-to-day use and technical issues encountered when using the portal. Cross et al., (2021) and Steele Gray et al., (2021) detailed how insufficient feedback and guidance from the provider disincentivized portal use amongst older adults.

A lack of caregiver involvement was observed to be a barrier in portal use in 4 of the included articles. Burgdorf et al., (2023), Gleason et al., (2023), and Portz et al., (2021) demonstrated increased difficulty of use, and decreased interest to use portals when caregivers were uninvolved, uninformed, or uninterested in using the patient portal. This was reinforced by the findings of Ploegmakers et al., (2024), which noted that patients who do not receive assistance or support were more likely to abandon or feel frustrated with the portal. Ramirez-Zohfeld et al., (2020) and Portz et al., (2021) noted that future portal efforts should focus on reducing barriers to proxy access to patient portals to promote continued use.

Difficulty of use

The joint most reported barrier, appearing in 14 of the included articles, difficulty of use proved a significant barrier to older adults’ usage of patient portals.

The most reported difficulties of use relate to patient portals’ complex interfaces, patients’ challenges surrounding navigation, and the relevance of the patient portal’s information (often excessive or outdated) to the portal user (patient or caregiver).

Problems related to interfaces and navigability of portals were reported by Nahm, Zhu et al., (2020), Barron et al., (2014), Cross et al., (2021), Zoorob & Hasbini (2023), Nahm, Son, et al., (2020), and Robben et al., (2012). These articles reported issues arising from the variability of interfaces in portals (Nahm, Son, et al., 2020; Nahm, Zhu, et al., 2020), and confusing layouts/interfaces causing navigation and usability issues (Barron et al., 2014; Cross et al., 2021; Robben et al., 2012; Zoorob & Hasbini, 2023).

Some articles reported difficulties in accessing, inputting, using, or interpreting information in the patient portal (Robben et al., 2012; Siek et al., 2010; Son & Nahm, 2019; Taha et al., 2014). Information in the patient portal was reported to be difficult to access, excessive, incorrect, missing, or too complicated to make use of by older adults across these studies.

Login and authentication errors complicating the ease of use of patient portals was reported as a barrier in 4 of the included studies (Son & Nahm, 2019; Son et al., 2022; Wildenbos et al., 2018; Willard et al., 2018). The complicated process of logging in, including 2-FA, compounded with the fact patients had multiple online portals and logins to track were reported to complicate the use of portals for older adults.

Other factors that increased the difficulty of using patient portals for older adults in the included articles were technical issues of use (Finkelstein et al., 2011), the complexity and breadth of tasks and features (Gleason et al., 2023; Willard et al., 2018), and physical health challenges that make operating a portal more difficult (i.e. arthritis impacting ability to operate the portal accessing device) (Gleason et al., 2023; Zoorob & Hasbini, 2023).

Lack of Trust

Eleven of the included articles reported a lack of trust in patient portals as a barrier to adoption or continued usage of the portal. This lack of trust centered around concerns relating to privacy/security, the reliability of available data, a perceived lack of engagement from healthcare providers, or general distrust of technology.

Concerns related to privacy/security arose in Eriksson-Backa et al., (2021), Nahm, Son, et al., (2020), and Ploegmakers et al., (2024), with older adults’ feelings surrounding the privacy/security of these portals inhibiting the use of patient portals amongst older adults.

Several studies reported a lack of trust in the patient portal caused by the reliability of available information (Robben et al., 2012; Son et al., 2022; Wildenbos et al., 2018). Robben et al., (2012) reported that information found in the portal could be outdated or excessively complex. Other studies reported that there were times when data could just be delayed, missing, or poorly contextualized for the user (Son et al., 2022; Wildenbos et al., 2018).

Healthcare providers failing to adopt or support the use of the patient portal decreased users’ trust and posed as a barrier to portal use amongst older adults. Cross et al., (2021) and Kim & Fadem (2018) reported that patients felt undervalued when it was unclear how the provider was supporting their use of a patient portal. Makai et al., (2014a), Makai et al., (2014b), and Eriksson-Backa et al., (2021) all reported fears that patient providers would replace in person visits with digital health tools.

Lastly, trust in patient portals was undermined by a general distrust towards digital technologies amongst older adults, as reported by Finkelstein et al., (2011), where technical unfamiliarity posed as a barrier to older adults accessing telehealth services. Additionally, Wildenbos et al., (2018) found that older adults preferred not to rely on devices such as tablets and smartphones for health management.

Age / Socio Economic Factors

Age related and socio-economic factors were grouped together and observed to be a barrier to portal use in 14 of the included articles. These barriers were sorted into challenges relating to income/education disparities, age-related limitations, racial and ethnic differences, as well as the availability of technology and internet infrastructure.

Patients of lower income were observed to be less likely to use a patient portal in 4 of the included articles. Taha et al., (2013) describes how lower education and cognitive ability prevented older adults from effectively using their patient portal. Cajita et al., (2021) and Huang & Ye (2024) detail how lower income individuals have less success navigating portals, and this problem may be exacerbated by a correlation between low-income and access to the technologies needed to use patient portals (i.e. smartphones and tablets). Cross et al., (2021) reflect these ideas as they reported financial instability contributing to lower digital engagement, and thus portal use amongst older adults.

Age related limitations may manifest in one of many ways for portal users. Siek et al., (2010) and Zoorob & Hasbini (2023) focus more on the tangible physical decline in health and ability associated with aging, reporting that declined physical ability, reduced vision, and joint pain made portal use more difficult. In contrast, Lafata et al., (2018) and Yoon et al., (2024), and Evans et al., (2018) emphasized how older adults may be unfamiliar and uncomfortable with technology, and how this can act as a barrier to portal use. Evans et al., (2018) explored the impacts of cognitive decline in particular, observing a correlation between SLUMS (Saint Louis University Mental Status Exam) scores and portal use, with higher SLUMS scores relating to greater use of the patient portal. Although the general trend indicated lower use with advanced age, some papers reported increased use of portals amongst older adults with more chronic illnesses or recent acute health events, highlighting the complex, intersectional nature of these factors (Portz et al., 2021; Son et al., 2022).

Racial and ethnic differences can act as structural barriers to accessing health services in minority communities. Burgdorf et al., (2023) specifically highlighted the experience of Black portal users and their caregivers, demonstrating increased difficulty with portal use and operating shared accounts operation. Yoon et al., (2024), Gordon & Hornbrook (2016), and Ploegmakers et al., (2024) noted lower portal adoption and satisfaction among non-White portal users. These disparities were particularly evident amongst Hispanic, Latino, Filipino and Black populations, who may face language-based barriers, have limited trust in the healthcare system, or lack the cultural acceptance and support for patient portals.

Technology access and infrastructure was reported to be a barrier by both Finkelstein et al., (2011) and Portz et al., (2021) who observed lower portal use in rural communities arising from a lack of internet access or caregiver or HCP support to promote the use of digital health tools.

Gordon & Hornbrook (2016) found disparities in tech literacy and portal functionality related to age, race/ethnicity, and educational attainment, commenting that these vulnerable subgroups are already disadvantaged in their access to care.

Low Literacy

One of the most reported barriers was low literacy, referring to ability to read as well as technical or digital literacy; 12 articles reported older adults being held back by their inability to understand medical terminology, operate technology, or interpret healthcare information.

Health literacy in specific was reported to be a barrier in patient portal use by (Cajita et al., 2021; Cross et al., 2021; Gleason et al., 2023; Yoon et al., 2024), and eHealth literacy, a combination of literacy in tech/electronics and healthcare, was reported as a barrier by Son et al., (2022). Lafata et al., (2018) mentioned a difficulty in understanding medical terminology, relating to health literacy.

Digital literacy or a lack of experience with the internet were captured under the umbrella of low literacy, and was reported by 8 articles (Burgdorf et al., 2023; Cajita et al., 2021; Cross et al., 2021; Gleason et al., 2023; Huang & Ye, 2024; Makai et al., 2014a; Robben et al., 2012; Taha et al., 2013), in addition to the eHealth literacy reported in Son et al., (2022).

The only article that reported a notable change in patient outcomes was Finkelstein et al., (2011). The study found changes in perception towards technology (Eighty-four subjects completed the Telemedicine Perception Questionnaire at baseline and after 60 days (Finkelstein et al., 2011). There were no significant differences on any items between the two groups at baseline (Finkelstein et al., 2011). At 60-day follow-up, the intervention group scores were significantly more positive towards technology compared to their own baseline (64.5, $P< 0.001$) and to the 60-day scores for the controls (57.8, $P < 0.001$) (Finkelstein et al., 2011). Six of 17 items were rated significantly higher ($P < 0.003$) by the intervention subjects compared to the control subjects at follow-up) and utilization of healthcare services (Intervention subjects made fewer emergency department visits than control subjects, more visits to the eye doctor, fewer visits in all categories of home care utilization and lower use of transportation services (Finkelstein et al., 2011). Pharmacy delivery services were used by the rural intervention subjects. However, they were not available to the urban intervention subjects or urban or rural control subjects) (Finkelstein et al., 2011).

2.2.4 Author Recommendations and Practice Implications

The studies included in this review provided many recommendations to improve the experience, outcomes, or usage of patient portals for older adults. The simplification of the language and content communicated through the platform was a prominent suggestion. Included articles suggested avoiding using complex medical terminology (or incorporating explanations) to better cater to those with lower health literacy and incorporating visual cues to assist with the communication of health information (i.e. indicator when value is out of normal range) (Barron et al., 2014; Son et al., 2022; Taha et al., 2013). Suggestions to simplify or improve design included simplifying layout and using clear fonts to help avoid confusion by Son et al., (2022), imitating the design of successful phone apps to reduce learning time and improve comfort by Cajita et al., (2021), and using simple landing pages with frequently accessed features (Gordon & Hornbrook, 2016). Several studies suggested design accommodations to help support users with vision, mobility, or cognitive impairments which may complicate portal use (Makai et al., 2014a; Portz et al., 2019; Son et al., 2022; Taha et al., 2013). Caregiver access and involvement in the portal was frequently cited as an area for improvement. Enabling and supporting caregivers to access patient portals may improve the patient portal's benefits to older adults (Barron et al., 2014; Burgdorf et al., 2023, 2024; Cajita et al., 2021; Cross et al., 2021; Huang & Ye, 2024; Portz et al., 2021). Recommendations to improve portal security and privacy features were briefly mentioned in one of the included studies (Eriksson-Backa et al., 2021). Recommendations related to training and educational supports were observed in 6 of the included studies. These recommendations included tutorials, guided instruction, or other support mechanisms designed to assist users with their portal use and navigation (Gordon & Hornbrook, 2016; Huang & Ye, 2024; Makai et al., 2014a; Nahm et al., 2016; Robben et al., 2012; Taha et al., 2013). Several studies discuss the importance of tracking and mitigating the race, culture, and language-based differences in portal use among older adults (Burgdorf et al., 2024; Gordon & Hornbrook, 2016; Lafata et al., 2018; Steele Gray et al., 2021). Aligning digital health tools, and programs for their rollout with the needs and diversity of the population can help to ensure portals are better equipped to serve the population, because as stated in Lafata et al., (2018), there is likely “no universal patient portal solution”, but alternative channels and supports can be prepared to mitigate divides based on social determinants of health. Employing a user-centred design was recommended by 3 of the included articles (Ploegmakers et al., 2024; Portz et al., 2019, 2020). Engaging users consistently and using their feedback to iteratively improve the design of a portal was suggested. The final recorded suggestion for improvement was the usage of a mobile app to improve patient ease of access, however older adult participants in the study suggested its benefits would be greater for a younger population (Eriksson-Backa et al., 2021).

2.3 Discussion

2.3.1 Overview

This systematic review provides a comprehensive breakdown of the use, perception, features, facilitators, barriers, and suggested improvements to portals in the included studies. Significant patterns in usage, preferred features, facilitators, and barriers emerged across the included articles.

2.3.2 Feature Importance

There was high heterogeneity in the reporting of portal features in eligible articles. It should be noted that just because a study did not report a feature, it does not mean it was absent. It is highly likely that most studies focused on a portal which had a secure login method, and ability to access via laptop/desktop, and chose not to report such features (rather than omit) due to a baseline assumption of features. It may be assumed that the features reported in articles were deemed to be important, and perhaps not universal to patient portals. Although 138 features were identified, synthesis and combination of like features revealed secure messaging, access to health record, medication management, and appointment scheduling to be the most prevalent features used by older adults. It may be assumed that these are the most critical features of a portal, essentially the defining features of a portal as they were observed widely across the included studies and were deemed relevant enough to be discussed (as opposed to login features or apps).

2.3.3 Intersection of Factors affecting Portal Use

There were significant differences in patient portal use amongst a variety of patient characteristics/traits. Some of the most significant factors impacting portal use were age, caregiver support, ethno-racial and language differences, and socioeconomic status (SES) as highlighted in the age/socioeconomic barriers section. These factors demonstrated significant interplay and overlap and often do not act independently.

Age related decline in portal use often overlaps with limited digital literacy, lower income, racial identity, and lower education status (Burgdorf et al., 2023; Yoon et al., 2024). These factors can combine to present significant barriers to portal use amongst already marginalized older adults who may find it difficult to access broadband, technology, and reliable and engaging healthcare (Gordon & Hornbrook, 2016). These challenges can be exacerbated by one another, as these factors may increase each other's likelihood due to systemic barriers and challenges faced by these groups. For example, the challenges faced by a Black, low-SES, low tech-access older adult compound on one another, making portal use increasingly difficult and unlikely. The overlap of these disadvantages underscores the intersectionality of structural inequities, and the need to develop strategies to overcome them.

The identified facilitators, barriers, and suggestions were synthesized to produce 5 key recommendations for the successful adoption and proliferation of a patient portal amongst older adults, as depicted in Figure 2-2.

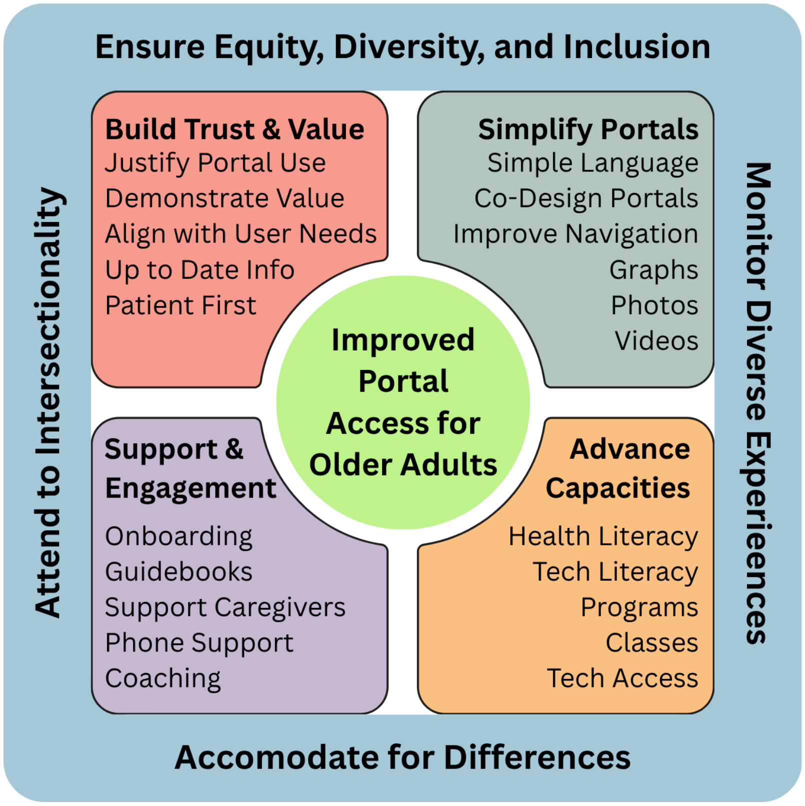


Figure 2-2. Keys to the successful adoption of patient portals for older adults.

Supporting and Engaging Patient Portal use

The most frequently reported facilitator to using patient portals was support and engagement, with lack of support being referenced as a barrier in 10 articles, and 6 articles recommending different strategies to improve the support afforded to users. The presence of caregivers or proxies can be a significant facilitator to use, especially for older adults with lower digital literacy, and it is important to ensure that these caregivers’ barriers to portal access are reduced (Portz et al., 2021; Ramirez-Zohfeld et al., 2020). Healthcare providers may shift the focus of portal interventions for individuals who are older or lower cognitive capacity to caregivers to improve portal access and use (Evans et al., 2018). Although caregivers and providers can be essential to supporting use, it is important that healthcare providers do not pressure patients into arranging for a family member or friend to act as their proxy portal user, in order to uphold the autonomy and privacy of patients (Gordon & Hornbrook, 2016). It is particularly important to ensure that these efforts are taken during onboarding as negative experiences during onboarding may dissuade older adults from continued use of the portal. Efforts should be aligned to support older adults how they prefer, employing tools such as paper guidebooks, phone support lines, caregiver training and coaching to meet the needs of older adults who seek to use patient portals.

Simplify Patient Portals

Simplifying patient portals amalgamates the facilitator and barrier which were ease of use and difficulty of use, while also helping address some of the barriers caused by low literacy and a lack of support. Making portals simpler may involve improving the navigability, simplifying the language used, limiting unnecessary functions, or incorporating features such as streamlined login processes to reduce the difficulty of using a patient portal. Small adjustments such as simple language and using graphs or visuals to convey complex information such as risks can improve user’s engagement with both simple and complex portal tasks (Taha et al., 2014). Older adults generally prefer more pictures, colours, larger and less text, with supportive videos or diagrams as they allow for better understanding and engagement with portals (Son et al., 2022; Zoorob & Hasbini, 2023). Engaging older adults during portal development and testing can provide a promising pathway to simplifying and tailoring portals for older adults (Portz et al., 2019; Son et al., 2022). User-centred design can promote this engagement and co-design to produce portals better suited for older adults (Ploegmakers et al., 2024; Siek et al., 2010).

Build Trust and Value

Patient portals and other digital health tools may suffer from a baseline lack of trust in older adults. This may arise from fears that technology will replace the human element and interactive aspects of healthcare, to concerns regarding the purpose or value of a tool such as a patient portal (Portz et al., 2019; Robben et al., 2012). It is essential that healthcare providers portray the portal as a tool to supplement but not replace the personal healthcare that they receive (Robben et al., 2012). When pitching a portal to patients, the potential benefits most outweigh the perceived potential drawbacks such as security concerns, concerns about information loss, among others (Eriksson-Backa et al., 2021). Building value for the patient portal is not about adding more features, but emphasizing or simplifying the features which align with patient goals, such as improving communication, saving time, and accessing health information (Portz et al., 2019). Healthcare providers can contribute to building value and trust by ensuring that information on the patient portal is reliable, and promptly communicated (Robben et al., 2012; Wildenbos et al., 2018). By emphasizing the role of the portal in communicating with the patient and giving them access to their care, healthcare providers can integrate patient portals in their practice to support and improve patient relationships (Cross et al., 2021). Dismantling older adults' anxieties and barriers towards using technologies such as patient portal is crucial to supporting patient portal use, and healthcare providers can do this by engaging, supporting, and communicating the value of patient portals to older adults (Portz et al., 2019; Zoorob & Hasbini, 2023).

Advance Community Capacities

Barriers presented due to low literacy and access to technology, and the facilitating effects of health literacy can be addressed simultaneously addressed by building health and tech literacy capacities in the community. As mentioned in the earlier section on supporting and engaging older adults, it is important that these initiatives align with the preferences of older adults, such as employing paper manuals, or providing technical assistance (Portz et al., 2019; Wildenbos et al., 2018; Willard et al., 2018).

Health Literacy

Health literacy extends beyond knowledge of medical jargon and terms and can be defined as the “degree to which individuals have the capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions” (Institute of Medicine (US) Committee on Health Literacy et al., 2004). A lack of health literacy not only serves as a barrier to the interpretation of health data and results but may also hinder one from accessing services and making health decisions that are in their best interest (Coughlin et al., 2020). Disparities in patient portal use amongst older adults with lower health literacy and those with greater health literacy were significantly exacerbated during the COVID-19 pandemic, highlighting the urgent need for action (Yoon et al., 2024).

Tech Access & Literacy

Tech access and literacy plays a key part in older adults’ willingness and ability to engage with patient portal technologies. Anxiety or distrust in computers was reported as a significant barrier to older adult use of patient portals, and building tech capacity through training, guides, and exposure can be key to overcoming this anxiety and improving perception of patient portals (Finkelstein et al., 2011; Huang & Ye, 2024; Robben et al., 2012; Zoorob & Hasbini, 2023). Initiatives can go beyond simple education and training to ensure that individuals from marginalized background have access to the internet and devices needed to effectively use a patient portal (Huang & Ye, 2024). Training may be personalized or tiered to support older adults with varying levels of computer literacy in order to better address the specific needs of older adults (Nahm, Zhu, et al., 2020).

Inclusive Portal Implementation and Support

Overall, the barriers to portal use experienced by older adults are exacerbated for those who belong to racialized backgrounds, are of lower SES, cannot speak English, and lack support (caregiver or spouse) (Gordon & Hornbrook, 2016; Lafata et al., 2018). The patient portal experiences of older adults at the intersection of these identities are particularly negative, like their general outcomes of healthcare (Gordon & Hornbrook, 2016). It is important that any initiatives taken to improve portal use or adoption do not abandon these subgroups, who may not share the belief that patient portals positively impact their communications with care providers (Gordon & Hornbrook, 2016). Further research and programs should focus on tracking the experiences and outcomes of vulnerable populations to ensure that they have an equitable experience with patient portals (Gordon & Hornbrook, 2016). Programs should also emphasize multilingual options to include those who cannot speak English (Lafata et al., 2018). Any initiatives should be sensitive to the fact that different cultures may possess unique values and characteristics which make them more and less likely to use a portal (i.e. high family involvement in Hispanic communities) (Logue & Effken, 2012). Regardless of the vulnerable groups present within a larger population, it is essential that patient portals are not approached as a “one size fits all” solution, and that the appropriate adjustments and steps are taken to promote inclusive and accessible patient portals (Siek et al., 2010).

2.3.5 Limitations

While this review illustrates a detailed picture of patient portal use amongst older adults, the challenges, successes, and factors impacting their use, there are several key limitations to consider. The heterogeneity of included studies, with relation to their geographic area, study design, methods, and portals of focus made direct comparison of patient portal use difficult between studies. This study’s exclusion of non-English texts may have excluded significant research on portals occurring outside of Western contexts. The lack of heterogeneity was particularly pronounced in the age of the included participants, as some studies defined older adults using different definitions, ranging from 50+ to 85+. The heterogeneity in populations as well as recorded outcomes and their reporting made any statistical analysis of usage rates irrelevant, ruling out meta-analysis or other statistical comparison of findings. The time period of the study’s search also poses a limitation, as some of the included articles focus on outdated versions or concepts of patient portals which may no longer be relevant or worth of examination. This was reflected as some of the suggestions for improvements in the older articles were well established paradigms of patient portals amongst the newer articles included in the review.

2.4 Conclusion

The intention of this review was to present the complex ways in which older adults’ interaction and engagement with patient portals can be affected. Although portals have immense capability to improve patient autonomy, communication, and access to care, a number of populations continue to struggle to obtain these benefits due to various barriers. In order to encourage portal adoption among older adults, change is required not only on an individual level by improving literacy abilities and increasing motivation, but also systemically, through design, implementation, and revision.

The findings of this review make clear that a few specific variables are particularly important to building patient trust and encouraging continued use of portals, including support during onboarding, clear communication, and provider engagement. This was found to be especially critical for those who were unfamiliar with, or skeptical of digital health tools. Overall satisfaction and engagement were also linked to ease of use, accessible portal design, and presence of features that aligned with user goals. Many of the studies included in this review emphasized a lack of digital and health literacy as a significant barrier to patient portal use amongst older adults.

As is the case in healthcare in general, individuals from marginalized backgrounds face additional barriers to accessing and using portals due to factors such as age, language, ability level, and socioeconomic status. These factors may overlap with barriers such as low health and technology literacy to pose significant challenges in marginalized older adults' ability to access and use patient portals. It is imperative for inequities in patient portal access to be addressed at each of the design, training, and implementation stages of portal development and rollout, because there is no "one size fits all" solution to making patient portals for all.

Understanding the findings of this review was necessary in the creation of Chapter 3, which explores how diversity, equity, and inclusion (DEI) based frameworks can guide the development and evaluation of digital health tools, with the goal of making them truly inclusive, accessible, and responsive to the needs of all older adults.

Chapter 3

Key EDI Frameworks to Support Older Adults Use of Patient Portals

As the population of the world is increasing, so is the diversity of the human population, unfortunately, this has been accompanied by an increase in health inequities that are exacerbated amongst minority populations (Buh et al., 2024). Equity, Diversity, and Inclusion initiatives seek to measure, track, and mitigate the causes of disparities amongst underrepresented minorities (Buh et al., 2024). Social Determinants of Health (SDoH) are “the circumstances in which humans are born, develop, live, earn, and age” (Chelak & Chakole, 2023). Impacting approximately 80% of health outcomes, SDoH are noted to be the most successful avenue to measure and to improve disparities in health (Ganatra et al., 2024; Greer et al., 2023), and thus are intrinsically linked to EDI. By increasing clinician awareness of social challenges, widening treatment focus to include lifestyle and economic factors, and improving the connection between clinical care and community support, it becomes possible for the healthcare system to make room for diverse patient realities and to provide holistic and individualized care (Ganatra et al., 2024).

The need for EDI and SDoH considerations is no less important in the creation and employment of patient portals. Socioeconomic status, education, gender, race, and ethnicity are all factors that play a role in who is able to access and utilize this online tool. Though technology solutions are often posited as a solution to gaps in health equity, the unfortunate reality is that those who are likely to benefit most from them are oftentimes also the people disadvantaged from the outset (Antonio et al., 2019; Johnson et al., 2023; Sarkar et al., 2010). Users of patient portals consist mainly of middle-aged, English-speaking, educated, and white individuals, with commonly marginalized groups (including Black, Hispanic, non-English speaking, lower education individuals) facing the greatest challenges in accessing this digital tool (Johnson et al., 2023; Sarkar et al., 2010). Disparities in portal access further increase existing disparities in healthcare (Johnson et al., 2023; McCann et al., 2025), and it is thus crucial to investigate and mitigate SDoH related barriers (Sarkar et al., 2010).

Employing equity focused frameworks alongside portal design frameworks is one way to begin to improve disparities present in portal access and utilization. Conceptual models can provide a guide to improve implementation of portals in populations that experience health inequity (Groom et al., 2024; Gustafson et al., 2023). Using equity focused frameworks in tandem with existing portal design models permits SDoH considerations along the entirety of portal creation and implementation processes, thereby aiding in the close of the digital divide and improving portal use in marginalized populations (Groom et al., 2024).

This chapter explores methodologies, tools, and frameworks for the mitigation of disparities in patient portal access among minority or marginalized individuals. In alignment with thesis objectives, this chapter explores the research question: What frameworks/means/approaches/concepts/tools can be applied to patient portals and their development to better support the needs of differently-abled and culturally diverse older adults according to EDI principles?

3.1 Methods:

3.1.1 Identifying Frameworks

Approaches and frameworks supporting inclusivity and accessibility of patient portals for diverse and differently abled older adults were identified using a multi-modal search approach.

Google and Bing were used to search for grey literature and published frameworks using a string of Boolean linked search terms below. PubMed was also searched using similar search terms.

("patient portal" OR "electronic health record" OR "PHR") AND
("older adults" OR "senior" OR "geriatric") AND
("framework" OR "model" OR "design" OR “tool”) AND
("equity" OR "accessibility" OR "Canada" OR "Indigenous" OR "racialized"
OR "Black" OR “minority” OR “disabled”)

The search terms were selected to produce a wide list of search results, relying on the search engine's ranking system to filter unwanted and/or irrelevant results. Search results from the first two pages were screened to identify relevant frameworks and outcomes. Relevant sources were then assessed to identify any linked relevant frameworks or methodologies until this yielded no additional frameworks.

Identified frameworks were considered relevant if they explicitly advocate for equity or the advancement of outcomes/experiences for a marginalized group, could be applied to patient portals even if that is not their explicit purpose, and were supported by scholarly work(s). In addition to the frameworks identified by this search, 2 data governance frameworks recommended by McMaster Equity and Inclusion Office's director of Equity, Inclusion and Anti-Oppression were included and analyzed.

3.1.2 Analytic approach

Following selection, each framework was summarized with an overview, purpose, and scope. To quantify applicability of the frameworks to our purpose, a scoring system was devised. Frameworks were scored from 1-5 (1= low relevance, 5 = high) on their relevance to patient portals, relevance to older adults, and relevance to EDI (using the expanded definitions for PROGRESS-Plus characteristics) (O'Neill et al., 2014) (Table 3-1). The scoring criteria were not weighted to emphasize importance of one criterion over another. Rubrics for the scoring of frameworks are available in Appendix B1-B3.

A crosswalk matrix (Appendix B3) was used to map framework relevance to each of the PROGRESS-Plus categories. These categories were scored from direct (green), indirect (yellow, describing situations where proxies for a characteristic are measured, i.e. technology literacy for older adults and education), to gray (no relation). The green matrix squares were awarded 1-point, yellow squares 0.5 points, yielding a score out of 10 representing 10 PROGRESS-Plus dimensions. This score was then divided by 2 so that it could be weighted equally to the other relevance scores (relevance to older adults and relevance to patient portals). This matrix was inspired by the crosswalk tool employed by Walter et al. (2021) for use in community energy planning. Findings from this matrix were used to produce scores for the relation of frameworks to PROGRESS-Plus. The scope of frameworks was assessed by determining the contexts in which the frameworks may be used. These contexts were determined by comparing the “levels” of action described in the included frameworks, drawing specifically from the National Institute for Minority Health Disparities Framework for Digital health Equity, and adapting the described “levels of influence” to encompass the levels of scope described in other frameworks such as the eHealth Equity Framework, and adding a domain when the existing domains could not adequately represent the level of scope (Antonio et al., 2019; Richardson et al., 2022).

Table 3-1. Scoring criteria used to determine relevance of EDI frameworks to patient portal use by diverse older adults. Criteria were scored from 1 to 5 with 1 being not relevant, and 5 being highly relevant (further details in Appendix B1-3).

Criteria	**Definition**
Relevance to portals	The relation of the framework to patient portals, or digital health tools more broadly. Described in Appendix B1.
Relevance to older adults	The consideration of age, and age-related factors affecting health equity, outcomes, or technology use. Described in Appendix B2
Relevance to EDI	The level to which the framework considers EDI factors defined in PROGRESS-Plus, identified using crosswalk matrix in Appendix B3

The frameworks must be relevant to patient portals as they are the intervention in question. Frameworks may apply to digital health tools generally, but as this scope broadens, the applicability to patient portals decreases. The relevance of the framework to older adults and patient portals is central to the chapter, and thesis report as a whole. If frameworks are not designed for older adults, they may be less relevant, and frameworks which do not consider age- or age-related variables may not be useful for implementing patient portals for older adults. Frameworks that do not demonstrate relevance to patient portals may not be easily applicable to patient portal related projects, despite their contributions to health equity. The relevance to EDI is central to this chapter, which seeks to explore frameworks which can assist in guiding or enacting the improvement of digital health equity. Based on similarities across the frameworks, they were grouped into overlapping coherent concepts. An initial screening of identified frameworks was conducted to determine appropriate group categories, yielding the groups health equity focused frameworks, technology adoption and use frameworks, and data governance focused frameworks.

Following scoring of frameworks, and the definition of frameworks' scope across the established categories, the frameworks were placed on a table with their relevance score, scope (levels of application), as well as strengths and weaknesses relevant to their application in a patient portal context. This table is intended to provide organizations, individuals, communities, or governments with a "menu" of frameworks, which they may select from depending on their needs, size, and resources.

3.2 Results

The search identified 11 frameworks which were categorized into health equity centered frameworks, technology adoption and use centered frameworks, and data governance frameworks. The frameworks are listed in Table 3-2.

Table 3-2. Included frameworks.

Category	**Framework**
Health equity-centred frameworks	National Institute on Minority Health and Health Disparities (NIMHD) Research Framework Expanded for Digital Health Equity (Framework for Digital Health Equity)
	Framework for assessing and advancing equity for healthcare solutions that involve digital technologies
	eHealth equity framework
	Digital Health Equity Framework
	Health Equity Implementation Framework
	The Health Equity Promotion Model
Technology adoption and use centered frameworks	Unified Theory of Acceptance and Use of Technology

	Conceptual Framework for Patient Portal Utilization (Arcury et al., 2017).
	Technology Acceptance Model
Data governance frameworks	First Nations Principles of OCAP® (Ownership, Control, Access, and Possession
	Engagement, Governance, Access, AND Protection (EGAP) Framework

From the methodology described earlier, 5 levels of influence/scope were derived from the included frameworks. These levels are the Individual Level (patient identity (SES, ethnicity), provider, trainers), Organizational Level (health systems/units, hospital networks, etc.), Community Level (Local government, community organizations, community champions), and Political/Government Level (policies, institutions, laws), all inspired by the NIMHD framework by Richardson et al., (2022), and the Developer/Designer Level.

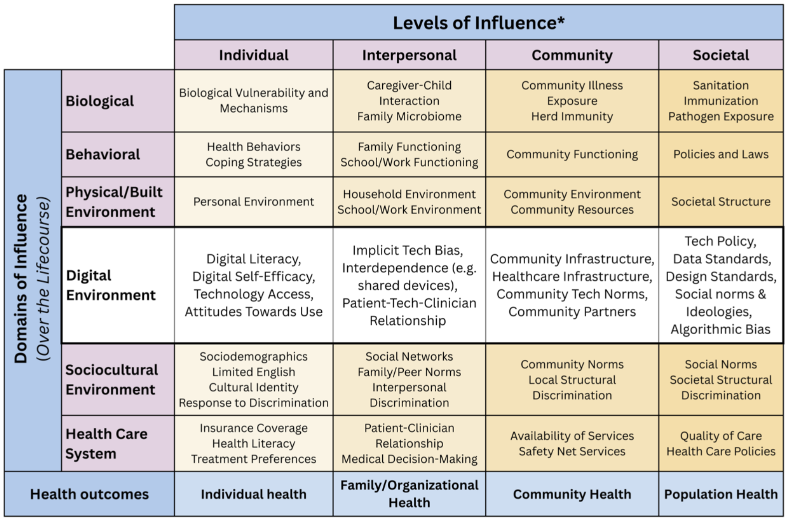
In the following sections, an overview, purpose, and scope for each framework is described and an adapted figure depicting the key elements of the framework is presented. The details of the relevance scoring for each framework is in Appendix B1-B3. The frameworks are presented by category.

3.2A Health Equity-Centred Frameworks

The primary focus of the frameworks in this section was the dismantling of barriers to health equity, and promotion of health equity advancing ideas and actions. These frameworks emphasize health equity or digital health equity as primary outcomes and focus on the reduction of health disparities experienced by certain disadvantaged groups. These frameworks can be used as a lens for researchers, portal developers, or individuals and institutions involved with patient portal projects to ensure that they are cognizant of the many characteristics and factors which may promote or discourage use of patient portals in older adults of all walks of life. The frameworks in this section may be combined to address equity related factors more comprehensively, as described later in the discussion section.

3.2.1 Framework for Digital Health Equity

The framework for digital health equity by the NIMHD expands on their existing research framework to encompass the digital domain of influence on health outcomes (Figure 3-1). This framework highlights the Digital Determinants of Health (DDoH) which impact health outcomes across populations. This framework lays out DDoH on 4 separate levels of influence: individuals, families and organizations, communities, and populations (Richardson et al., 2022).



		Levels of Influence*			
		Individual	Interpersonal	Community	Societal
Domains of Influence *(Over the Lifecourse)*	Biological	Biological Vulnerability and Mechanisms	Caregiver-Child Interaction Family Microbiome	Community Illness Exposure Herd Immunity	Sanitation Immunization Pathogen Exposure
	Behavioral	Health Behaviors Coping Strategies	Family Functioning School/Work Functioning	Community Functioning	Policies and Laws
	Physical/Built Environment	Personal Environment	Household Environment School/Work Environment	Community Environment Community Resources	Societal Structure
	Digital Environment	Digital Literacy, Digital Self-Efficacy, Technology Access, Attitudes Towards Use	Implicit Tech Bias, Interdependence (e.g. shared devices), Patient-Tech-Clinician Relationship	Community Infrastructure, Healthcare Infrastructure, Community Tech Norms, Community Partners	Tech Policy, Data Standards, Design Standards, Social norms & Ideologies, Algorithmic Bias
	Sociocultural Environment	Sociodemographics Limited English Cultural Identity Response to Discrimination	Social Networks Family/Peer Norms Interpersonal Discrimination	Community Norms Local Structural Discrimination	Social Norms Societal Structural Discrimination
	Health Care System	Insurance Coverage Health Literacy Treatment Preferences	Patient-Clinician Relationship Medical Decision-Making	Availability of Services Safety Net Services	Quality of Care Health Care Policies
Health outcomes		Individual health	Family/Organizational Health	Community Health	Population Health

Figure 3-1. Framework for Digital Health Equity. Adapted from (Richardson et al., 2022)

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Purpose

The NIMHD research framework emphasizes the digital factors which may disproportionately impact minorities from obtaining equitable health outcomes across different levels of action. It promotes multi-level interventions, and most importantly emphasizes the value of “up-stream” action (Richardson et al., 2022). The framework highlights many factors affecting health outcomes in disadvantaged populations, with the inclusion of important demographic characteristics that have been demonstrated to be fundamental to health outcomes (i.e., sex, gender, socioeconomic status) (Alvidrez et al., 2019).

Scope,

The NIMHD research framework can be applied to understand and target the factors affecting digital health equity, particularly among minorities. The scope of application may vary, as the authors emphasize action upstream because most existing action on determinants of digital health is taken on an individual level (Richardson et al., 2022). The NIMHD framework covers 4 of the predefined levels of scope (individual level, organizational level, community level, political/governmental level), visible in the bottom row of the diagram, with a lack of consideration for development and design considerations (Richardson et al., 2022).

Table 3-3. Scoring of relevance for National Institute on Minority Health and Health Disparities (NIMHD) Research Framework Expanded for Digital Health Equity (Framework for Digital Health Equity)

Criteria	**Score**	**Justification**
Relevance to portals	4	This tool expands upon an existing tool for broader health initiatives to focus on digital health tools.
Relevance to older adults	3	This tool is broadly applicable across age groups, with considerations for age-related factors such as digital literacy, sociodemographic factors, and perhaps discrimination.
Relevance to EDI	4.25	7 green squares, 3 yellow in crosswalk matrix.
Score:	**11.25**	

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3.2.2 Framework for assessing and advancing equity for healthcare solutions that involve digital technologies.

The framework for assessing and advancing equity for healthcare solutions that involve digital technologies proposed by Hatef et al. (2024) was developed to advocate for the consideration of equity in digital health tools and technologies (Figure 3-2). The framework may assist digital health developers, or other stakeholders (including health systems, policymakers, clinical providers and more) in upholding equity throughout all phases of the digital healthcare lifecycle (planning and development, acquisition, implementation, and monitoring of improvements) (Hatef et al., 2024).

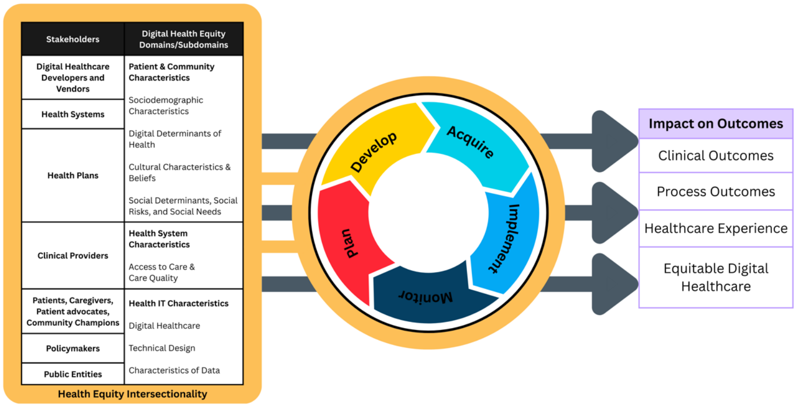

Figure 3-2. Framework for assessing and advancing equity for healthcare solutions that involve digital technologies. Adapted from (Hatef et al., 2024)

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Purpose

The framework’s purpose is to emphasize the role stakeholders and characteristics related to the patient, community, health system, and health IT in impacting digital health equity, and health outcomes. The framework examines factors that act on a number of stakeholders, at a number of levels, emphasizing a holistic approach to addressing inequities in digital health technologies from their development all the way through to evaluation and monitoring (Hatef et al., 2024). This may be used to value equity in patient portals from development to the monitoring phase.

Scope

This framework is uniquely flexible in the scope of its application. This framework can be applied for numerous levels of stakeholder, and at any stage of the product development cycle, including tech developers. This allows the framework to be applied by product developers seeking to assess or improve their product’s health equity, by healthcare systems (organizational) who seek to select or implement the ideal product to ensure equity, or by users or providers (individual level), to address the equity related factors impacting their digital health tool (including patient portals). The framework also encourages community level action through public entities and community champions, covering all 5 levels of scope identified earlier (individual, organizational, community, political/governmental, developers).

Table 3-4. Scoring of relevance for framework for assessing and advancing equity for healthcare solutions that involve digital technologies.

Criteria	**Score**	**Justification**
Relevance to portals	3	The framework is made for digital health tools more broadly, and requires some interpretation/adjustment to be used on patient portals
Relevance to older adults	3	There is consideration of sociodemographic characteristics which most likely include age, and digital determinants of health relate strongly to older adults, but the connection is not explicit, or the focus.
Relevance to EDI	1.5	2 green squares, 2 yellow squares in cross walk matrix.
Total Relevance Score:	**7.5**	

3.2.3 eHealth Equity Framework

The eHealth Equity Framework (eHEF; Figure 3-3), developed by Antonio et al. (2019) builds upon the WHO's social determinants of health framework with considerations made for the eHealth context. The eHealth Equity framework emphasizes 3 key points: that SDOH influence eHealth use, that the multi-layered context one is in impacts their eHealth use and outcomes, and finally that a disadvantaged social position can be worsened if people from these positions are not involved in eHealth implementation (Antonio et al., 2019).

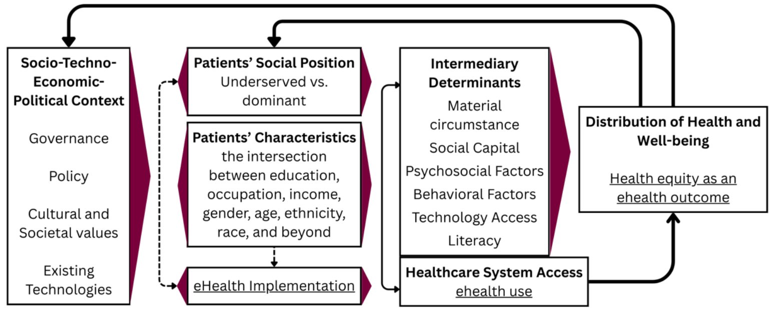

Figure 3-3. eHealth equity framework. Adapted from (Antonio et al., 2019).

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Purpose

The intent of the eHEF was to ensure that eHealth initiatives are not exacerbating the disparities in health outcomes and experienced by those in disadvantages positions. The eHEF acts as a lens for examining the context of eHealth initiatives to identify sources of potential inequities in outcome or experience at all stages of the health information technology lifecycle (Antonio et al., 2019). It was used by the authors to structure and guide a scoping review on whether research on patient portals at the time it was published was attuned to health equity (Antonio et al., 2019).

Scope

This tool has value for application at a broad organizational scale, due to the structural and societal barriers it considers, and at a political/governmental level as defined under the "socio-techno-economic-political context" box in the diagram (Antonio et al., 2019). There is limited action that may be taken using this tool on an individual level, but this could be used to guide policy actions or to emphasize eHealth equity as an outcome in large scale eHealth implementations (i.e. portal rollout at hospital system). The considerations for developers/designers are also limited, as technologies are a consideration in the socio-techno-economic-political context described, but not adequately explored. This framework covers the organizational and governmental/political levels of action defined earlier.

Table 3-5. Scoring of relevance for eHealth equity framework

Criteria	Score	Justification
Relevance to portals	5	Framework was developed for the purpose of guiding a scoping review on the attunement of research on patient portals to health equity.
Relevance to older adults	3	Consideration of age under patient characteristics is explicit, but not a focus of the eHEF.
Relevance to EDI	4	7 green squares, 2 yellow squares in crosswalk matrix
Total Relevance Score:	**12**	

3.2.4 Digital Health Equity Framework

Overview

The Digital Health Equity Framework by Crawford & Serhal (2020) examines the role of digital health innovations in deepening or combatting health inequities (Figure 3-4). The framework draws upon the health equity measurement framework by Dover and Belon which examines the direct and indirect effects of SDOH on health equity (Dover & Belon, 2019). The framework highlights the role of DDOH and their interplay between SDOH, environmental factors, digital equity, and the quality of care (Crawford & Serhal, 2020).

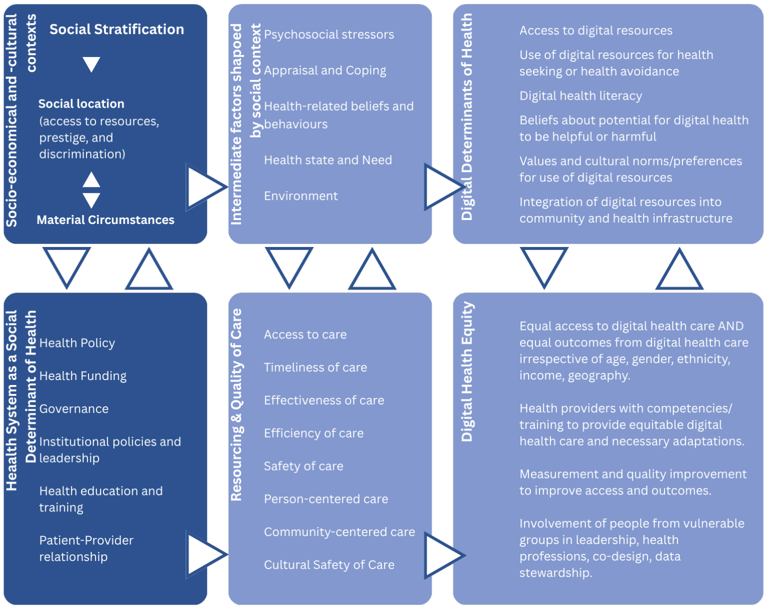

Figure 3-4. Digital Health equity framework. Adapted from (Crawford & Serhal, 2020)

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Purpose

The framework's purpose, similar to that of the eHEF, is to ensure that digital health innovations are not reinforcing existing health inequities which are a result of systemic issues, discrimination, and marginalization (Crawford & Serhal, 2020). This framework calls for emphasis on person-centred care with consideration for culture, the SDOH, as well as DDOH such as digital health literacy (an important facilitator for portal adoption noted in Chapter 2), and access to digital resources (linked to another facilitator from Chapter 2).

Scope

The DHEF highlights important factors for digital health equity which are targetable on many different levels of influence. The DHEF advocates for broader and larger actions such as health policy, governance, and institutional policies, but is also actionable on an operational level, with emphasis on the patient-provider relationship and person-centered care (Crawford & Serhal, 2020). The DHEF may work best when acted upon on multiple levels as opposed to higher level alone, as many of the strategies within the “boxes” align but occur on different levels of influence (i.e. access to digital resources [individual], integration of digital resources into community and health infrastructure [community, organizational]). Although the coverage in other domains is substantial and relates well, there are limited points for designers/developers to consider. Overall, the DHEF covers 4 of the predefined levels of action (individual, organizational, community, political/governmental)

Table 3-6. Scoring of relevance for Digital Health Equity framework.

Criteria	**Score**	**Justification**
Relevance to portals	4	This framework focuses on digital health innovations broadly, encompassing portals and requiring little adjustment for use on portals given the comprehensive digital determinants of health section.
Relevance to older adults	4	This framework was not developed specifically for older adults, but focuses on factors such as digital literacy, and

		mentions age as a key factor in digital health equity.
Relevance to EDI	3	6 green squares on crosswalk matrix.
Total Relevance Score:	**11**	

3.2.5 Health Equity Implementation Framework

Overview

The Health Equity Implementation Framework (HEIF) developed by Woodward et al. (2021) builds upon the existing Integrated Promoting Action on Research in Implementation in Health Services (i-PARIHS) by applying an equity lens and emphasis (Figure 3-5). The HEIF proposes determinants which may be used to guide and predict the success of equity focused health implementations (Woodward et al., 2021). The HEIF defines determinants within the domains of societal context, clinical encounter, culturally relevant factors of recipients, the innovation, clinical context, and the recipient.

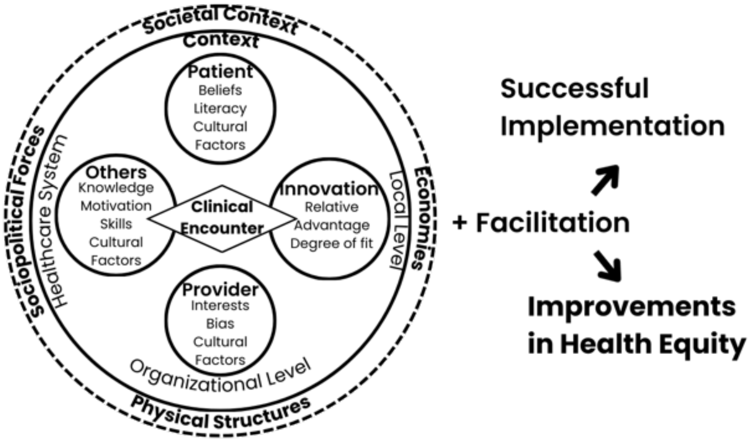

Figure 3-5. Health Equity Implementation Framework. Adapted from (Woodward et al., 2021).

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Purpose

The purpose of the HEIF is to structurally identify and address factors that deepen or reinforce inequities during health implementations (Woodward et al., 2021). The addition of the domains of societal context, culturally relevant factors, and the clinical context to existing implementation frameworks centers equity in the focus of healthcare implementation (Woodward et al., 2021).

Scope

The HEIF is aimed at healthcare innovation implementations and thus would perform best when a novel patient portal platform is being implemented. Although scope may seem limited due to its implementation focus, the framework can be valuable to organizations seeking to identify and address factors contributing to health inequity (Woodward et al., 2021). The inclusion of sociopolitical factors and economies makes the HEIF relevant on a political/governmental, in addition to the organizational level described above. The authors define the domains of culturally relevant factors, clinical encounters, and societal contexts to be crucial to the mitigation or progression of healthcare disparities arising from health implementations (Woodward et al., 2021). These domains may be integrated to help existing frameworks expand the breadth of equity related factors considered (Woodward et al., 2021).

Table 3-7. Scoring of relevance for Health Equity Implementation Framework.

Criteria	**Score**	**Justification**
Relevance to portals	2	The HEIF is broadly focused on healthcare implementations with no clear digital health specific considerations, requiring significant adaptation or interpretation for use on portals.
Relevance to older adults	2	The framework considers factors such as health literacy, and beliefs and preferences, which relate to older adults' portal use, but there is no other clear or strong connection to older adults.
Relevance to EDI	2	3 green squares, 2 yellow squares on crosswalk matrix
Total Relevance Score:	**6**	

3.2.6 The Health Equity Promotion Model

Overview

The Health Equity Promotion Model situates LGBT health across the life course, focusing on how minority status related specifically to gender and sexual identity can lead to disparities and inequities in health outcomes (Figure 3-6) (Fredriksen-Goldsen et al., 2024). This framework identifies structural, environmental, and community level factors which impact health outcomes (with relation to both physical and mental health) (Fredriksen-Goldsen et al., 2024). The Health Equity Promotion model considers not only the historical exclusion of LGBT people, but also their unique resistance and capability to resist by building communities and coping mechanisms in the face of marginalization (Fredriksen-Goldsen et al., 2024).

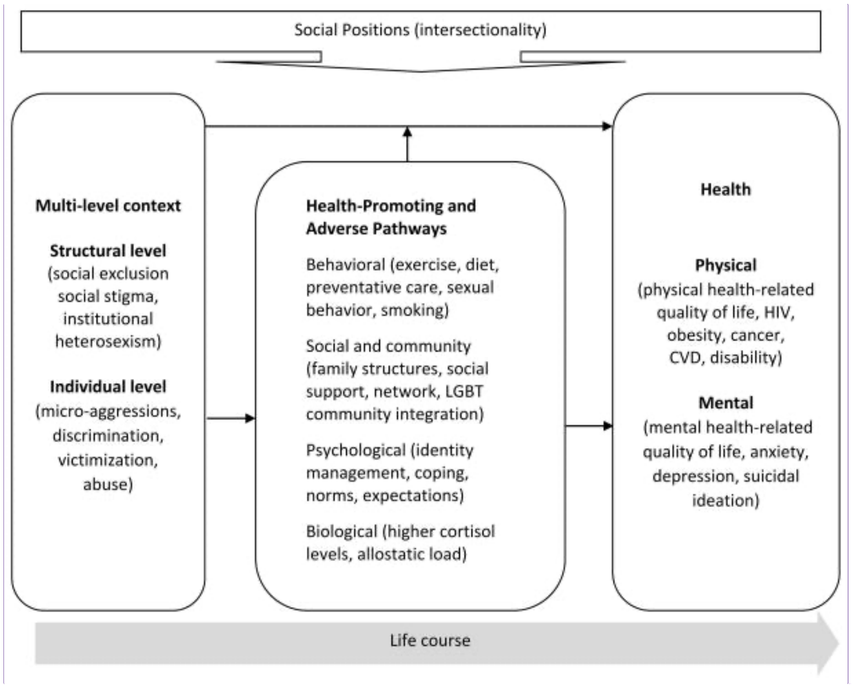

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Figure 3-7. Health Equity Promotion Model. Adapted from (Fredriksen-Goldsen et al., 2024)*.*

Purpose

The Health Equity Promotion Model examines how social positions, individual and structural and environmental context, and health-promoting and adverse pathways intersect and interact to impact LGBT communities' health outcomes (Fredriksen-Goldsen et al., 2024). This framework is not meant to be an exhaustive classification of the determinants of health for LGBT people, but it can illuminate the multiple intersecting influences on the health of LGBT communities (Fredriksen-Goldsen et al., 2024).

Scope

The Health Equity Promotion Model is unique to the frameworks previously identified as while it does have a broad scope in terms of structural to individual application and relevance, the Health Equity Promotion Model seeks to isolate the factors relevant to the health of LGBT people and their communities. The framework may be incorporated into a larger project to consider LGBT communities, or perhaps integrated into a broader framework, to strengthen that framework’s breadth of considerations with relation to the LGBT community. The Health Equity Promotion Model relates to individual, community, and political/governmental levels, with little direct reference to organizational actions/factors or designer considerations which affect LGBT health equity.

Table 3-8. Scoring of relevance for Health Equity Promotion Model

Criteria	**Score**	**Justification**
Relevance to portals	2	This framework is designed to broadly be applied to any health intervention or program which affects LGBT people. There are no specific considerations for digital health tools or portals
Relevance to older adults	2	The health equity promotion model does not have any specific consideration of age but relates uniquely to the experiences of LGBT older adults, warranting a rating above 1.
Relevance to EDI	2.5	3 green squares, 4 yellow squares on crosswalk matrix
Total Relevance Score:	**6.5**	

3.2B Technology Adoption & Use Frameworks

The frameworks in this section consider equity related factors, and may be adapted to expand upon these factors, but primarily focus on interactions with technology, intentions to use technology, and actual use patterns and behaviours as outcomes. These frameworks consider the impact of numerous external and internal factors impacting a potential technology user’s behaviour. Their primary focus is to explain or understand these interacting forces effect on behavioural outcomes as opposed to the advancement of health equity for a population or particular group, as was the case for the health equity centered frameworks.

3.2.7 UTAUT

Overview

The Unified Theory of Acceptance and Use of Technology (UTAUT; Figure 3-7) was developed by Venkatesh et al. (2003) following a review and synthesis of 8 of the then most recognized models of user acceptance (including the later described Technology Acceptance Model). The UTAUT proposes that the 4 key constructs of performance expectancy, effort expectancy, social influence, and facilitating conditions model the intention and actual use of technologies by users. These effects on technology adoption and intentions to use are also moderated by additional external factors such as age, gender, experience, and voluntariness of use (Venkatesh et al., 2003).

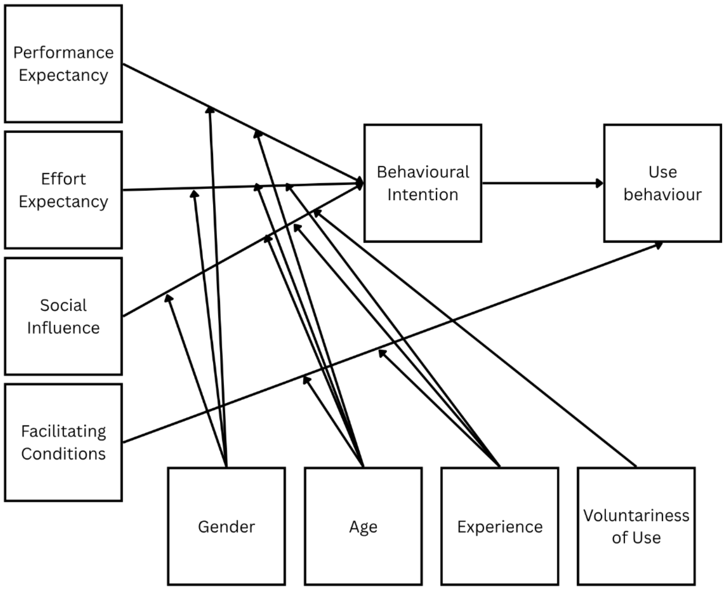

Figure 3-6, Unified Theory of Acceptance and Usage of Technology, Adapted from (Venkatesh et al., 2003)

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Purpose

The purpose of the UTAUT is to understand the different factors impacting behavioural intentions and use behaviours for technologies. UTAUT can highlight the social influences and facilitating conditions for technologies such as patient portals, providing useful contextual analysis of technology implementations (Marikyan & Papagiannidis, 2025). The UTAUT can predict up to 70% of variance in usage intentions, and thus has demonstrated value in understanding usage factors for technology solutions (Venkatesh et al., 2003). When applied to patient portals, the UTAUT can be employed to consider systemic and general barriers to use and usage intention, with consideration for factors such as age, experience, expectations, and the need to use a technology. Many of these factors were identified as important to portal use through Chapter 2, demonstrating relevance to applications in patient portals.

Scope

The UTAUT best applied at smaller scales as it could be used to examine and target the improvement of individual level motivators of use such as performance and effort expectancies, as well as age, and experience. The UTAUT does not make explicit considerations to organizational factors which may be vaguely encompassed under facilitating conditions, demonstrating lower applicability on larger scales. Organizations may employ the UTAUT to develop a better understanding of usage behaviours and technology acceptance amongst specific populations, allowing them to identify and target facilitators and barriers to patient portal use. The UTAUT can also be valuable for informing the design of a patient portal, as it describes factors related to technology acceptance, or testing the efficacy of an existing portal. The UTAUT is most relevant on the individual, organizational, and developer levels, although the community and political/governmental levels may be encompassed under facilitating conditions (albeit vaguely).

Table 3-9 Scoring and Justification for UTAUT

Criteria	**Score**	**Justification**
Relevance to portals	4	This tool was developed for use on technology acceptance broadly. This tool can be easily modified to focus

		specifically on portals (i.e. by defining the facilitating conditions using findings from chapter 2, or an existing framework focused on health equity identified in chapter 3)
Relevance to older adults	4	Age is a key factor in the UTAUT, affecting all 4 of the categories which impact behavioural and use intentions.
Relevance to EDI	2	2 green squares, 4 yellow squares in crosswalk matrix.
Total Relevance Score:	**10**	

3.2.8 Conceptual Framework for Patient Portal Utilization

Overview

Arcury et al. (2017) propose a conceptual framework for understanding patient portal utilization among ethnically diverse low-income older adults (Figure 3-8). The model draws upon the TAM, among other earlier models on interaction and behaviour to lay out the interrelated individual, social, organizational, environmental, and technological interactions, supports, and factors affecting the use of patient portals (Arcury et al., 2017).

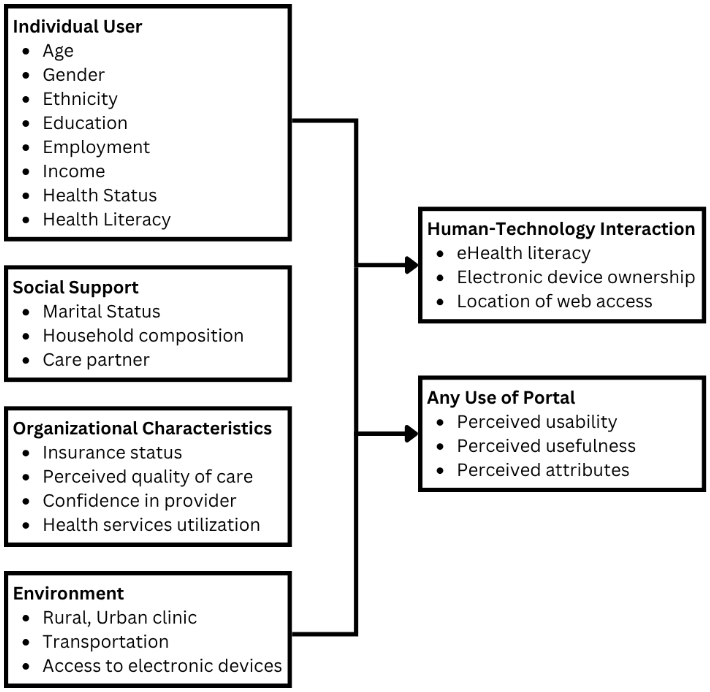

Figure 3-7. Conceptual Framework for Patient Portal Utilization, adapted from (Arcury et al., 2017)

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Purpose

This framework identifies the actionable factors affecting portal use, aligning well with findings from chapter 2 (SDOH, computer literacy, tech access, perceived usefulness and more). The model by Arcury et al. (2017) focuses on many of the social and environmental factors not considered by its inspiration the TAM.

Scope

The model proposed by Arcury et al. (2017) is meant to be used for understanding usage factors related to patient portals, and due to the varying levels/domains of influence it may present utility in varying scopes (individual, organizational, community levels). The model may be applied by HCPs or trainers to target individual level barriers and issues with portal access, highlighting potential areas of focus to attend to. This framework makes some reference to community level factors such as the location of a clinic, and access to transportation. The model may prove useful for organizations as it considers their characteristics (i.e., confidence in providers, healthcare utilization) which may affect portal use (Arcury et al., 2017). Developers may find some value in exploring the factors affecting portal usability, perceived usefulness, and perceived attributes, but this framework does not offer strong connections between causal factors and outcomes.

Table 3-10 Scoring and Justification for Arcury et al. (2017) framework

Criteria	**Score**	**Justification**
Relevance to portals	5	This tool was developed specifically for the purpose of understanding factors affecting patient portal use, usability, and perceptions amongst low income and diverse older adults.
Relevance to older adults	5	This framework focuses on portal use amongst low income and diverse older adults.
Relevance to EDI	4.25	8 green squares, 1 yellow square on crosswalk matrix
Total Relevance Score:	**14.25**	

3.2.9 Technology Acceptance Model

Overview

Expanding upon the original Technology Acceptance Model, as described by Davis (1989), the TAM modified for MyHealth manager describes the factors impacting user behaviour and intentions to use patient portals (Figure 3-9) (Portz et al., 2019). This framework emphasizes the interconnected value of perceived ease of use and the perceived usefulness of products in influencing user intentions and use. This model highlights computer self-efficacy and anxiety as key to the perceived ease of using portals, suggesting action upon these factors may potentially improve portal engagement (Portz et al., 2019).

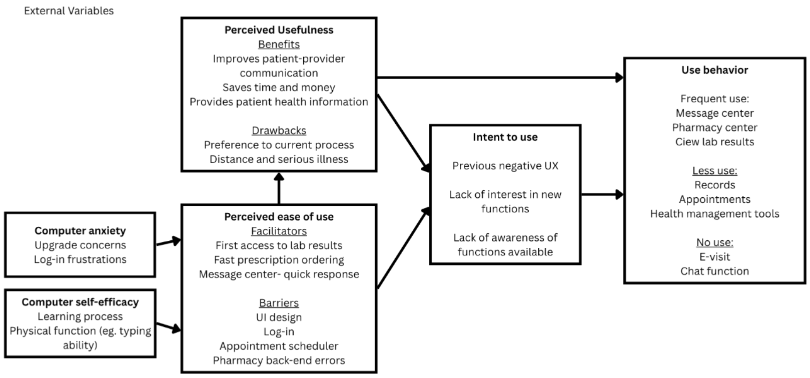

Figure 3-8. Technology Acceptance Model, modified for MyHealth manager portal, adapted from (Portz et al., 2019)

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Purpose

The TAM is a theoretical framework designed to understand the reasons why a user may accept or reject a technology. Placing emphasis on the perceived benefits and ease of use, this is particularly relevant given the findings from the systematic review (building value and simplifying portals were two of the keys to successful portal adoption) (Portz et al., 2019).

Scope

The TAM is most applicable on a health system or hospital (organizational) scale, where it may serve as a guide for primary research or exploration on the factors impacting portal acceptance amongst a population, or the developer scale, as there is a rich description of user preferences and behaviours in the modified version by Portz et al. (2019). On individual level, the TAM could be employed by healthcare providers or other care providers (i.e., portal trainers, allied health, or support workers) to understand the factors influencing an older adult’s rejection of technology (or portals in this case), but this may be impractical as it would require sufficient education and familiarity with the framework. There is no consideration of broader levels of influence such as the community or political/governmental levels, but the external variables could potentially be altered to reflect this (Portz et al., 2019).

Table 3-11 Scoring and Justification for TAM

Criteria	**Score**	**Justification**
Relevance to portals	5	This framework adapts an existing, well-established framework for understanding the acceptance of technologies by "filling" in the categories to reflect older adults experience with the My Health Manager portal.
Relevance to older adults	5	This framework was developed as part of a study examining the portal use behaviour, intent to use, and user experience of older adults with multiple chronic conditions.
Relevance to EDI	0.75	1 green square, 1 yellow square on crosswalk matrix
Total Relevance Score:	**10.75**	

3.2C Data Governance Frameworks

In addition to these frameworks for use in the development and implementation of portals, there were 2 frameworks related to data governance identified as part of the search. These governance frameworks are created to promote the involvement and equity of specific groups, Indigenous, and black members of the community in specific. These frameworks were not rated as they operate on a different level and focus then the frameworks previously mentioned in this chapter. These frameworks emphasize ideas such as data rights, ownership, and governance, as opposed to health equity and outcomes. These frameworks should be applied to electronic health records and portals were possible, as they promote the ownership, protection, and control of data related to historically marginalized groups (Black Health Equity Working Group, 2021; Konczi & Bill, 2024).

3.2.10 OCAP®

OCAP® is a registered trademark of the First Nations Information Governance Centre (FNIGC).

The First Nations principles of Ownership, Control, Access, and Possession (OCAP®) establish rules for the collection, protection, usage, and sharing of First Nations' data. OCAP® emphasizes that First Nations should be in control of how and where their data is shared, as well as the processes of data collection within their communities (First Nations Information Governance Centre, 2023). The principles of OCAP® do not correlate directly with pathways to improving health equity or patient portals specifically but should be applied to the data that is collected and represented within patient portals, regardless of if they are tethered to a medical record. According to the principles of OCAP®, First Nations communities who use a portal should have collective ownership and control over their data, with the ability to retrieve and/or revoke access to their data (First Nations Information Governance Centre, 2023). Furthermore, this access should be enforced from the beginning through to the end of any endeavors involving the collection and/or analysis of First Nations' data (First Nations Information Governance Centre, 2023). The implementation of OCAP® ensures First Nations' data sovereignty and promotes the usage of information to benefit First Nations, while simultaneously minimizing harm (Konczi & Bill, 2024).

3.2.11 EGAP

The Engagement, Governance, Access, and Protection (EGAP) framework was developed by the Black Health Equity Working Group (2021) to ensure that data from Black communities is collected, used, and promoted in a manner that promotes equity. EGAP emphasizes engaging with the black community when working with or planning to use their data, promoting data ownership and governance through community led decision making, giving communities the right to access and control access over their data, and protecting the rights of all individuals whether data is identified, de-identified, or anonymous (Black Health Equity Working Group, 2021). The EGAP framework places the principle of data sovereignty at its core, aligning well with the identified goals and purpose of OCAP®. EGAP is intended to be used alongside other frameworks, with the intention of supporting black communities, and minimizing inequities (Black Health Equity Working Group, 2021).

3.3 Discussion

The included frameworks had their relevance scores, scopes of application, strengths (with insights on relevant applications/scenarios), and weaknesses. Tables 3-12 and 3-13 are designed to guide considerations when selecting relevant frameworks for promoting health equity or understanding technology to be used by organizations who are engaging in patient portal projects.

Table 3-12. The relevance, scope, strengths, and weaknesses for the health equity centred frameworks identified.

Framework	**Relevance Score (/15)**	**Scope of Application /Levels of Action**	**Strengths**	**Weaknesses**
Health Equity Centered Frameworks				
NIMHD Framework for Digital Health Equity	11.25	☑ Individual ☑ Organization ☑ Community ☑ Political/ Government ☐ Dev/Design	Broadly applicable across scopes, considerate of numerous health inequities (tied highest relevance to EDI score with 4.25), and highly cited (342). Highly suitable for research applications.	Highlights factors of health equity without presenting pathways to improve them. Applicable across wide scope but does not specialize at any.
Framework for assessing and advancing equity for healthcare solutions that involve digital tech	7.5	☑ Individual ☑ Organization ☑ Community ☑ Political/ Government ☑ Dev/Design	Broad coverage of factors and entities impacting health equity. Considers entire product lifecycle. Uniquely applicable to software (portal) developers.	Relatively abstract to interpret. No clear causal pathways defining contributions or impact of factors and entities. Vague definition of SDOH and DDOH.
eHEF	12	☐ Individual	Considerate of many EDI related factors and can be expanded to include	No individual or community level actions evident. Abstract and

		☑ Organization ☐ Community ☑ Political/ Government ☐ Dev/Design	additional factors not listed. Highly relevant to patient portals.	unclear in the relations and actions of variables.
DHEF	11	☑ Individual ☑ Organization ☑ Community ☑ Political/ Government ☐ Dev/Design	Considers a broad range of factors impacting health equity, with considerably more actionable suggestions than other identified frameworks. Highly suitable for multi-level spanning projects.	May be hard to estimate or examine effects of actions taken to reduce disparities due to the highly interrelated nature of variables.
HEIF	6	☐ Individual ☑ Organization ☐ Community ☑ Political/ Government ☐ Dev/Design	Interesting in recognition of social context, clinical context, and culturally relevant factors as the domains which effect implementation. These may be extracted and integrated into other frameworks to broaden their considerations.	Highly abstract in application, with no clear actionable steps. Requires significant adaptation to adequately consider the concerns related to patient portal implementation.

The Health Equity Promotion Model	6.5	☑ Individual ☐ Organization ☑ Community ☑ Political/ Government ☐ Dev/Design	Unique in its consideration of LGBT individuals, and the factors affecting their health equity. Should be integrated or applied alongside other health equity centered frameworks in places with significant LGBT populations.	Little consideration of technology related factors, and highly irrelevant when serving the needs of non-LGBT individuals. This framework has little utility as is, demonstrating value in the extractable ideas/concepts.

Table 3-133. The relevance, scope, strengths, and weaknesses for the Technology Adoption and Use frameworks identified.

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Technology Adoption & Use frameworks				
UTAUT	10	☑ Individual ☑ Organization ☐ Community ☐ Political/ Government ☑ Dev/Design	The UTAUT is highly validated and said to be able to predict up to 70% of variance in usage intentions for technologies. The UTAUT is highly suited to small-medium scale projects focusing specifically on user intentions and behaviour. The UTAUT may be combined with an equity centred framework to understand some of the social influences and facilitating	The UTAUT requires adaptation, with specification of the facilitating conditions, and an understanding of the social influences related to the use of a particular technology.

			conditions impacting the acceptance of a technology.	
Arcury et al.’s Conceptual Framework for Patient Portal Utilization (2017)	14.25	☑ Individual ☑ Organization ☑ Community ☐ Political/ Government ☐ Dev/Design	This framework was designed and applied in a study on lower income older adults’ utilization of patient portals, making this portal extremely tailored and relevant to the issue of older adult portal use. This framework may be very suitable for organizations with limited capacity to expand or adapt a framework,	This framework may oversimplify or inadequately describe the relation between factors and the use of patient portals. There is no weight, and the causal effects of social support and organizational characteristics are unclear
TAM	10.75	☑ Individual ☑ Organization ☐ Community ☐ Political/ Government ☑ Dev/Design	The TAM is a validated measure of technology acceptance, and this version was derived from a study on a patient portal. This framework can be “plug and played” by smaller organizations or individuals to save the resources required to adapt a more abstract or broad scoped framework. There are portal specific factors for technology acceptance described in each category.	The version of the TAM adapted for patient portals may be too specific to the experience of older adults with multiple chronic conditions using My Health Manager. The specificity of factors and suggestions may seem like a strength at first but limit the generalizability of this framework.

3.3.2 Comparison of Frameworks

Organizations should lay out their goals and priorities with health equity and or portal implementation projects to clearly define their desired outcomes, and available resources. For instance, it may be impractical for an individual HCP, or patient portal trainer to attempt to use the eHEF (which is actionable on the organizational and political/government levels) to guide a small-scale initiative aiming to promote portal use in diverse older adults. In contrast, the same trainer or HCP may find the UTAUT to be uniquely applicable and relevant to their context, due to the mix of systemic and health equity related variables, and individual characteristics/considerations. The table above (3-10) allows organizations to view frameworks which correspond to their scope, with additional recommendations on specific use cases, strengths, and weaknesses of frameworks, so that organizations can select the framework best suited to them.

3.3.3 Moving Towards Combining Frameworks

The analysis of the frameworks in chapter 3 reveals that although numerous frameworks exist for the advancement of equity in patient portal use in diverse and older adult populations, there is no comprehensive framework for approaching this problem. Frameworks such as the eHEF (Antonio et al., 2019) and the Digital Health Equity Framework (Crawford & Serhal, 2020) may address health equity and identify SDOH affecting outcomes and access to health but cannot offer clear pathways to acting upon these factors to increase the equity of portal access. Conversely, the UTAUT (Venkatesh et al., 2003) and TAM (Davis, 1989; Portz et al., 2019) do a great job at capturing the factors likely to influence a person’s intentions or behaviours of use related to a patient portal (or technology more broadly), but have weaknesses (particularly in the TAM) when it comes to assessing the interaction and impact of various features, systems, identities, and communities on health access and outcomes.

A combined approach which draws upon one or more digital health equity frameworks in combination with a technology acceptance/use framework may allow users to optimally consider SDOH and equity related factors while focusing on portal use and access outcomes. Several digital health equity frameworks may simultaneously be drawn upon to expand the breadth of external or environmental factors considered in one of the technology acceptance/use frameworks. The consideration of several SDOH and diversity related factors in a model of acceptance or use such as the UTAUT would emphasize EDI while focusing on and measuring outcomes such as intention to use and use behaviour. Frameworks such as the Health Equity Promotion Model may not demonstrate high utility across a population in their current form, but can increase the applicability of existing tools, by incorporating considerations for LGBT equity, which are noticeably lacking from all of the identified frameworks for equity except the Health Equity Promotion Model (Fredriksen-Goldsen et al., 2024).

Organizations interested in putting EDI at the centre of portal or other digital health initiatives should consider table 3-10 and the crosswalk matrix in

Appendix B-3 to see how frameworks align with their organizational scope, how the strengths and weaknesses of these frameworks relate to their own circumstances, and how well these frameworks address health equity in relevant disadvantaged populations (i.e. in an area with a significant LGBT population, the health equity promotion model may need to be integrated into another model, or used alongside it to ensure adequate coverage of the population). Data governance frameworks should be incorporated into organizational practices whenever possible, especially in areas with significant Indigenous and black populations.

3.3.4 Strengths and Limitations

There are several key strengths to this chapter including the wide array of identified frameworks, scoring of frameworks to provide a means of comparison, and visualization through the matrix. The frameworks fall within 3 categories, with 6 identified frameworks related to digital health equity. Scoring of the frameworks allowed for 1-to-1 comparison between frameworks, with a breakdown of scoring factors that may be of greater value to certain organizations.

Limitations include the non-systematic, multi-modal search approach, subjectiveness of framework scoring metrics with equal weight for each relevance score, and variability in the reliability and validation of frameworks. The multi-modal search approach leads to non-exhaustive identification of frameworks, which may be difficult to replicate. Framework identification may be skewed due to search engine optimization, and lesser known or referenced frameworks may have been missed. The framework scoring for relevance was subjective which further complicates replicability, and the scores were applied by only one reviewer. Scoring metrics were defined prior to scoring, but suffer from being open to interpretation, as they are not based in quantitative observations. Lastly, there is a high amount of variability in the styles of framework, as well as the work taken to validate them. The UTAUT, for instance, is one of the most validated frameworks for understanding user behaviours, having been extensively validated in countries with varying cultures, economies, and technology use, in comparison to tools such as Arcury et al.'s (2017) conceptual framework which was created for the purpose of application within their own scoping review (Marikyan & Papagiannidis, 2025).

Conclusion

This chapter described 11 frameworks for promoting health equity, understanding of technology use/acceptance, and setting guidelines for data governance. Although no framework comprehensively promotes the adoption and use of patient portals amongst diverse older adults, the crosswalk matrix and table of framework relevance, scope, strengths, and weaknesses provide valuable information on the frameworks which can be combined and/or adapted to best serve the needs of entities interested in promoting patient portal use among older adults.

Chapter 4

Context and Application

This chapter will focus on drawing from existing reports and playbooks for digital health equity, and the findings from Chapter 2 and Chapter 3 to recommend best practices for the development and implementation of patient portals. The wide variety of frameworks identified and the various use cases each presents necessitates a structured process for interested entities to follow when engaging in a patient portal project. This chapter will provide resources and structures that they could follow to effectively promote digital health equity and mitigate disparities in digital health.

4.1 The Need for Tailored Solutions

The findings and conclusions from Chapter 2 and Chapter 3 underscore that there is no “one-size-fits-all” solution to making portals inclusive and accessible for older adults. It is important that the context of use and target population be considered when engaging in the development, implementation, or use/training of patient portals that will be used by older adults. Many of the identified frameworks offer options for ensuring digital health equity and technology use behaviours but there are equity related blind spots to be addressed. In the following sections, approaches to integrate these frameworks into practice were divided into two types of patient portal projects: patient portal development and patient portal implementation. While both may be aimed at improving patient portal access and use as their goals, the fundamental approaches differ. Portal development (or improvement) projects will have consideration for the developer/designer level at the core and focus on the design of a patient portal to better serve the needs of its users. In contrast, implementation focused projects are concerned with optimizing the conditions for use and mitigating the effects of barriers to accessing patient portals. By thoroughly defining scope and the target population, one can select a combination of frameworks that serve to comprehensively address health equity and patient portal promotion.

4.2 Liberatory Design for Patient Portal Development

Patient portal development should consider methods for improving the equitability of the patient portal as an outcome, but also in improving the equity and number of unique and diverse voices involved in the development of a patient portal. Drawing back to the definition of EDI, a patient portal truly considerate of the concept would be attuned to equity by removing systemic barriers or challenges to access, involve individuals from diverse and intersecting identities, and perhaps most importantly, engage and empower the community/population through meaningful inclusion. Liberatory Design is an example of a design thinking approach that may provide portal developers with a meaningful structure and process for the inclusion of diverse populations to co-design meaningful and equitable solutions.

Liberatory design is an approach that provides an equity-centred problem-solving approach that supports product designers and developers to design for liberation (Anaissie et al., 2021). Liberatory design expands upon the existing design thinking methodology (empathize, define, ideate, prototype, and test) by splitting the ideate step into inquire and imagine, encouraging deeper inquiry and problem definition for clear direction in design (Anaissie et al., 2021). The developers of liberatory design recommend the combination and sequencing of the “Liberatory Design Modes”, or steps, to best suit the purpose they are applied for (Anaissie et al., 2021). At the core of the changes proposed to the design thinking process is the emphasis on the additional ‘notice and reflect’ stages which are integrated between each of the 6 “steps” of the process (empathize, define, inquire, imagine, prototype, try) (Anaissie et al., 2021). In addition to augmenting the design thinking process and steps, liberatory design also integrates a number of “mindsets” or values intended to ground the design process in equity, which may potentially be valuable to product designers and developers (Anaissie et al., 2021). Each step of the liberatory design process has its aim and recommended actions (in the context of patient portal development) described in Appendix C in greater detail (with Notice & Reflect being combined). The liberatory design deck by the liberatory design organization may also help developers interested in learning more about the mindsets and steps involved (Anaissie et al., 2021).

4.3 Roadmap for Implementation Projects

In addition to the frameworks identified in Chapter 3, numerous other frameworks for implementing health interventions with older adults exist (Estabrooks & Glasgow, 2023). The dissemination and implementation (D&I) web tool developed by the University of Colorado in Denver lays out sections, or steps that guide researchers or practitioners in selecting and using dissemination and implementation frameworks (University of Colorado Denver, 2025; Woodward et al., 2021). These steps are to plan, select, combine, adapt, use, and finally assess frameworks to help guide health dissemination and implementation projects) (University of Colorado Denver, 2025). This section will contextualize these steps for organizations engaging in patient portal implementations and provide specific recommendations and tools to assist in the process of applying these frameworks from planning through assessment. This section contextualizes and expands upon the steps defined in the (D&I) framework developed by the University of Colorado Denver (2025) to aid entities interested in developing, implementing, researching, supporting, or using a patient portal to interact with older adults (or their caregivers).

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4.3.1 Plan

Define Scope

The first step when engaging in a patient portal related project should be to define the scope of the operation (individual, organizational, community, political/government, or a combination), the resources available (i.e., time, money, stakeholders) to dedicate to the promotion of health equity in the intended project, and the goals of the broader project (i.e., improve usage of portals, acceptance of portals, reduce disparities in portal use).

Understand Population

Following the definition of these points, entities should understand the target population, and significant subgroups (using PROGRESS-Plus) which experience disparities in health or digital health outcomes. Establishing the scope of the undertaking, as well as the target population will help select the appropriate framework in the next step. Entities should draw on the most relevant information to their environment available (i.e., municipal level data, or publications within the same geographical and political context) to understand disparities in health and digital health outcomes and access across PROGRESS-Plus categories. When possible, the inclusion of individuals from target populations, particularly those who experience a heightened level of disparities or are at the intersection of several factors which increase disparities should be involved. The inclusion of diverse viewpoints enhances the design of research and enhances patient care, and works to combat structural racism caused by historic non-inclusion (Togioka & Young, 2025). In addition to identifying the relevant PROGRESS-Plus characteristics to a patient portal project, organizations should explore the issue more broadly to understand any other constructs or factors that are highly relevant to the subject matter (i.e., digital health literacy in patient portals). The figure developed in Chapter 2 provides some key constructs relevant to older adults’ use of patient portals (i.e., trust, value, support, health literacy), as do the barriers and facilitators to portal use identified in the results.

4.3.2 Identification and Selection

Identification

Following the definition of project goals, population (PROGRESS-Plus and additional constructs), resources, and scope, selection of the appropriate frameworks can occur. Organizations should first attempt to supplement the included list of frameworks with a literature search (gray or structured) for any frameworks which relate specifically to the defined problem/goals and/or population (i.e., if engaging in a patient portal project for frail older adults, the search should include terms such as [“frail*” OR “chronic conditions” OR “debility”]). Organizations focused on implementation should also consider exploring the frameworks available in the D&I models web tool, which can be filtered for frameworks focused on implementation (rather than dissemination) (University of Colorado Denver, 2025). Frameworks which relate to the populations and project goals typically require the least amount of adaptation as they may already be fine-tuned to the specific situation at hand (i.e., Arcury et al.’s (2017) model for the use of patient portals by diverse and lower income older adults is almost ready to “plug-and-play” for patient portal projects focusing on marginalized older adults). Figure 4-1 provides organizations with a schema for going about the framework identification process.

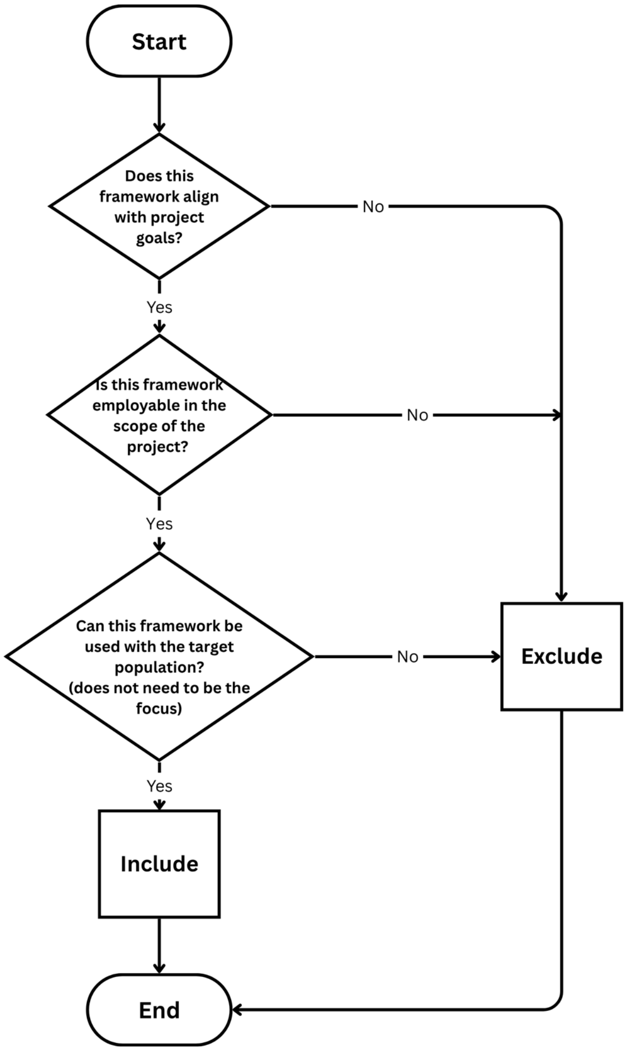


Figure 4-1. Flowchart for identifying relevant frameworks for consideration.

After relevant frameworks have been identified and added to the list of potential frameworks, they should be assessed and ranked to determine which frameworks are most relevant. Organizations engaging in implementation should employ the Theory, Model, and Framework Comparison and Selection Tool (T-CaST), for ranking and selecting appropriate frameworks in healthcare implementation projects (Birken et al., 2018). The T-CaST was developed by a team of 19 implementation researchers and 19 implementation practitioners, to emphasize the four criteria domains of usability, testability, applicability, and familiarity in the selection of frameworks for implementation. The T-CaST asks 15-16 questions (15 in the version for practitioners, and 16 in the version for researchers) which rate the framework of interest from 0 (poor fit) to 2 (good fit) (with 1 representing moderate fit). This score is then averaged to determine the fit, and this process can be repeated between team members to decrease subjectivity. The TMF should be repeated for all frameworks which pass initial screening, to determine the frameworks which are best suited for the purpose.

Following rating, all frameworks should be assessed using two simple iterative prompts: whether the framework provides anything novel not covered by a framework that has been reviewed, and whether the framework improves or expands upon what an already reviewed framework accomplishes (Figure 4-2). This will lead to a final selection of the most effective and comprehensive frameworks for combination in the next step. Novelty with relation to the application can vary, but novelty with relation to the number or breadth of SDOH and DDOH identified can be addressed by creating a "crosswalk matrix" similar to that employed in chapter 3 (Appendix B-3).

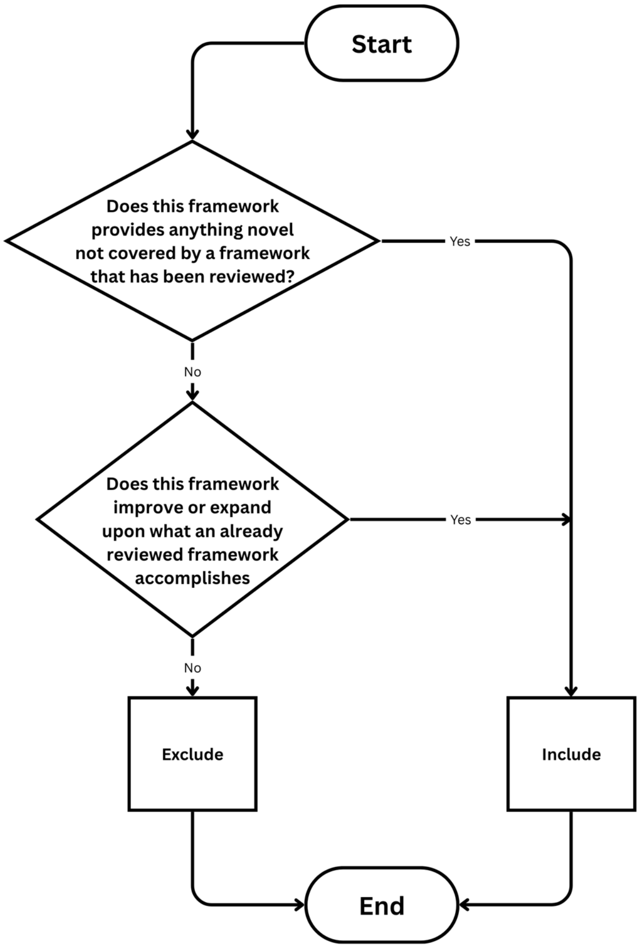


Figure 4-2. Flowchart for finalizing framework selection.

4.3.3 Combine & Adapt

The combine and adapt steps proposed by the D&I web tool were combined due to the fact that certain frameworks may require adaptation before combination, and at other times frameworks may not be combined at all.

Combine

The multilayered and complex considerations necessary to make portals inclusive for all older adults makes it impossible for one solution or framework to be all encompassing. Rather, several frameworks could be used in combination to comprehensively address gaps in areas of implementation. By doing so, it becomes possible to lend on the unique strengths of each framework in tandem, to address different needs. For example, combining models like the NIMHD Digital Health Equity Framework and TAM or Arcury et al., (2017) framework can permit integration of more equity related characteristics at various levels of scope without compromising broader and more comprehensive insights**.** However, it's important to revisit the purpose of the project and consider alignment with the framework prior to utilizing them. Without having clearly defined and intentional roles for each framework that is used, the process is likely to become confusing resource intensive, rather than informative and impactful. In some cases, frameworks do not offer clear pathways to combine but may still complement each other. In such cases, the frameworks should be adapted as best possible to better fit the purpose.

Adapt

Some models may align well with the population or core objectives of the project but lack consideration of certain target populations or be specific to patient portals. For example, the UTAUT considers the facilitating conditions affecting a user's intentions and behaviours without specifying the nature of these conditions. The UTAUT can be adapted to reflect the facilitating conditions for older adults' use of patient portals observed in Chapter 2 (support and engagement, trust and value, digital literacy, as ease of use and literacy are already addressed by the UTAUT). Adaptation may simply involve the addition of certain constructs into pre-defined categories (i.e., integrating considerations from the Health Equity Promotion model aimed at LGBT health disparities into the model examining low-income older adult patient portal use by Arcury et al. (2017) to better address PROGRESS-Plus categories), context specific modification (i.e. changing the Health Equity Implementation Framework to apply specifically to digital health interventions by integrating digital health considerations, or even more specifically to patient portals), or a more complex adaptation of a model to span across further scopes and/or stakeholders. The D&I webtool offers a worksheet for adaptation of frameworks which should be applied in cases where framework adaptation is unclear and complex (University of Colorado Denver, 2025). Adaptation should be avoided when the pathway from the current state of the framework to a relevant one is unclear in order to avoid unnecessary expenditure of resources.

4.3.4 Use

The frameworks which have been selected, combined, and adapted where necessary are now ready for use at this stage of the process. Frameworks should be employed in the development of study protocols, to define aims and objectives, recognize target population(s), identify design features, interpret findings among more (University of Colorado Denver, 2025). Frameworks may be applied as early as the ideation and design phase of a project, and can even be integrated into grant applications and other funding requests to improve robustness (University of Colorado Denver, 2025). Frameworks can help break intangible ideas into measurable and addressable constructs, and should be applied as such (University of Colorado Denver, 2025). A key pitfall in application of frameworks in the use stage are a lack of project-wide integration of the framework (often at early stages such as grant writing), caused by integration of frameworks into facets of a project, rather than at the core. Frameworks can be used all the way through dissemination of the findings of a study, making this the longest and most important step of the D&I web tool’s process.

4.3.5 Assess

The application of frameworks into projects is an iterative process, as the frameworks employed at the beginning of a study may be revisited or changed altogether as a study progresses. It is important that projects which have reached the end of a cycle, or projects that are concluding assess the impact and success of the applied framework(s) on the outcomes of focus in the study. This assessment can occur through a structured assessment tool as described by the D&I web tool but can also be performed through surveys or research measuring the outcome(s) of focus in the study, particularly amongst any marginalized or disadvantaged populations within the group. The D&I web tool offers numerous assessment tools, which may be sorted by constructs such as acceptance, health equity, adoption, and compatibility (University of Colorado Denver, 2025). Selected tools for assessment should align with project goals and the frameworks selected and employed for the purpose of the project (i.e., using TAM based questionnaire from D&I web tool when technology acceptance was primary outcome, and TAM was an included framework.)

4.3.6 Conclusion

The D&I web tool offers an end-to-end description of the process which institutions or individuals engaging in patient portal implementation ought to follow when selecting frameworks to guide their project. These steps align with the conscious, inclusive, evaluative, and iterative nature of liberatory design methodologies earlier, with specific context and use for patient portal implementation and proliferation focused projects.

Chapter 5

Conclusion

5.1 Key Findings

This thesis yielded valuable insights on how older adults are using patient portals, what is promoting and preventing this use, as well as strategies which can be applied by patient portal developers, health care providers, health care systems, communities, governments, and more to encourage equitable access to patient portals for older adults. This thesis employed an EDI lens, using PROGRESS-Plus, to focus on intersecting disparities in digital health for older adults to advocate for the integration of frameworks and methodologies that promote equitable patient portal access and use.

Chapter 2 examined the current state of patient portal use among older adult and the facilitators and barriers affecting said use, yielding a set of pathways to promote patient portal use in older adults. These pathways included building trust and value in patient portals among older adults, advancing the capacities of older adults (with relation to both health and digital literacy), supporting and engaging older adults through their patient portal use journeys, and simplifying patient portals so that they are better attuned to the needs and skills of older adults.

Chapter 3 explored the frameworks and tools which could be applied in the development and implementation of patient portals to ensure that they are attuned to equity and the needs of older adults. A crosswalk matrix was used for examining how frameworks align with different equity relating factors or characteristics. The frameworks were also scored for relevance to patient portals as well as to older adults, and displayed in a table, along with their strengths, weaknesses, as well as the scopes in which they may be applied.

Chapter 4 recommended best practices for the selection and application of frameworks identified in Chapter 3, with additional consideration of the context of patient portals and older adults. Findings from Chapter 2 are used to inform this context, and Chapter 4 ultimately serves as a guide for framework selection whether engaging in a project related to the development or implementation of a patient portal for older adults.

5.2 Strengths and Limitations of this Thesis

This thesis benefits from a strong foundation in background research and subject matter expertise derived from the systematic review in Chapter 2, helping provide a rich current understanding of older adults' experience with patient portals before diving into frameworks which may support their application or development. Additionally, the thesis integrates recognized frameworks and methodologies for equity and equitable design such as PROGRESS-Plus and liberatory design. The thesis is grounded in application, focusing and describing how the findings from each step may be applied specifically to patient portal contexts.

The search process for frameworks in Chapter 3 was not exhaustive nor systematic in the methodological sense; it may be difficult to replicate as it employed a multi-modal approach leveraging search engines, real world connections, reference search, and database searches. The applicability of the findings may be limited by the lack of involvement of older adults through primary research. Many of the strategies and frameworks identified in the thesis call for collaboration and involvement of older adults. This was not done due to barriers in obtaining participants for primary research, as well as the expected difficulties in recruiting a diverse and representative group to aid in the research process within the timeframe available. While there was no inclusion or involvement of older adults in this thesis, there is an opportunity for future studies to validate the findings with older adults and to build in cocreation activities.

Lastly, some numerical analysis is included, but even this was grounded in qualitative observations in most instances (except for the crosswalk matrix for scoring). The data were derived through the observations of a single reviewer, making them prone to bias.

5.3 Suggestions for Future Work

Further efforts to examine the use and acceptance of patient portals by older adults, particularly those from the intersections of negative health-determining characteristics, should include primary research to build empathy and understanding. Primary research using qualitative methods should be conducted to assess the use or acceptance of patient portals amongst diverse and lower income populations firsthand. Much of the reported data and patterns regarding patient portal use is derived from studies conducted in the United States, where the healthcare and societal contexts are analogous, but not identical to Canada. Exploration of more local patterns in usage and acceptance could improve local relevance and applicability of results. Further studies should also include more exhaustive search of frameworks and a more structured and replicable approach for rigour. Qualitative research strategies such as concept mapping (exploring topics related to a prompt, and exploring how these topics relate and contribute to an overall idea, i.e., asking users what features affect their portal use in order to gather concepts relevant to portal use), or journey mapping (asking participants to navigate through/around a series of touchpoints which relate to a certain service or experience in order to understand their emotions, motivations, support, and experience throughout this journey) can help researchers or others engaged in portal projects to empathize with, and understand the parts of a patient portal, and the experience of its use which are most relevant to target for successful portal design or implementation.

5.4 Reflection

This study provided a valuable experience in research, as it allowed me to learn skills related to health research, implementation methodologies, underscored the importance of primary research, and helped me gain appreciation for knowledge translation.

Prior to engaging in the systematic review included, I had not engaged in any formal secondary research apart from a single systematic review. This review was also my first leadership position in a research endeavour, and this proved to be much more difficult than it seems. Coordinating a team of student researchers and maintaining deadlines can be very difficult while attempting to keep quality standards high. In situations where I was not clear, I risked having students spend large amounts of time on fruitless tasks. Initially this led to tasks needing to be redone by me with a heightened level of attention. I quickly learned that I had to be precise in my instructions, rubrics/forms, and feedback to ensure that quality standards could be upheld. This review process was ultimately extremely rewarding, as I have already applied findings from this review in real life, to guide conversations, suggest solutions to real world issues, and demonstrate my understanding of digital health as a space.

This project has also underscored the importance of primary research to me, particularly when working with marginalized populations. Many of the suggestions and findings in this thesis are focused on examining, involving, and helping those who experience intersecting marginalized factors/identities.

Unfortunately, despite the apparent value of having these individuals be a part of the research and project, they are often the most difficult to recruit. Potential avenues of research were deemed pointless due to their inability to draw diverse participants whose experiences could inform this study. It is important for researchers and research boards to recognize the many barriers to having diverse and marginalized individuals participate in research, and work to mitigate these barriers, so that they have a seat at the research table.

Lastly, this project demonstrated to me the value of the field of knowledge translation. This study involved the identification of research relating to older adults’ use of patient portals via systematic review, framework to support health equity and patient portal use for older adults, as well as ways for either designers or implementation focused organizations to select, and apply these frameworks, and approach equitable design/implementation in general. The bridging from theories and stats to applicable pathways and guides proved to be more conceptually challenging but also rewarding than I had initially expected.

All in all, I am beyond grateful for having this opportunity, and all that I have learned throughout the process of completing this study. I am excited to apply the findings of this thesis in my career, and hope that this may be of use to institutions and/or individuals engaging in patient portal related projects for older adults.

Appendix A: Chapter 2 Tables

Table A1: Populations, study designs, and evaluated systems from included articles.

Study	Study design or duration	Systems evaluated	Participants
Barron 2014	Qualitative; interviews and cognitive walkthrough (one-time)	Patient portal developed at Johns Hopkins University geriatric medical practice	N=33; 14 older adults (avg. age 78.6), 19 caregivers. Gender: 50% of older adults were female.
Burgdorf 2023	Quantitative; cross-sectional secondary analysis of linked national survey data (NHATS, NSOC, ACS; 2017)	Provider-sponsored patient portals (general, not system-specific)	N=1,417 older adults (weighted N=7.4 million) and N=2,232 caregivers (weighted N=20.6 million); nationally representative U.S. sample
Burgdorf 2024	Quantitative; retrospective cohort study (Oct 2017 – Aug 2022)	Provider-sponsored patient portal at a large academic health system	8,409 home health episodes involving 4,878 unique older adult patients
Cajita 2021	Cross-sectional, correlational survey	Patient portals	N = 100 community-dwelling older adults (≥65 years); Mean age = 74.7; 58% female
Cross 2021	Cross-sectional survey (March to June 2019)	Patient portals tethered to	N = 158 older adults (≥65 years); Mean age = 71.4 years; 66.5% female

		providers' EHRs	
Portz 2021	Quantitative – Retrospective cohort study (2016–2019)	My Health Manager (Epic's KP HealthConnect at Kaiser Permanente Colorado)	N = 6129 (serious illness cohort) and N = 6517 (end-of-life cohort); adults aged ≥18
Eriksson-Backa 2021	Qualitative – Focus group study	My Kanta (Finland's National Electronic Health Record system)	N = 24 older adults (aged 55–73); six focus groups (3–5 participants each) in two Finnish cities
Evans 2018	Quantitative; Cross-sectional observational study	Electronic personal health record (ePHR) – Microsoft HealthVault	N = 50 community-dwelling older adults Age range: 55 to 95 years; Mean: 67.64 years Gender: 64% female (32/50)
Finkelstein 2011	Quantitative; 9-month randomized controlled trial	VALUE (Virtual Assisted Living Umbrella for the Elderly) home telehealth portal	N = 99 frail older adults (59 female, 40 male) Eighty-four subjects were active participants for nine months (40 intervention, 44 control)
Gleason 2023	Quantitative; Observational cohort study (October 3, 2017 – October 2, 2022)	Patient portal at an academic health system	**N = 3,170** adults aged 65+ with diagnosed dementia and ≥2 visits within 24 months

Gordon 2016	Quantitative; Administrative data analysis (2013) and mailed survey (2013–2014)	Kaiser Permanente’s secure patient portal (kp.org)	Administrative data: N = 183,092 adults aged 65–79: 183,565 non-Hispanic white, 16,898 Black, 12,409 Latino, 11,896 Filipino, and 6,314 Chinese members. Survey subsample = 2,602 respondents (849 White, 567 Black, 653 Latino, 219 Filipino, 314 Chinese)
Huang 2024	Quantitative; Secondary analysis of 2022 HINTS 6 cross-sectional survey data	Multiple health information technologies (HITs): Internet use, health apps, telehealth, social media for health, wearables, online medical records	N = 6,252 U.S. adults (2203 65+ adults) analysis focused on comparisons between older adults (65+) and adults aged 18–64
Kim 2018	Mixed-methods; Online surveys, review of existing portals, and participatory design workshops	Patient portals	N = 17 older adults aged 65+, organized into 4 workshop groups
Lafata 2018	Quantitative; Retrospective cohort study (Dec 1, 2012 – Mar 31, 2014)	Epic’s MyChart patient portal	N = 20,282 insured adult (18+) primary care patients at 26 clinics in an integrated health system in metropolitan Detroit, MI
Logue 2012	Quantitative; Descriptive survey (pilot study)	Medicare-linked personal health records	N = 38 older adults (65+), Medicare beneficiaries with chronic illness, recruited from two

		(PHRs) offered in Arizona and Utah	community settings in Arizona (senior living center and church)
Makai 2014 (a)	Quantitative; Controlled before-after study with 12-month follow-up. July 2010 to July 2011	ZWIP (health and welfare portal with secure messaging and shared electronic health record)	N = 682 frail older adults (290 intervention, 392 control) in 11 family practices in the Netherlands
Makai 2014 (b)	Mixed methods; 2-year quantitative follow-up + qualitative semistructured interviews	ZWIP (Health and Welfare Information Portal) – a personal online health community for frail older adults	N = 290 frail older adults (quantitative); 23 older adults and informal caregivers (qualitative) in 11 family practices in the Netherlands
Nahm 2016	Quantitative; Secondary data analysis of 3 datasets (2014–2015)	General patient portals (including one tied to an education intervention; unspecified platforms)	N = 1,230 older adult online users total: 619 from HINTS 4 (65+), 553 from SeniorNet survey, and 58 from a clinic-based RCT baseline sample
Nahm 2020 (a)	Mixed methods; Baseline data from ongoing RCT	General patient portals	N = 272 older adults (aged 50–92) with chronic conditions across 29 U.S. states. 70.2% of participants were female
Nahm 2020 (b)	Mixed methods; Secondary analysis of discussion forum	General patient portals (via T-PeP program)	272 older adults (50+ years) with chronic conditions across 29 states

	content from a two-arm RCT		intervention group: 138; 114 completed follow-up survey at 4 months
Ploegmakers 2024	Quantitative; Cross-sectional survey	Fall-prevention patient portal (hypothetical; under development)	N = 121 older adults (mean age 77.9, 69.4% female) from 7 European countries, all with fall-related clinic visits
Portz 2019	Qualitative; Descriptive focus groups 6 focus groups (3 nonuser groups and 3 user groups) lasting approximately 90 min	My Health Manager (Kaiser Permanente Colorado)	N = 24 older adults (mean age 78.4), with multiple chronic conditions (MCC), split into portal users (n=15) and nonusers (n=9)
Portz 2020	Qualitative; Sub-study of case study via focus groups	My Health Manager (Kaiser Permanente Colorado), specifically the advance care planning (ACP) and AD sections	N = 24 older adults (≥65 years) with multiple chronic conditions (MCC), including both portal users and nonusers
Ramirez-Zohfeld 2020	Mixed methods; Retrospective review (6 months), July 1, 2016, to December 31, 2016	MyChart (tethered to Epic EHR)	N = 144 users (62 patients aged ≥85 years, 82 caregivers) from outpatient internal medicine and geriatric clinics at an academic health cente
Robben (2012)	Mixed methods; Sept 2010 – July 2011 implementation	ZWIP (Health and Welfare Information Portal)	290 community dwelling frail older adults, 169 professionals, Netherlands (Gelderland

	phase of evaluation		& Noord-Brabant provinces)
Siek 2010	User-centered iterative design over 2 years (6-month needs assessment and 18-month development)	Colorado Care Tablet (CCT) – a Personal Health Application (PHA) for medication management	N = 31 (22 older adults, mean age 76.4; 9 caregivers, mean age 52.7); 6 iterative usability studies with 4–8 participants each User needs assessment conducted with four focus groups and fourteen in situ interview
Son 2019	Mixed methods; Secondary analysis of baseline data from RCT	General patient portals (T-PeP program context)	N = 272 older adults (mean age = 70.0 ± 8.5; 70.2% female; 78.3% White)
Son 2022	Secondary data analysis from two studies: a cross-sectional survey and an RCT (T-PeP baseline)	General patient portals	N = 300 older adults (≥65); Recruited from a healthcare system (n = 174), recruited from nationwide communities (n = 126)
Steele Gray 2021	Mixed methods; 15-month pragmatic RCT with stepped-wedge design and ethnographic case studies	ePRO tool (electronic patient-reported outcome)	N = 45 patients (of 142 eligible) across 6 Ontario primary care practices; patients with complex care needs
Taha 2013	Quantitative; Simulated PHR usability study over 2 days	Simulated version of Epic's MyChart	N = 107 adults (56 aged 40–59; 51 aged 60–85), Miami-based.

Taha 2014	Quantitative; Simulated portal usability study with training	Simulated version of Epic's MyChart CREATE - Center for Research and Education on Aging and Technology Enhancement Patient Portal Simulation	N = 51 older adults (aged 60–85, M = 69.3), Miami based
Turner 2015	Qualitative; Semi-structured interviews	Patient portals, including Epic’s MyChart	N = 74 older adults (60+ years)
Wildenbos 2018	Quantitative (Conjoint Analysis Questionnaire)	Patient portals	N = 1294 adults; 81% aged 55+, from heart/vascular and lung disease patient panels in The Netherlands
Willard 2018	Mixed methods (User-Centred Design over 6 months)	Online Community Care Platform (OCC-platform)	N = 55 frail older adults tested the platform (33 completed 6-month period; age 65–80) To assess the user requirements: Direct observations (N = 3) and interviews (N = 14)
Yoon 2024	Retrospective cohort study using data from a longitudinal study (January 1, 2019, to December 31, 2022). Data	Health care portal (MyChart; Epic Systems, via EHR login data)	536 adults aged 23 to 91(mean age 66.7); all with ≥1 chronic condition; recruited from 5 NIH-funded studies

	analyzed between march and June 2022. Data from the COVID-19 & Chronic Conditions (C3) study		
Zoorob (2023)	Secondary analysis of a 2-phase cross-sectional study (July 1 and July 31, 2021) using surveys informed by focus groups	Patient portals and telehealth in urogynecology care	205 older adult female patients (≥65 years) at large academic tertiary care center in northwest Ohio; 10 in focus groups

Table A2: Summary of Patient Portal use by Study

Study ID	Summary
Lafata 2018	32.6% of study-eligible participants were portal adopters. 92% of adopters had at least 2 online sessions, and 86% had 3 or more sessions. African Americans, Hispanics, those 70 years and older, and those preferring a non-English language were less likely to be adopters. Those with higher CGI score or physicians' visits were more likely to be adopters. The most commonly used feature was record access and management (95.9%). This was followed by appointment management features (76.6%), messaging features (59.1%),

	and lastly, the visit/admission summary component (41.0%). With the exception of accessing visit/admission summaries, patients of African American race were significantly and substantively less likely to have accessed each of the portal features. With the exception of record access and management patients 70 years and older were also significantly and substantively less likely to have accessed each of the portal features. As a patient’s CCI score or number of primary care visits increased, so too did their likelihood of accessing the different portal features.
Turner 2015	Portal users and nonusers were similar in age. A higher proportion of users were female (87%) compared to males (13%). Most portal users (60%) lived independently in private residences whereas the majority of nonusers (74%) lived in retirement or assisted living facilities. Informal/unpaid caregivers were more common among nonusers (28%) than users (7%). Portal users were more likely to have completed postgraduate education (46.7%) compared to nonusers (18.6%).

Cajita 2021	52 participants (of 100) reported using a portal. 28 used the portal independently; 6 received assistance from others; 5 had others access the portal on their behalf;13 received assistance from others and/or had others access the portal on their behalf. Among the participants who received assistance in using the patient portal, 3 reported receiving assistance all the time and 16 only some of the time. Among those who had someone else access the portal on their behalf, 6 reported having someone else access their portal all the time and 12 only some of the time. Marital status and patient activation were significantly associated with independent portal use.
Burgdorf 2023	73.6% of older adults and their caregivers did not use the patient portal. 13.7% of caregivers were the sole portal user. 10.0% of older adults were the sole portal user. only the older adult does. Among 2.7% of participants, both the older adult and their caregiver accessed the portal. Older adults whose caregivers were the sole portal users were more likely to be over the age of 80, display social vulnerability and complex care needs, have probable dementia, be unmarried and living alone. Caregivers were more likely to use the portal if they were aged 65 or older, had a college education, received

	respite care or caregiving training, reported difficulties related to caregiving. Caregivers were less likely to use the portal if they were Black (compared to White, had a non-spousal relationship to the older adult, were part of a caregiving network with three or more caregivers.
Gleason 2023	The majority were registered for the patient portal (71.20%), and 330 (10.41%) had at least one registered shared access user. Most registered patient portal accounts (91.9%, 2075/2257) were used. Patients with (vs without) a shared access user had a higher level of patient portal activity and were more likely to be a portal user. Patients with a shared access user had a higher number of messages originating through portal accounts. Of patients with a registered care partner, shared access users sent an average of 24.64 messages and patient users sent an average of 31.13 messages. The average length of portal sessions was slightly longer for patients with (vs. without) a shared access user. Patient portal activity increased during the observation period among patients with and without a shared access user. The pace of increased portal activity was greater for those with (vs. without) a shared access user.

Barron 2014	85.7% of patients and 100% of caregivers desired continued use.
Burgdorf 2024	The patient portal was used in more than half (58%) of home health (HH) episodes incurred by older primary care patients. Portal use was highest during the first 5 days of an HH episode. Portal use remains fairly level during the episode with a slight decrease from days 11 to 55 and slight increase in the last 5 days of the episode. Use of the patient portal was greater among HH patients who were married or partnered, white, receiving HH post-COVID pandemic, following a hospitalization, and in their first HH episode. Compared with white patients, black patients had significantly lower odds of using the patient portal overall, and lower odds of using the portal to view test results, message a provider, or view clinical notes. The portal was most often used to view test results (84%), manage existing appointments (77%), manage medications (72%). Viewing health conditions (24%) and managing billing (24%) were the least used functions. Of episodes during which at least 1 message was sent to a provider, an

	average of 7.1 messages were sent during the episode and 94% of messages were categorized as medical advice requests.
Cross 2021	47% of participants used 4 or more portal features (extensive user), 30.4% used 1-3 features (moderate user), 22.6% of participants did not use the portal (nonuser). Respondents who were nonusers and moderate portal users were significantly less likely than extensive users to have high EHR value perception The most commonly used features were viewing test or lab results (73%) and

	communicating with their doctor (56%). Finding medications was the least commonly used feature (13%).
Kim 2018	Older adults primarily use portals for communication rather than health management. Participants rated medication information, lab results, and communication with providers as the most important portal features.
Makai 2014	27.2% of frail older adults enrolled in the personal online health community (POHC) intervention used the POHC frequently. The most frequently used ZWIP function was messaging. Nearly half (47.9%) of participants used the goal-setting function. Few participants modified or evaluated goals during ZWIP usage (13.1%). 33.1% of participants defined care-related activities to reach their goals while only 9.0% actively evaluated these activities during their period of ZWIP usage.
Finkelstein 2011	There were approximately 14 logins/subject/week initially, which decreased to four logins/subject/week by the end of each subject's participation. Messaging (795) and education (526) accounted for most of the portal function accesses. Videoconference scheduling and general conversation each accounted for approximately one-third of transmitted

	messages. The remaining message function visits were for testing, checking, and confirming orders. There were 218 usages of the service ordering functions over the study period. Prescription refills accounted for 65% of all service orders and coupon book orders accounted for another 15% of all orders placed. There was an average of 26 videoconferences conducted for each of the 40 subjects who participated for at least nine months.
Robben 2012	Of the frail older adults invited to use the ZWIP portal, 290 (49%) created an account. During the study period, 14.8% logged in once, 40.3% accessed the portal multiple times. Frail older adults and their informal caregivers sent an average of 0.8 messages using ZWIP. 7.2% of ZWIP users sent five or more messages. Interviewees suggested that variation in portal adoption by patients across general practices was due to differences in local professionals’ attitudes towards the ZWIP, as well as by variation in computer literacy due to social-economic differences between the general practices. Interviewees described that most frail older people and their informal caregivers made limited use of the ZWIP. On the other

	hand, they also gave examples of frequent users of the ZWIP. One interviewee described that the use of the ZWIP was limited when the frail older person was in good health, but that its use increased when the frail older person became ill.
Willard 2018	The frequency of use of the OCC-platform generally decreased over time, with a few peaks between weeks 4 and 5 and weeks 7 and 8. In the first 2 weeks of the study, the participants clicked 500–550 times (all of the functions included). This frequency decreased to approximately 170–205 clicks per week over the last 2 weeks. The functions of 'contacts', 'services', 'messages' and 'my community' were the most frequently used (74% of total usage). Conversely, the functions of 'news', 'clock' and 'emergency call' were rarely accessed (6% of total usage)

Portz 2021	Caregiver use of MHM was low in both cohorts. Of the 6129 patients in the onset of serious illness cohort, 6030 used MHM at least once in the study period. Patients and caregivers used MHM on average 50.4 days in the 12 months following the onset of serious illness. Patients and caregivers in this cohort most commonly used new MHM features, including eChat functions and eVisits, patient–provider communication tools, and visit-scheduling options. For the 6517 patients in the end-of-life cohort, 6308 used the portal at least once in the last 12 months of life. Patients and caregivers used MHM for 43 days in the last 12 months of life. Users in this cohort also commonly used patient–provider communication and visit-scheduling tools but showed less usage of new MHM features (eChat and eVisit tools). Health management and cost coverage tools were the least used tools in both cohorts. In both cohorts, rates of use of MHM were lower for females than for males, for Asian and Black participants than for White participants, and for users as they aged.

Nahm 2020 (Patient Portal Use Among Older Adults: What Is Really Happening Nationwide?)	The majority (71.3%) had at least one PP account. Among those, 51% reported having two or more PP accounts. The mean number of PP accounts for the entire sample was 2. Among the participants who have PP accounts, 39.2% reported use 3-9 times in the past 12 months, 15.5% reported using the portal more than monthly in the past 12 months, 16.5% of participants reported using the portal about monthly in the past 12 months, 15.5% reported using the portal 1-2 times in the past twelve months and 13.4% reported no portal use in the past 12 months. When selected PP functions were ranked by frequency of usage participants ranked viewing lab results and communicating with health care team members as the most frequently used functions, followed by reviewing visit summaries requesting prescription refills, and viewing reminders.
Nahm 2016	Portal adoption was greatest for clinic patients (92.3% adoption for those aged 65 and older, 68.9% for those aged 50-64). The SeniorNet sample showed moderate rates of portal adoption (59.3% for those aged 50-64 and 61.3% for those aged 65 and older). Adoption was lowest among the Health Information National Survey Trends (HINTS 4)

	sample (32% for those aged 50-64 and 29.8% for those aged 65 and older).
Yoon 2024	With respect to the median number of days of portal logins, logins increased from a median (IQR) of 16 (0 to 45.3) days in 2019 to 31 (2 to 52) days in 2020. The median (IQR) number of days of portal logins was 31.5 (6 to 65.3) days in 2021 and 31 (4.8 to 65) days in 2022. The most frequent portal activity was checking laboratory or test results. All other activities, such as scheduling and messaging, were low and had medians at or close to 0 across each year. Higher login activity was associated with adequate health literacy and multimorbidity. Participants who were older, female had lower portal activity. Compared with non-Hispanic White participants, lower portal use was observed in Hispanic or Latinx participants, non-Hispanic Black participants, and participants who identified as other race or ethnicity. Tangible social support was not associated with login activity.

Son 2019	71.3% of participants reported having at least one patient portal account. The mean number of patient portal accounts for those having at least one patient portal account was 2.0 ± 1.2.
Huang 2024	Controlling for gender, race, education, income, general health status, personal cancer history, and family cancer history, in comparison to adults between ages of 18 to 64, the elderly accessed their online medical record or patient portal less frequently. Results showed that the elderly with more education, higher income and having personal cancer history accessed their online medical record/patient portal more often than their counterparts.
Son 2022	The mean number of PP accounts was 2.2 for the HC sample and 1.9 for the community sample. The highest proportion of both sample groups used PPs one to nine times in the past 12 months: 53.4% of the HC sample and 65.9% of the community sample. the most frequently used functions were viewing laboratory results (97.7% of the HC sample and 84.8% of the community sample) and receiving eMessages

	(94.8% of the HC sample and 80.8% of the community sample) in both sample groups. Self-efficacy and health condition variables (number of chronic diseases, recent acute illnesses, and recent hospitalization) were statistically significant predictors of portal use.

Table A-3: Extraction Template for Systematic Review (modified from Covidence)

Context and Study Design	
Portal Name	Free text
Study design	Free text
Title	Free text
Lead Author Last Name	Free text
Country in which the study conducted	1. United States 2. UK 3. Canada 4. Australia 5. Netherlands 6. Other
Aim of Portal	Free text
Age Limits	Free text
Condition	Free text
Care Environment	Free text
Other Inclusion Criteria	Free text
Method of recruitment of participants	1. Phone 2. Mail 3. Clinic patients

	4. Voluntary 5. Other
Total number of participants	Free text
Population Characteristics (Separated intervention(s) and control where applicable)	
Age	Table
Sex	Table
Gender	Table
Race/Ethnicity/Culture Overall	Table
Religion	Table
Education	Table
Socioeconomic Status/Income	Table
Marital Status=	Table
Ability Level	Table
Frailty Score/Level	Table
Living Arrangement	Table
Requirement for Care	Table
Disability	Table
Results	
UX Themes Explored	UX Themes Explored 1. Usability 2. Accessibility 3. User Satisfaction 4. Ease of Use

	5. Perceived Value/Utility 6. Desirability 7. Other
Qualitative Outcomes Measured	Free text
Facilitators to UX Identified	Free text
Barriers to UX Identified	Free text
Outcomes of User Experience (Neutral, positive, or negative)	Free text
Perspectives Gathered	Free text
Relevant Quotes	Free text
Portal Features	Free text
Description, acceptance, and performance of portal features if described	Free text
Author Recommendations/Suggestions	Free text
Quantitative Outcomes Measured	Quantitative Outcomes Measured 1. Usage 2. Satisfaction 3. Patient Outcome 4. Messages Exchanged 5. Logins 6. Patient Activation 7. Patient Knowledge 8. Patient Experience 9. Other

Quantitative Results	Table separated by intervention(s) and control
Subgroup Analysis?	Yes/No
Subgroup Analysis Results	Free text
Author Global Assessment	Author Global Assessment 1. Poor 2. Fair/Mixed 3. Good 4. Excellent 5. Cannot be determined 6. Other
Author Global Assessment Justification	Free text

Appendix B: Chapter 3 Tables

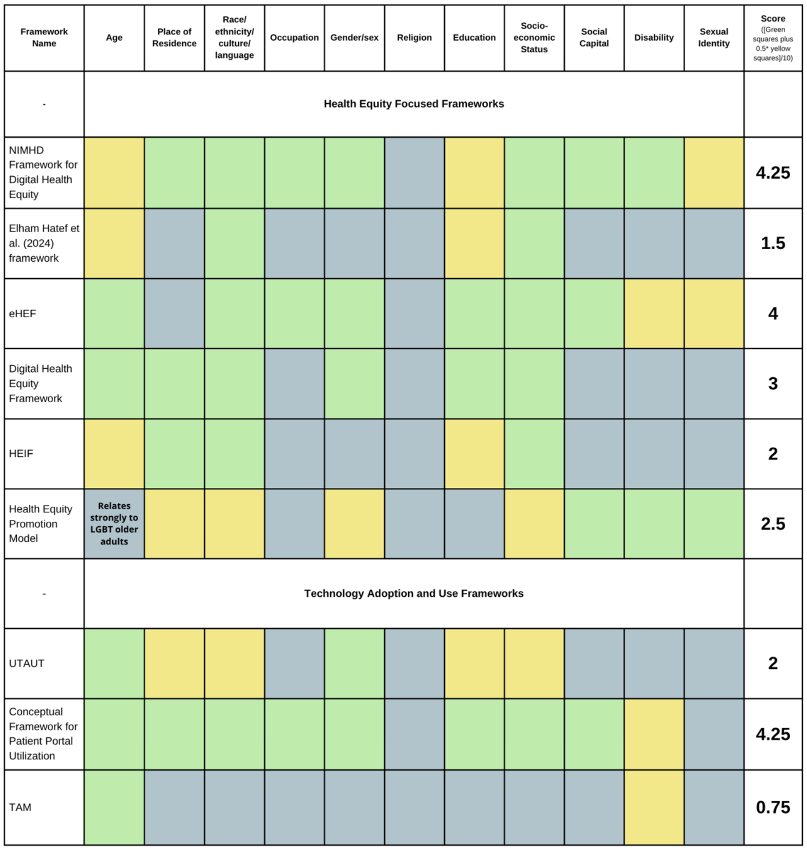
Appendix B1: Rubric for scoring frameworks' relevance to patient portals

Score	Description
1	No mention of patient portals or clear connection to application in patient portal related projects.
2	Framework focused broadly on health implementation or intervention without mention of portals. Some factors relevant to portals may be extracted/adapted.
3	Framework focused on digital health equity or technology use, with no explicit mention of portals, but factors relevant to portals are considered.
4	Framework developed or adapted for use on digital health tools or interventions, and not portals explicitly, but is directly applicable to portals.
5	Framework created with or adapted for the purpose of research on or promoting the use of patient portals.

Appendix B2: Rubric for scoring frameworks' relevance to older adults. Based on factors affecting older adults' patient portal use identified in Chapter 2 (socioeconomic status, digital literacy and health literacy, support, portal simplicity/ease of use, and perceived value).

Score	Description
1	No mention of older adults or factors related to older adults' use of patient portals (from chapter 2).
2	Framework mentions factors related to older adults' use of patient portals without a specific mention of age.
3	Framework addresses factors related to older adults' use of patient portals, but age may not be a focus.
4	Framework considers age as a key factor related to the primary outcome(s) considered in the framework.
5	Framework created with or adapted for the purpose of research on or promoting outcomes (most often tech use or digital health equity) for older adults.

Appendix B3: Crosswalk matrix with relevance of each framework to PROGRESS-Plus (plus age, disability, sexual identity). Findings from this matrix were used to produce scores in the rightmost column.



Framework Name	Age	Place of Residence	Race/ ethnicity/ culture/ language	Occupation	Gender/sex	Religion	Education	Socio-economic Status	Social Capital	Disability	Sexual Identity	Score ([Green squares plus 0.5* yellow squares]/10)
-	**Health Equity Focused Frameworks**											
NIMHD Framework for Digital Health Equity	🟨	🟩	🟩	🟩	🟩	▒	🟨	🟩	🟩	🟩	🟨	**4.25**
Elham Hatef et al. (2024) framework	🟨	▒	🟩	▒	▒	▒	🟨	🟩	▒	▒	▒	**1.5**
eHEF	🟩	▒	🟩	🟩	🟩	▒	🟩	🟩	🟩	🟨	🟨	**4**
Digital Health Equity Framework	🟩	🟩	🟩	▒	🟩	▒	🟩	🟩	▒	▒	▒	**3**
HEIF	🟨	🟩	🟩	▒	▒	▒	🟨	🟩	▒	▒	▒	**2**
Health Equity Promotion Model	▒ **Relates strongly to LGBT older adults**	🟨	🟨	▒	🟨	▒	▒	🟨	🟩	🟩	🟩	**2.5**
-	**Technology Adoption and Use Frameworks**											
UTAUT	🟩	🟨	🟨	▒	🟩	▒	🟨	🟨	▒	▒	▒	**2**
Conceptual Framework for Patient Portal Utilization	🟩	🟩	🟩	🟩	🟩	▒	🟩	🟩	🟩	🟨	▒	**4.25**
TAM	🟩	▒	▒	▒	▒	▒	▒	▒	▒	🟨	▒	**0.75**

Appendix C: Chapter 4

Appendix C1: Notes on Liberatory Design Steps and Application for Patient Portal Developers

Liberatory Design Step	Notes for Patient Portal Developers
Notice & Reflect	This stage is focused on awareness of one's self as well as the systems they are designing within to understand the impacts of privilege, and limitations in the current ways the design process is being undertaken or approached (Anaissie et al., 2021). Teams should revisit this step between each of the later defined steps to reconsider if their process is truly acting to liberate those who are most affected or marginalized. This stage can also occur within the other steps but required conscious consideration of potential biases and weaknesses in the equitability of the design approach. This emphasizes the findings of Chapter 2, which state that the 4 paths for improving patient portal use for older adults must be centred in, measuring, and constantly considering equity at each stage of patient portal development or implementation. The crosswalk matrix from Chapter 3 may potentially be used to evaluate or reconsider how

	different populations are being considered throughout the design process.
Empathize	When starting the design process, liberatory design advocates for “seeing” the system as a first step (Anaissie et al., 2021). The first part of “seeing” the system is to empathize with the community or person(s) that one is designing for (Anaissie et al., 2021). This step should be focused on learning more about the target population, and their equity challenge(s). This step should not focus on statistics, but rather the stories and unique perspectives which can be obtained through interaction with the group (Anaissie et al., 2021). With relation to patient portals and equity, this is a good time to ask who is most affected by them, who cannot stand to benefit or gain from them, who has the power to change this, and how the experiences of an individual or community may mold their approach and view of the issue. This step can also be used to construct a crosswalk matrix, including all of the marginalized groups represented by various PROGRESS-Plus identities in the target population, for use when noticing and reflecting between stages. Understanding and learning from these communities can provided deep insights on

	their needs and reveal problems or pain points not otherwise considered.
Define	Following the empathize stage, liberatory design advocates for designers to define the issue as the next part of “seeing” the grander issue (Anaissie et al., 2021). Defining the issue encompasses the gathering of qualitative and quantitative background data to support hypotheses or guide explorations and developing a point of view through which the equity challenges, and designing will take place (Anaissie et al., 2021). Patient portal developers can use this step to define the user needs which they have observed or determined through empathizing with the target population, and through the secondary and/or primary research which is compiled at the beginning of this step. This step should also work to define the outcome(s) of interest, with clear indication on how this outcome will be measured, and thresholds for success/failure if applicable. At this stage of the development process, designers may also identify the framework(s) they wish to centre their project design around. This can be done using the figures 4-1 and 4-2, described in detail later this chapter.

Inquire	The inquire step is not entirely necessary, but a useful step to go through when definition of the challenge has proven to be difficult or unclear, and a clearer understanding is needed before imagining and prototyping solutions (Anaissie et al., 2021). Inquiry should be approached through open questioning of outstanding information needs required for prototyping, and the exploration of “safe to fail” activities and research actions which might illuminate the problem further (Anaissie et al., 2021). Patient portal developers may take this time to revisit with stakeholders or user advisory groups to understand what is needed to be known for a coherent prototype idea to form. This may be performed through open questioning, brainstorming, or other opportunities such as journey mapping, a technique which explored how users/customers (specified by persona) navigate through an experience (Kalbach, 2016).
Imagine	This step of Liberatory Design is focused on the brainstorming and imagining of potential solutions to equity challenges and the design problem (Anaissie et al., 2021). Although this step follows the empathizing, defining, and inquiry processes, it may be necessary to revisit if quickly iterating a new prototype, or a

	project has gotten stuck (Anaissie et al., 2021). Brainstorming should involve in the broad collection of as many ideas as possible, involving multiple perspectives in a manner that is free of judgement and barriers to participation (Anaissie et al., 2021). With relation to patient portals, this step emphasizes the inclusion of users, particularly those who may have additional needs or worse experiences due to certain SDOH factors and characteristics. This may require providing monetary credit for participation in lieu of missed work for those in precarious economic situations, providing transport or digital participation options for those who have limited mobility, and avenues for people to participate according to their strengths, whether they be verbal, visual, or physical (Anaissie et al., 2021). This step may emphasize creativity and novelty so as to move past status quo solutions (Anaissie et al., 2021).
Prototype	Prototyping involves turning the ideas generated through the design process into action, by developing (at the very least) rough or rudimentary versions of the solution that has been ideated. Prototyping within liberatory design emphasizes empathy, and the purpose of prototyping is actually to deepen this empathy with the target community of the design. Designers

	should ask themselves how they might approach the building of any suggested prototypes, what this prototype can help them to learn, the goals of their design projects, and if there was a truly liberatory and co-designed process that took place (Anaissie et al., 2021). Patient portal designers may seek to develop mock-ups, simple webpages, or even slideshows which demonstrate the flow of a patient portal and understand how it interfaces with target populations and addresses their needs. Because patient portals are digital health tools, this process is likely to be deeply iterative, and may need to occur alongside re-iteration in development if following an agile methodology. Designers could go back to the criteria for success defined in the define stage and examine how their prototype may be evaluated.
Try	When designers have obtained clarity on the direction, design, and intentions of a prototype, it is time to put the prototype to the test, and try it (Anaissie et al., 2021). This stage is focused on gathering authentic feedback on the prototype, and examine how the assumptions, intentions, and perspectives in the process may have affected this process or outcome (Anaissie et al., 2021). Designers should evaluate their prototype based on the criteria set out in the define stage. Designers should focus

	on learning throughout this process, disseminating findings to involved stakeholders clearly and openly (Anaissie et al., 2021). Designers should follow the evaluation of the prototype by engaging the users who provided feedback, particularly those who may have raised concerns about the prototype and/or its suitability for marginalized groups. It is important that the try phase is not harmful to the people/population(s) it is tried upon, as that would be antithetical to the harm reduction values in Liberatory Design. Patient portal developers could focus on drawing information from marginalized user groups and employ tools which explore user experience and technology acceptance amongst these groups.

References

Ali-Hassan, H., Eloulabi, R., & Keethakumar, A. (2020). Internet non-use among Canadian Indigenous older adults: Aboriginal Peoples Survey (APS). *BMC Public Health*, *20*. https://doi.org/10.1186/s12889-020-09659-5

Alturkistani, A., Qavi, A., Anyanwu, P. E., Greenfield, G., Greaves, F., & Costelloe, C. (2020). Patient portal functionalities and patient outcomes among patients with diabetes: Systematic review. *Journal of Medical Internet Research*, *22*(9), e18976. https://doi.org/10.2196/18976

Alvidrez, J., Castille, D., Laude-Sharp, M., Rosario, A., & Tabor, D. (2019). The National Institute on Minority Health and Health Disparities Research Framework. *American Journal of Public Health*, *109*, S16–S20. https://doi.org/10.2105/ajph.2018.304883

Anaissie, T., Cary, V., Clifford, Malarkey T., D., & Wise, S. (2021). *Liberatory Design*. Liberatory Design. https://www.liberatorydesign.com/

Antonio, M. G., Petrovskaya, O., & Lau, F. (2019). Is research on patient portals attuned to health equity? A scoping review. *Journal of the American Medical Informatics Association: JAMIA*, *26*, 871–883. https://doi.org/10.1093/jamia/ocz054

Arcury, T. A., Quandt, S. A., Sandberg, J. C., Miller, D. P., Latulipe, C., Leng, X., Talton, J. W., Melius, K. P., Smith, A., & Bertoni, A. G. (2017). Patient Portal Utilization Among Ethnically Diverse Low Income Older Adults:

Observational Study. *JMIR Medical Informatics*, *5*, e47–e47. https://doi.org/10.2196/medinform.8026

Avdagovska, M., Stafinski, T., Ballermann, M., Menon, D., Olson, K., & Paul, P. (2020). Tracing the Decisions That Shaped the Development of MyChart, an Electronic Patient Portal in Alberta, Canada: Historical Research Study. *Journal of Medical Internet Research*, *22*, e17505–e17505. https://doi.org/10.2196/17505

Barron, J., Bedra, M., Wood, J., & Finkelstein, J. (2014). Exploring Three Perspectives on Feasibility of a Patient Portal for Older Adults. *Studies in Health Technology and Informatics*, *202*, 181–184. https://doi.org/10.3233/978-1-61499-423-7-181

Birken, S. A., Rohweder, C. L., Powell, B. J., Shea, C. M., Scott, J., Leeman, J., Grewe, M. E., Alexis Kirk, M., Damschroder, L., Aldridge, W. A., 2nd, Haines, E. R., Straus, S., & Presseau, J. (2018). T-CaST: an implementation theory comparison and selection tool. *Implementation Science: IS*, *13*(1), 143. https://doi.org/10.1186/s13012-018-0836-4

Black Health Equity Working Group. (2021). *Engagement, Governance, Access, and Protection (EGAP): A Data Governance Framework for Health Data Collected from Black Communities*.

Buh, A., Kang, R., Kiska, R., Fung, S. G., Solmi, M., Scott, M., Salman, M., Lee, K., Milone, B., Wafy, G., Syed, S., Dhaliwal, S., Gibb, M., Akbari, A., Brown, P. A., Hundemer, G. L., & Sood, M. M. (2024). Effect and outcome of equity, diversity and inclusion programs in healthcare institutions: a systematic review protocol. *BMJ Open*, *14*(4), e085007. https://doi.org/10.1136/bmjopen-2024-085007

Burgdorf, J. G., Fabius, C. D., & Wolff, J. L. (2023). Use of provider-sponsored patient portals among older adults and their family caregivers. *Journal of the American Geriatrics Society*, *71*. https://doi.org/10.1111/jgs.18187

Burgdorf, J. G., Fabius, C. D., Wu, M. M. J., Gleason, K. T., & Wolff, J. L. (2024). Patient Portal Use during Home Health Care at an Academic Health System. *Journal of the American Medical Directors Association*, *25*, 729–733. https://doi.org/10.1016/j.jamda.2023.10.015

Cajita, M. I., Nilsen, M. L., Irizarry, T., Callan, J. A., Beach, S. R., Swartwout, E., Mecca, L. P., Schulz, R., & Dabbs, A. D. (2021). Predictors of Patient Portal Use Among Community-Dwelling Older Adults. *Research in Gerontological Nursing*, *14*, 33–42. https://doi.org/10.3928/19404921-20200918-03

Carini, E., Villani, L., Pezzullo, A. M., Gentili, A., Barbara, A., Ricciardi, W., & Boccia, S. (2021). The Impact of Digital Patient Portals on Health Outcomes, System Efficiency, and Patient Attitudes: Updated Systematic Literature Review. *Journal of Medical Internet Research*, *23*, e26189. https://doi.org/10.2196/26189

Chelak, K., & Chakole, S. (2023). The role of social determinants of health in promoting health equality: A narrative review. *Cureus*, *15*(1), e33425. https://doi.org/10.7759/cureus.33425

Chen, C., Ding, S., & Wang, J. (2023). Digital health for aging populations. *Nature Medicine*, *29*(7), 1623–1630. https://doi.org/10.1038/s41591-023-02391-8

Choudhury, A., Elkefi, S., Strachna, O., & Asan, O. (2022). Effect of patient portals on perception of care quality, general health, and mental health: An exploratory analysis. *Human Factors in Healthcare*, *2*, 100018–100018. https://doi.org/10.1016/j.hfh.2022.100018

Coughlin, S. S., Vernon, M., Hatzigeorgiou, C., & George, V. (2020). Health Literacy, Social Determinants of Health, and Disease Prevention and Control. *Journal of Environment and Health Sciences*, *6*, 3061. https://pmc.ncbi.nlm.nih.gov/articles/PMC7889072/

Crawford, A., & Serhal, E. (2020). Digital Health Equity and COVID-19: The Innovation Curve Cannot Reinforce the Social Gradient of Health. *Journal of Medical Internet Research*, *22*, e19361. https://doi.org/10.2196/19361

Cross, D. A., Levin, Z., & Raj, M. (2021). Patient Portal Use, Perceptions of Electronic Health Record Value, and Self-Rated Primary Care Quality Among Older Adults: Cross-sectional Survey. *Journal of Medical Internet Research*, *23*. https://doi.org/10.2196/22549

Curtis, J., Cheng, S., Rose, K., & Tsai, O. (2011). Promoting Adoption, Usability, and Research for Personal Health Records in Canada: The MyChart Experience. *Forum Gestion Des Soins de Sante [Healthcare Management Forum]*, *24*, 149–154. https://doi.org/10.1016/j.hcmf.2011.07.004

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly: Management Information Systems*, *13*(3), 319. https://doi.org/10.2307/249008

Dover, D. C., & Belon, A. P. (2019). The health equity measurement framework: a comprehensive model to measure social inequities in health. *International Journal for Equity in Health*, *18*. https://doi.org/10.1186/s12939-019-0935-0

El-Toukhy, S., Méndez, A., Collins, S., & Pérez-Stable, E. J. (2020). Barriers to Patient Portal Access and Use: Evidence from the Health Information National Trends Survey. *Journal of the American Board of Family Medicine: JABFM*, *33*, 953–968. https://doi.org/10.3122/jabfm.2020.06.190402

Eriksson-Backa, K., Hirvonen, N., Enwald, H., & Huvila, I. (2021). Enablers for and barriers to using My Kanta – A focus group study of older adults’ perceptions of the National Electronic Health Record in Finland. *Informatics for Health & Social Care*, *46*, 399–411. https://doi.org/10.1080/17538157.2021.1902331

Estabrooks, P. A., & Glasgow, R. E. (2023). Developing a dissemination and implementation research agenda for aging and public health: The what, when, how, and why? *Frontiers in Public Health*, *11*, 1123349. https://doi.org/10.3389/fpubh.2023.1123349

Evans, B. A., Beverly, C. J., Tsai, P.-F., Rettiganti, M., Lefler, L. L., & Parks, R. F. (2018). Older Adults’ Live Demonstration of Electronic Personal Health Record Use. *Computers, Informatics, Nursing: CIN*, *36*, 603–609. https://doi.org/10.1097/cin.0000000000000448

Finkelstein, S. M., Speedie, S. M., Zhou, X., Potthoff, S., & Ratner, E. R. (2011). Perception, satisfaction and utilization of the VALUE home telehealth service. *Journal of Telemedicine and Telecare*, *17*, 288–292. https://doi.org/10.1258/jtt.2011.100712

First Nations Information Governance Centre. (2023). *The First Nations Principles of OCAP®*. The First Nations Information Governance Centre. https://fnigc.ca/ocap-training/

Fredriksen-Goldsen, K. I., Simoni, J. M., Kim, H.-J., Lehavot, K., Walters, K. L., Yang, J., Hoy-Ellis, C. P., & Muraco, A. (2024). The health equity promotion model: Reconceptualization of lesbian, gay, bisexual, and transgender (LGBT) health disparities. *American Journal of Orthopsychiatry*, *84*, 653–663. https://doi.org/10.1037/ort0000030

Ganatra, S., Khadke, S., Kumar, A., Khan, S., Javed, Z., Nasir, K., Rajagopalan, S., Wadhera, R. K., Dani, S. S., & Al-Kindi, S. (2024). Standardizing social determinants of health data: a proposal for a comprehensive screening tool to address health equity a systematic review. *Health Affairs Scholar*, *2*(12), qxae151. https://doi.org/10.1093/haschl/qxae151

Gleason, K. T., Wu, J., Wec, A., Powell, D. S., Zhang, T., Gamper, M. J., Green, A. R., Nothelle, S., Amjad, H., & Wolff, J. L. (2023). Use of the patient portal among older adults with diagnosed dementia and their care partners. *Alzheimer's & Dementia: The Journal of the Alzheimer's Association*, *19*, 5663–5671. https://doi.org/10.1002/alz.13354

Gordon, N. P., & Hornbrook, M. C. (2016). Differences in Access to and Preferences for Using Patient Portals and Other eHealth Technologies Based on Race, Ethnicity, and Age: A Database and Survey Study of Seniors in a Large Health Plan. *Journal of Medical Internet Research*, *18*, 1–30. https://doi.org/10.2196/jmir.5105

Government of Canada, & Canada, S. (2022, April 27). *A portrait of Canada's growing population aged 85 and older from the 2021 Census*. https://www12.statcan.gc.ca/census-recensement/2021/as-sa/98-200-x/2021004/98-200-x2021004-eng.cfm

Greer, M. L., Garza, M. Y., Sample, S., & Bhattacharyya, S. (2023). Social determinants of health data quality at different levels of geographic detail. *Studies in Health Technology and Informatics*, *302*, 217–221. https://doi.org/10.3233/SHTI230106

Griffin, A., Skinner, A., Thornhill, J., & Weinberger, M. (2016). Patient Portals: Who uses them? What features do they use? And do they reduce hospital readmissions? *Applied Clinical Informatics*, *7*(2), 489–501. https://doi.org/10.4338/ACI-2016-01-RA-0003

Griffin, J. M., Kroner, B. L., Wong, S. L., Preiss, L., Smith, A. W., Cheville, A. L., Mitchell, S. A., Lancki, N., Hassett, M. J., Schrag, D., Osarogiagbon, R. U., Ridgeway, J. L., Cella, D., Jensen, R. E., Flores, A. M., Austin, J. D., & Yanez, B. (2023). Disparities in electronic health record portal access and use among patients with cancer. *JNCI Journal of the National Cancer Institute*, *116*, 476–484. https://doi.org/10.1093/jnci/djad225

Groom, L. L., Schoenthaler, A. M., Mann, D. M., & Brody, A. A. (2024). Construction of the Digital Health Equity-Focused Implementation Research conceptual model - bridging the divide between equity-focused digital health and implementation research. *PLOS Digital Health*, *3*(5), e0000509. https://doi.org/10.1371/journal.pdig.0000509

Gustafson, P., Abdul Aziz, Y., Lambert, M., Bartholomew, K., Rankin, N., Fusheini, A., Brown, R., Carswell, P., Ratima, M., Priest, P., & Crengle, S. (2023). A scoping review of equity-focused implementation theories, models and frameworks in healthcare and their application in addressing ethnicity-related health inequities. *Implementation Science: IS*, *18*(1), 51. https://doi.org/10.1186/s13012-023-01304-0

Halamka, J. D., Mandl, K. D., & Tang, P. C. (2007). Early Experiences with Personal Health Records. *Journal of the American Medical Informatics Association: JAMIA*, *15*, 1–7. https://doi.org/10.1197/jamia.m2562

Hatef, E., Scholle, S. H., Buckley, B., Weiner, J. P., & Austin, J. M. (2024). Development of an evidence- and consensus-based Digital Healthcare Equity Framework. *JAMIA Open*, *7*. https://doi.org/10.1093/jamiaopen/ooae136

Hollands, G. J., South, E., Shemilt, I., Oliver, S., Thomas, J., & Sowden, A. J. (2024). Methods used to conceptualize dimensions of health equity impacts of public health interventions in systematic reviews. *Journal of Clinical Epidemiology*, *169*(111312), 111312. https://doi.org/10.1016/j.jclinepi.2024.111312

Huang, M., & Ye, Y. (2024). "A Matter of Life and Death": Mitigating the Gray Digital Divide in Using Health Information Technologies in the Post-Pandemic Era. *Health Communication*, 1–11. https://doi.org/10.1080/10410236.2024.2358279

Institute of Medicine (US) Committee on Health Literacy, Nielsen-Bohlman, L., Panzer, A. M., & Kindig, D. A. (2004). What Is Health Literacy? In *Health Literacy: A Prescription to End Confusion*. National Academies Press (US). https://www.ncbi.nlm.nih.gov/books/NBK216035/

Jaul, E., & Barron, J. (2017). Age-Related Diseases and Clinical and Public Health Implications for the 85 Years Old and Over Population. *Frontiers in Public Health*, *5*. https://doi.org/10.3389/fpubh.2017.00335

Johnson, K. B., Ibrahim, S. A., & Rosenbloom, S. T. (2023). Ensuring equitable access to patient portals-closing the "techquity" gap. *JAMA Health Forum*, *4*(11), e233406. https://doi.org/10.1001/jamahealthforum.2023.3406

Kalbach, J. (2016). *Mapping experiences : a guide to creating value through journeys, blueprints and diagrams*. O'reilly Media Inc.

Kelly, C., Dansereau, L., Sebring, J., Aubrecht, K., FitzGerald, M., Lee, Y., Williams, A., & Hamilton-Hinch, B. (2022). Intersectionality, health equity, and EDI: What's the difference for health researchers? *International Journal for Equity in Health*, *21*(1), 182. https://doi.org/10.1186/s12939-022-01795-1

Kim, E.-H., Stolyar, A., Lober, W. B., Herbaugh, A. L., Shinstrom, S. E., Zierler, B. K., Soh, C. B., & Kim, Y. (2009). Challenges to using an electronic personal health record by a low-income elderly population. *Journal of Medical Internet Research*, *11*(4), e44. https://doi.org/10.2196/jmir.1256

Kim, S., & Fadem, S. (2018). Communication matters: Exploring older adults' current use of patient portals. *International Journal of Medical Informatics*, *120*, 126–136. https://doi.org/10.1016/j.ijmedinf.2018.10.004

Koh, H. K., Oppenheimer, S. C., Massin-Short, S. B., Emmons, K. M., Geller, A. C., & Viswanath, K. (2010). Translating Research Evidence Into Practice to Reduce Health Disparities: A Social Determinants Approach. *American Journal of Public Health*, *100*, S72–S80. https://doi.org/10.2105/ajph.2009.167353

Konczi, A. E., & Bill, L. (2024). *Advancing First Nations Principles of OCAP®* (pp. 37–39). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-56806-0_8

Lafata, J. E., Miller, C. A., Shires, D. A., Dyer, K., Ratliff, S. M., & Schreiber, M. (2018). Patients’ adoption of and feature access within electronic patient portals. *The American Journal of Managed Care*, *24*. https://pubmed.ncbi.nlm.nih.gov/30452203/

Logue, M. D., & Effken, J. A. (2012). An exploratory study of the personal health records adoption model in the older adult with chronic illness. *Informatics in Primary Care*, *20*, 151–169. https://doi.org/10.14236/jhi.v20i3.21

Makai, P., Perry, M., Robben, S. H. M., Schers, H., Heinen, M., Olde Rikkert, M. G. M., & Melis, R. J. F. (2014a). Which frail older patients use online health communities and why? A mixed methods process evaluation of use of the Health and Welfare portal. *Journal of Medical Internet Research*, *16*(12), e278. https://doi.org/10.2196/jmir.3609

Makai, P., Perry, M., Robben, S. H. M., Schers, H. J., Heinen, M. M., Olde Rikkert, M. G. M., & Melis, R. F. (2014b). Evaluation of an eHealth intervention in chronic care for frail older people: why adherence is the first target. *Journal of Medical Internet Research*, *16*(6), e156. https://doi.org/10.2196/jmir.3057

Marikyan, D., & Papagiannidis, S. (2025). *Unified theory of acceptance and use of technology: A review* (S. Papagiannidis, Ed.). Newcastle University. https://open.ncl.ac.uk

McCann, L., Johnson, L., Gkiouleka, A., Pearce, H., & Ford, J. (2025). EQUALSS GUIDE Multiple: A novel framework for equity-focused evidence synthesis. *Public Health in Practice (Oxford, England)*, *9*(100600), 100600. https://doi.org/10.1016/j.puhip.2025.100600

McMaster University. (2020). *Defining EDI and Inclusive Excellence*. McMaster Equity and Inclusion Office. https://equity.mcmaster.ca/strategy/towards-inclusive-excellence/edi-definitions/

Nahm, E.-S., Sagherian, K., & Zhu, S. (2016). Use of patient portals in older adults: A comparison of three samples. *Studies in Health Technology and Informatics*, *225*, 354–358. https://www.ncbi.nlm.nih.gov/pubmed/27332221

Nahm, E.-S., Son, H., & Yoon, J. M. (2020). Older adults’ use of patient portals: Experiences, challenges, and suggestions shared through discussion board forums. *Geriatric Nursing (New York, N.Y.)*, *41*(4), 387–393. https://doi.org/10.1016/j.gerinurse.2019.12.001

Nahm, E.-S., Zhu, S., Bellantoni, M., Keldsen, L., Charters, K., Russomanno, V., Rietschel, M., Son, H., & Smith, L. (2020). Patient portal use among older adults: What is really happening nationwide? *Journal of Applied Gerontology: The Official Journal of the Southern Gerontological Society*, *39*(4), 442–450. https://doi.org/10.1177/0733464818776125

Norouzi Aval, R., Rafatpanah, H., Sarbaz, M., Mousavi Baigi, S. F., & Kimiafar, K. (2025). Identification and classification features of patient portal, A systematic review. *Health Science Reports*, *8*(3), e70520. https://doi.org/10.1002/hsr2.70520

O'Neill, J., Tabish, H., Welch, V., Petticrew, M., Pottie, K., Clarke, M., Evans, T., Pardo Pardo, J., Waters, E., White, H., & Tugwell, P. (2014). Applying an equity lens to interventions: using PROGRESS ensures consideration of socially stratifying factors to illuminate inequities in health. *Journal of Clinical Epidemiology*, *67*, 56–64. https://doi.org/10.1016/j.jclinepi.2013.08.005

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ (Clinical Research Ed.)*, *372*, n71. https://doi.org/10.1136/bmj.n71

Perzynski, A. T., Roach, M. J., Shick, S., Callahan, B., Gunzler, D., Cebul, R., Kaelber, D. C., Huml, A., Thornton, J. D., & Einstadter, D. (2017). Patient portals and broadband internet inequality. *Journal of the American Medical Informatics Association: JAMIA*, *24*, 927–932. https://doi.org/10.1093/jamia/ocx020

Ploegmakers, K. J., Linn, A. J., Medlock, S., Seppälä, L. J., Bahat, G., Caballero-Mora, M. A., Ilhan, B., Landi, F., Masud, T., Morrissey, Y., Ryg, J., Topinkova, E., van der Velde, N., van Weert, J. C. M., & European Geriatric Medicine Society (EuGMS) Task and Finish group on Fall-Risk Increasing Drugs (FRIDs). (2024). A European survey of older peoples' preferences, and perceived barriers and facilitators to inform development of a medication-related fall-prevention patient portal. *European Geriatric Medicine*, *15*(3), 817–829. https://doi.org/10.1007/s41999-024-00951-w

Portz, J. D., Bayliss, E. A., Bull, S., Boxer, R. S., Bekelman, D. B., Gleason, K., & Czaja, S. (2019). Using the Technology Acceptance Model to explore user experience, intent to use, and use behavior of a patient portal among older adults with multiple chronic conditions: Descriptive qualitative study. *Journal of Medical Internet Research*, *21*(4), e11604. https://doi.org/10.2196/11604

Portz, J. D., Lum, H. D., Bull, S., Boxer, R. S., Bekelman, D. B., Ford, K. L., Gleason, K., Casillas, A., & Bayliss, E. A. (2020). Perceptions of patient portal use for advance directive documentation among older adults with multiple chronic conditions. *Journal of Social Work in End-of-Life &*

Palliative Care, *16*(3), 238–249. https://doi.org/10.1080/15524256.2020.1771806

Portz, J. D., Powers, J. D., Casillas, A., Baldwin, M., Bekelman, D. B., Palen, T. E., Bull, S., Kutner, J. S., & Bayliss, E. (2021). Characteristics of Patients and Proxy Caregivers Using Patient Portals in the Setting of Serious Illness and End of Life. *Journal of Palliative Medicine*, *24*, 1697–1704. https://doi.org/10.1089/jpm.2020.0667

Public Health Agency of Canada, & Pan-Canadian Public Health Network. (2018). *Key health inequalities in Canada : a national portrait*. Public Health Agency of Canada = Agence de santé publique du Canada.

Ramirez-Zohfeld, V., Seltzer, A., Xiong, L., Morse, L., & Lindquist, L. A. (2020). Use of electronic health records by older adults, 85 years and older, and their caregivers. *Journal of the American Geriatrics Society*, *68*(5), 1078–1082. https://doi.org/10.1111/jgs.16393

Richardson, S., Lawrence, K., Schoenthaler, A. M., & Mann, D. (2022). A framework for digital health equity. *Npj Digital Medicine*, *5*. https://doi.org/10.1038/s41746-022-00663-0

Robben, S. H. M., Perry, M., Huisjes, M., van Nieuwenhuijzen, L., Schers, H. J., van Weel, C., Rikkert, M. G. M. O., van Achterberg, T., Heinen, M. M., & Melis, R. J. F. (2012). Implementation of an innovative web-based conference table for community-dwelling frail older people, their informal caregivers and professionals: a process evaluation. *BMC Health Services Research*, *12*(1), 251. https://doi.org/10.1186/1472-6963-12-251

Ronquillo, Y., Meyers, A., & Korvek, S. J. (2023). Digital health. In *StatPearls*. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/pubmed/29262125

Sakaguchi-Tang, D. K., Bosold, A. L., Choi, Y. K., & Turner, A. M. (2017). Patient portal use and experience among older adults: Systematic review. *JMIR Medical Informatics*, *5*(4), e38. https://doi.org/10.2196/medinform.8092

Sarkar, U., Karter, A. J., Liu, J. Y., Adler, N. E., Nguyen, R., Lopez, A., & Schillinger, D. (2010). The literacy divide: health literacy and the use of an internet-based patient portal in an integrated health system-results from the diabetes study of northern California (DISTANCE). *Journal of Health Communication*, *15 Suppl 2*, 183–196. https://doi.org/10.1080/10810730.2010.499988

Siek, K. A., Ross, S. E., Khan, D. U., Haverhals, L. M., Cali, S. R., & Meyers, J. (2010). Colorado Care Tablet: the design of an interoperable Personal Health Application to help older adults with multimorbidity manage their medications. *Journal of Biomedical Informatics*, *43*(5 Suppl), S22–S26. https://doi.org/10.1016/j.jbi.2010.05.007

Son, H., & Nahm, E.-S. (2019). Older adults' experience using patient portals in communities: Challenges and opportunities. *Computers, Informatics, Nursing: CIN*, *37*(1), 4–10. https://doi.org/10.1097/CIN.0000000000000476

Son, H., Nahm, E.-S., Zhu, S., Galik, E., Van de Castle, B., Seidl, K. L., & Russomanno, V. (2022). Older adults' perception on and use of patient portals. *Computers, Informatics, Nursing: CIN*, *40*(1), 61–68. https://doi.org/10.1097/cin.0000000000000802

Steele Gray, C., Chau, E., Tahsin, F., Harvey, S., Loganathan, M., McKinstry, B., Mercer, S. W., Nie, J. X., Palen, T. E., Ramsay, T., Thavorn, K., Upshur, R., & Wodchis, W. P. (2021). Assessing the implementation and effectiveness of the electronic patient-Reported Outcome tool for older adults with complex care needs: Mixed methods study. *Journal of Medical Internet Research*, *23*(12), e29071. https://doi.org/10.2196/29071

Taha, J., Czaja, S. J., Sharit, J., & Morrow, D. G. (2013). Factors affecting usage of a personal health record (PHR) to manage health. *Psychology and Aging*, *28*, 1124–1139. https://doi.org/10.1037/a0033911

Taha, J., Sharit, J., & Czaja, S. J. (2014). The impact of numeracy ability and technology skills on older adults' performance of health management tasks using a patient portal. *Journal of Applied Gerontology: The Official Journal of the Southern Gerontological Society*, *33*(4), 416–436. https://doi.org/10.1177/0733464812447283

The Cochrane Collaboration. (2025). *PROGRESS-Plus | Cochrane Equity*. Cochrane.org. https://methods.cochrane.org/equity/projects/evidence-equity/progress-plus

Togioka, B. M., & Young, E. (2025). Diversity and discrimination in health care. In *StatPearls*. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK568721/

Turner, A. M., Osterhage, K., Hartzler, A., Joe, J., Lin, L., Kanagat, N., & Demiris, G. (2015). Use of patient portals for personal health information management: The older adult perspective. *AMIA Annual Symposium Proceedings*, *2015*, 1234–1241. https://www.ncbi.nlm.nih.gov/pubmed/26958263

University of Colorado Denver. (2025). *Dissemination Implementation – An interactive webtool to help you use D&I models*. https://dissemination-implementation.org/

Venkatesh, Morris, Davis, & Davis. (2003). User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly*, *27*, 425. https://doi.org/10.2307/30036540

Vroman, K. G., Arthanat, S., & Lysack, C. (2014). “Who over 65 is online?” Older adults’ dispositions toward information communication technology. *Computers in Human Behavior*, *43*, 156–166. https://doi.org/10.1016/j.chb.2014.10.018

Wade-Vuturo, A. E., Mayberry, L. S., & Osborn, C. Y. (2013). Secure messaging and diabetes management: experiences and perspectives of patient portal users. *Journal of the American Medical Informatics Association: JAMIA*, *20*(3), 519–525. https://doi.org/10.1136/amiajnl-2012-001253

Walter, C., Adams, M., & MacDonald, A. L. (2021). The CEP Crosswalk: A community energy planning tool for interdepartmental alignment and stakeholder engagement. *Canadian Planning and Policy / Aménagement et Politique Au Canada*, *2021*(2), 55–68. https://doi.org/10.24908/cpp-apc.v2021i2.13930

Wildenbos, G. A., Horenberg, F., Jaspers, M., Peute, L., & Sent, D. (2018). How do patients value and prioritize patient portal functionalities and usage factors? A conjoint analysis study with chronically ill patients. *BMC Medical Informatics and Decision Making*, *18*(1), 108. https://doi.org/10.1186/s12911-018-0708-5

Willard, S., Cremers, G., Man, Y. P., van Rossum, E., Spreeuwenberg, M., & de Witte, L. (2018). Development and testing of an online community care platform for frail older adults in the Netherlands: a user-centred design. *BMC Geriatrics*, *18*(1). https://doi.org/10.1186/s12877-018-0774-7

Woodward, E. N., Singh, R. S., Ndebele-Ngwenya, P., Castillo, A. M., Dickson, K. S., & Kirchner, J. E. (2021). A more practical guide to incorporating health equity domains in implementation determinant frameworks. *Implementation Science Communications*, *2*. https://doi.org/10.1186/s43058-021-00146-5

Yoon, E., Hur, S., Opsasnick, L., Huang, W., Batio, S., Curtis, L. M., Benavente, J. Y., Lewis-Thames, M. W., Liebovitz, D. M., Wolf, M. S., & Serper, M. (2024). Disparities in Patient Portal Use Among Adults With Chronic

Conditions. *JAMA Network Open*, *7*, e240680–e240680. https://doi.org/10.1001/jamanetworkopen.2024.0680

Zoorob, D., & Hasbini, Y. (2023). Older patient receptivity to the integration of patient portals and telehealth in urogynecology: Promoters and deterrents. *Urogynecology (Hagerstown, Md.)*, *29*(12), 923–929. https://doi.org/10.1097/SPV.0000000000001359