

Review

Recommendations for the Design and Delivery of Transitions-Focused Digital Health Interventions: Rapid Review

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Abstract

Background: Older adults experience a high risk of adverse events during hospital-to-home transitions. Implementation barriers have prevented widespread clinical uptake of the various digital health technologies that aim to support hospital-to-home transitions.

Objective: To guide the development of a digital health intervention to support transitions from hospital to home (the Digital Bridge intervention), the specific objectives of this review were to describe the various roles and functions of health care providers supporting hospital-to-home transitions for older adults, allowing future technologies to be more targeted to support their work; describe the types of digital health interventions used to facilitate the transition from hospital to home for older adults and elucidate how these interventions support the roles and functions of providers; describe the lessons learned from the design and implementation of these interventions; and identify opportunities to improve the fit between technology and provider functions within the Digital Bridge intervention and other transition-focused digital health interventions.

Methods: This 2-phase rapid review involved a selective review of providers' roles and their functions during hospital-to-home transitions (phase 1) and a structured literature review on digital health interventions used to support older adults' hospital-to-home transitions (phase 2). During the analysis, the technology functions identified in phase 2 were linked to the provider roles and functions identified in phase 1.

Results: In phase 1, various provider roles were identified that facilitated hospital-to-home transitions, including navigation-specific roles and the roles of nurses and physicians. The key transition functions performed by providers were related to the 3 categories of continuity of care (ie, informational, management, and relational continuity). Phase 2, included articles (n=142) that reported digital health interventions targeting various medical conditions or groups. Most digital health interventions supported management continuity (eg, follow-up, assessment, and monitoring of patients' status after hospital discharge), whereas informational and relational continuity were the least supported. The lessons learned from the interventions were categorized into technology- and research-related challenges and opportunities and informed several recommendations to guide the design of transition-focused digital health interventions.

Conclusions: This review highlights the need for Digital Bridge and other digital health interventions to align the design and delivery of digital health interventions with provider functions, design and test interventions with older adults, and examine multilevel outcomes.

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KEYWORDS

transitions; health; medical informatics; aged; mobile phone

Introduction

Background

Hospital-to-home transitions can be a challenging time for older adults [1-10] owing to the high risk of adverse events, including medical errors, hospital readmission, and death [4,7,11,12]. It has been noted that almost half of the adverse events experienced during these transitions could be prevented or minimized [4,7,11,12]. Furthermore, pressures facing health care systems have resulted in decreased lengths of hospital stay, leading to patients being discharged *quicker and sicker* and an increased risk of hospital readmissions and poor health outcomes [13-16]. The costly and negative impacts of poor transitions have made transitions a high priority for the health care system and prompted significant efforts to improve hospital-to-home transitions [17].

Multidisciplinary teamwork is one of the critical aspects of high-quality continuity of care [18]. Facilitating successful hospital-to-home transitions involves team effort because multiple tasks must be completed by various health care providers across inpatient and community settings [16]. Information-sharing and communication issues combined with a lack of role clarity can cause poor continuity of care and service fragmentation during transitions [16,19-22].

Improving hospital-to-home transitions entails improving communication and coordination among multiple providers and across multiple health care settings [23,24]. Rennke and Ranji [17] have suggested that successful hospital-initiated transitional care programs include a “bridging” strategy with pre- and postdischarge interventions. Although numerous transitional care models and strategies have been proposed [17,25-31], they require considerable resources, such as a dedicated transition provider, because of the additional work required [16,17,32,33]. However, this may not be a feasible or affordable solution for health care organizations because organizations tend to seek solutions that are “high-value, low-cost” [17].

The use of digital health technologies is an approach used to facilitate safe hospital-to-home transitions because they can augment provider roles and functions during transitions while

attempting to minimize costs [34-36]. Many digital health technologies have been proposed to mitigate transition issues experienced by older adults and their caregivers and facilitate efficiency and coordination in the discharge process. For example, digital health interventions can be used to monitor older adults' symptoms [37], provide educational material and discharge instructions [38,39], and facilitate timely information sharing among providers across settings [40]. However, digital health technologies, in general, have not been well integrated into clinical practice settings because of persistent barriers, including poor fit with providers' roles and functions because digital health interventions add additional functions to the existing workloads of providers [41,42]. An improved understanding of which providers are involved in care transitions and how the technologies can support their existing provider functions may address some of these implementation barriers [43,44].

Objectives

Despite the vast landscape of digital health technologies, there have been limited syntheses of digital health interventions used to support hospital-to-home transitions and the lessons learned from their implementation. This information is critical to avoid duplication of problematic factors that can limit the uptake of digital health technologies within the development and implementation of new transition-focused digital health interventions. To guide the development of an information communication technology to support transitions from hospital to home (the Digital Bridge intervention [45]), the specific objectives of this review were as follows:

- Understand the various roles and functions of health care providers supporting hospital-to-home transitions for older adults, allowing future technologies to be more targeted to support their work.
- Describe the types of digital health interventions used to facilitate the transition from hospital to home for older adults and elucidate how these interventions support the roles and functions of providers.
- Describe the lessons learned from the design and implementation of these interventions.

- Identify opportunities to improve the fit between technology and provider functions within the Digital Bridge intervention and other transition-focused digital health interventions.

Methods

A rapid review methodology [46] was suitable for this review because we intended to generate a timely overview of the existing landscape of digital health technologies. This rapid review was based on our previously published protocol [43].

Phase 1: A Selective Literature Review to Understand Roles and Functions of Health Care Providers Supporting Hospital-to-Home Transitions

A selective review [47,48] was undertaken using MEDLINE (Ovid) and Google Scholar on September 19, 2020, to provide greater insights and clarity regarding health care providers' roles and their essential functions [44] in supporting hospital-to-home transitions. These 2 databases were selected for the following reasons: (1) they are multidisciplinary, (2) MEDLINE (Ovid) is a widely used database to identify peer-reviewed health-related literature [49], and (3) Google Scholar is a "powerful addition to other traditional search methods" to help identify known studies [50]. A selective literature review limited the search to "key studies that significantly contribute to our understanding" [47,48]. The search terms included concepts related to *navigation*, *hospital-to-home transition*, and *older adults* [43]. Any study design published in English that identified a role and function related to a hospital-to-home transition was included. The following data were extracted from relevant articles:

1. What provider role (ie, job title) is identified?
2. What is the provider's function (ie, responsibilities related to supporting a hospital-to-home transition)?

Key roles were identified, and their functions were thematically analyzed on NVivo 11 (QSR International) using inductive thematic analysis [51]. Subsequently, the coded functions were organized according to the 3 categories of continuity of care: informational, management, and relational [52]. These categories were used because they could create a shared understanding and language for continuity of care across disciplinary and organizational boundaries [52].

Phase 2: Identifying Digital Health Technologies Supporting Transitions

Literature Search

In phase 2, MEDLINE (Ovid), CINAHL (EBSCO), and Embase (Ovid) were searched on November 26, 2020, to identify literature on digital health interventions supporting the transition from hospital to home for older adults (Multimedia Appendix 1). These databases were selected because they (1) could identify health-related literature and (2) were determined by our research team (including a medical librarian HVC) to be appropriate for the scope of our search [43]. The review adhered to the PRISMA-S (Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Literature Search) checklist [53]. The reference lists of some included articles (n=20) were

hand searched, and content experts (n=6) were consulted to identify additional studies.

Study Selection

The search results were uploaded to the Covidence website. On the basis of the inclusion and exclusion criteria (Multimedia Appendix 2 [54,55]), each article's title and abstract were screened by a single reviewer from the screening team (HS, TT, KK, RT, DP, MH, CMJ, AA, or JXN), followed by a full-text review conducted independently by 2 reviewers from the screening team. Any conflicts were resolved through team discussions. Studies were included if they tested a digital health intervention that supported a hospital-to-home transition for older adults and were published in or after 2010. For this review, an intervention that *supported a hospital-to-home transition* had to have recruited participants before their hospital discharge and continued in the home or community setting. The studies had to include ≥ 1 older adult but did not need to focus on older adults exclusively. No limits were imposed on study design to ensure that we included relevant studies, but articles had to report findings from empirical studies. Given that we intended to inform recommendations for the Digital Bridge intervention [45], a high-technology intervention for use in a "high-income country," strictly telephone-based interventions, and interventions tested in a "low-income country" were excluded [54].

Data Extraction

The following data were extracted from the articles using a customized form informed by the Template for Intervention Description and Replication framework [56]: author details; country and year of publication; sampling strategy; inclusion and exclusion criteria; the medium of technology, function of technology, and who provided the intervention; study findings; and limitations and future directions. Data regarding intervention effectiveness were not extracted, reported, or synthesized in this review because this was outside its purpose, scope, and intent [57].

Data Analysis

We descriptively reported study characteristics and qualitatively analyzed data using a thematic analysis [51]. We first analyzed each study's discussion using data-driven codes to identify *lessons learned*. We then coded data deductively by grouping the technology functions according to the 3 categories of continuity of care described by Haggerty et al [52]. The technology functions and providers involved in intervention delivery were compared with the provider roles and functions identified in phase 1.

Results

Phase 1

The literature review revealed several provider roles that commonly support hospital-to-home transitions (Textbox 1). In addition to the professional roles of allied health clinicians, pharmacists, nurses, and physicians, several navigation-specific roles were noted. Key provider functions during transitions are presented in Textbox 2. Of note, roles and functions supporting

transitions differed by type of institution and many roles performed overlapping functions.

Textbox 1. Provider roles identified as engaged in facilitating hospital-to-home transitions.

Navigation-specific roles: providers with known navigation-related role titles [58]

- Advanced practice navigator, care manager (could be a nurse, social worker or clerical staff [59]), care or program coordinator, care transition nurse, case manager, discharge coordinator, discharge liaison nurse or liaison nurse, discharge planner or facilitator or discharge planning nurse (typically a social worker or nurse [60]), case manager, discharge coordinator, geriatric care manager, guided care nurse, intensive geriatric service worker, nurse navigator, post-acute care coordinator (typically allied health or nurse [61]), patient navigator, surgical coordinated transitional care program nurse, transition coach

Allied health

- Occupational therapist, physiotherapist, social worker

Pharmacist

- Hospital or community pharmacist

Nursing

- Trained nurse (trained in device use), research nurse, cancer nurse specialist, telemedicine nurse, rehabilitation nurse, nurse tutor, nurse practitioner, registered nurse, chronic obstructive pulmonary disease nurse, clinical nurse specialist, community nurse, telemedicine nurse

Physician

- Community physician (eg, primary care physician, ambulatory physician, or community physician), hospital physician (eg, hospitalist, resident, or most responsible physician), specialist

Textbox 2. Key functions performed by providers during the hospital-to-home transitions.

Informational continuity: “The use of information on past events and personal circumstances to make current care appropriate for each individual” [52]

- Communicate or liaise: communication or liaising with patients, caregivers, and other providers
 - Ensure the flow of information across multidisciplinary teams in the same or different sectors [62,63]. Advise and share relevant information about the patient with other providers (eg, primary care provider) [64-67]. Coordinate with other providers to ensure that services, resources, and equipment are set up for the patient. Make connections with community-based services and resources [68,69]. Communicate with patients and caregivers promptly [63]. Inform patients and caregivers and family when and how they will be contacted and whom to follow-up with if they do not receive follow-up [60,68,70,71]
- Educate: providing education to patients and caregivers
 - Educate patients about condition, disease management, symptoms, adverse events or red flags, symptom management, dietary recommendations, medication instructions, general condition or health, explain care protocols [25,68,72-81], reinforce education (eg, teach-back strategies) [82], and provide verbal or written instructions and demonstrations [63,83]
- Knowledge: providers having relevant knowledge
 - Have solid knowledge about disease and treatment, community services, where patients can seek support, and the best practices [79]. Be familiar with available community services and their eligibility
- Support or resource: providing relevant information to patients and caregivers
 - Provide informational or social support and personalized hospital-to-home support [83,84]
- Counsel (fell within 2 different categories): providing advice and recommendations to motivate behavior change
 - Provide medication, rehabilitation, dietary, or emotional counseling to patients and caregivers to motivate behavior change [79-81,85]
- Document: documenting relevant information accurately
 - Document all actions and entire plan to ensure timely information exchange between providers and ownership of the accuracy and completeness of the information [65,86]

Management continuity: “A consistent and coherent approach to the management of a health condition that is responsive to a patient’s changing needs” [52]

- Confirm and verify: confirming and verifying that appropriate processes and procedures were carried out to ensure continuity of care
 - Confirm that discharge summaries have complete information about a patient [87] and are sent to the team [75]. Ensure that follow-up appointments and services have been scheduled [65,75,78,88]. Confirm that patients and caregivers and families understand discharge instructions and that logistics are in place in preparation for discharge [75]. Verify that the appropriate practitioners are involved [75]
- Plan: creating a personalized care plan for patients
 - Create or contribute to a patient’s care plan based on knowledge of the patient’s individual needs and goals [89]
- Refer: referring patients and caregivers to appropriate services and resources
 - Refer patients to appropriate community services and resources to maintain continuity of care after discharge (eg, transportation) [62,72,90-93]
- Assist in navigation: helping patients and caregivers to navigate the health system
 - Assist patients in navigating through complex health systems and discharge pathways [62,72,90-93]
- Advocate: advocating patients’ access to appropriate resources and services
 - Advocate for access and entry to appropriate health and social services across settings and providers to ensure that patients’ needs are met, and break down health system and communication barriers [58,63,94]
- Follow-up: following up with patients and caregivers after discharge
 - Postdischarge follow-up and outreach with patients to identify unmet needs [95]
- Arrange or set up: facilitating access to different providers, services, and resources
 - Coordinate with different providers and services to arrange and organize timely access to postdischarge appointments and services, including primary care, medication delivery, medical devices, and transportation. Assist patients and caregivers and families in meeting their health care needs (eg, assistance completing forms) [25,58,61,62,90,91,96-98]

- Assess patients' needs: assessing patients' various needs to support safe transitions
 - Have a comprehensive knowledge of the patients' care needs (eg, "patient's medical, functional, cognitive, affective, psychosocial, nutritional, and environmental status" [76,99]) and goals to inform care and discharge plan through assessment findings [58,63,100]. Assess patients' needs for home care and community support and resources, and identify and address potential medication adherence issues to prevent readmission [63,67,76,78,83,95,101,102]
- Direct care provision: clinical intervention
 - Provide in-person and hands-on clinical care (eg, medical, nursing, or rehabilitation intervention) [58]
- Manage: manage health and social care and needs during transitions
 - Be a manager of the patient's care and discharge pathways [72,89]
- Monitoring: activities conducted to monitor patients' status after discharge
 - Monitor patients for medical, health, physical, or functional status declines or the inability to self-manage their condition [86,87]. Monitor the results of medical tests and treatment adherence [89]. Conduct ongoing evaluations of the discharge plan and patient and caregiver and family needs (eg, through home visits) and create a new action plan or refer to other providers if necessary [63,89]
- Improve: improving care based on organizational quality improvement initiatives
 - Participate in quality improvement plans [59]
- Prepare: preparing providers, patients, and caregivers for patients' discharge
 - Prepare personalized discharge plans with the patient, caregiver and family, and providers and complete discharge preparation, including determining discharge location [62,89-91]. Prepare discharge hand-over sheets [75]. Prepare a community care plan [96]

Relational continuity: "An ongoing therapeutic relationship between a patient and one or more providers" [52]

- Collaborate: work with patients, caregivers, and other providers to manage care
 - Collaborate with patients, caregivers and family, and other providers (eg, hospital physician-primary care physician) to create care plans [60,103]
- Empower: facilitate patient and caregivers' involvement in the case
 - Facilitate active participation of patients and caregivers and family in care and integrate them as full partners in decisions about treatment [60,85,89,104]
- Counsel (2 categories): providing counseling to patients and caregivers in an understandable way
 - Provide individual medication counseling and ensure that patients can comprehend medication instructions and potential side effects of medication [80]. Provide emotional or dietary counseling and counseling regarding the patients' rehabilitation needs to motivate behavior change [69,79,85]
- Coaching: providing coaching and guidance to patients and caregivers
 - Provide clinical advice, troubleshoot problems, and provide coaching about self-management skills [72,85,104-106]. Answer questions regarding concerns or issues from patients or caregivers and family [107]. Inform patients about what to expect during the transition and provide tips on communication with providers [82]
- Rapport: building relationships with patients and caregivers
 - Develop rapport and trusting relationships with patients and caregivers or family [25,98,108-110]

Phase 2

Overview

The phase 2 database search identified 29,359 articles. Additional articles (n=10) were identified from hand-searching reference lists of the included articles. After removing duplicates, 81.88% (24,048/29,369) remained for the title and abstract screening and 4.02% (967/24,048) met the criteria for full-text review. Of these 967 articles, 142 (14.7%) met the

study inclusion criteria (see [Figure 1](#) [111] for the PRISMA [Preferred Reporting Items for Systematic Reviews and Meta-Analyses] flow diagram). [Table 1](#) provides details of the study characteristics.

The studies were conducted in multiple countries, most of them in the United States ([Table 1](#)). They were published between 2010 and 2020, with a growing rate of publications over the years ([Figure 2](#)).

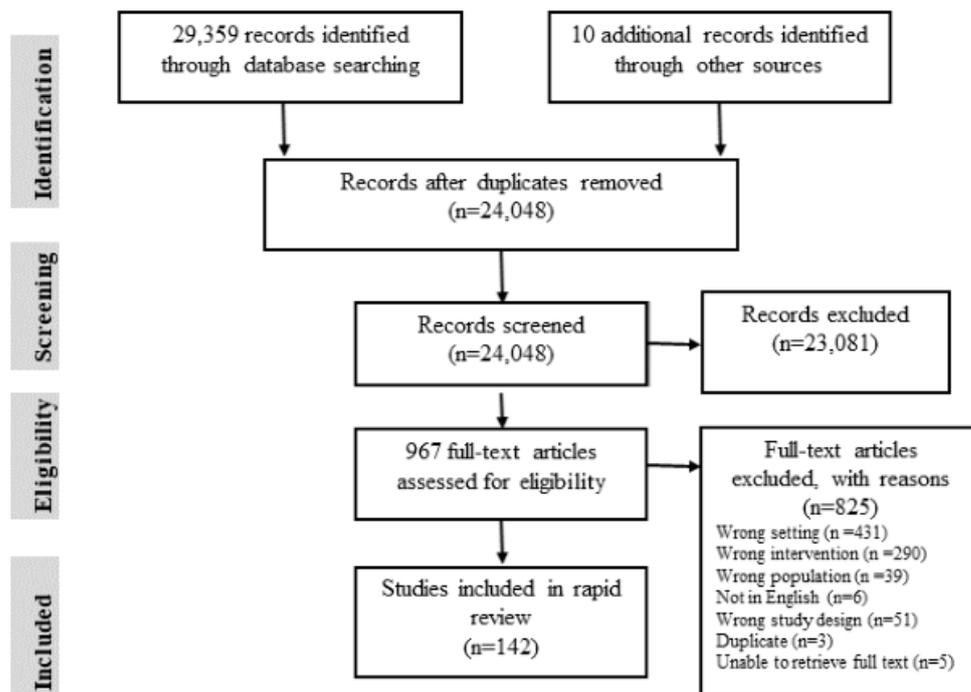
Figure 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram. Adapted from Moher et al [111].

Table 1. Study characteristics.

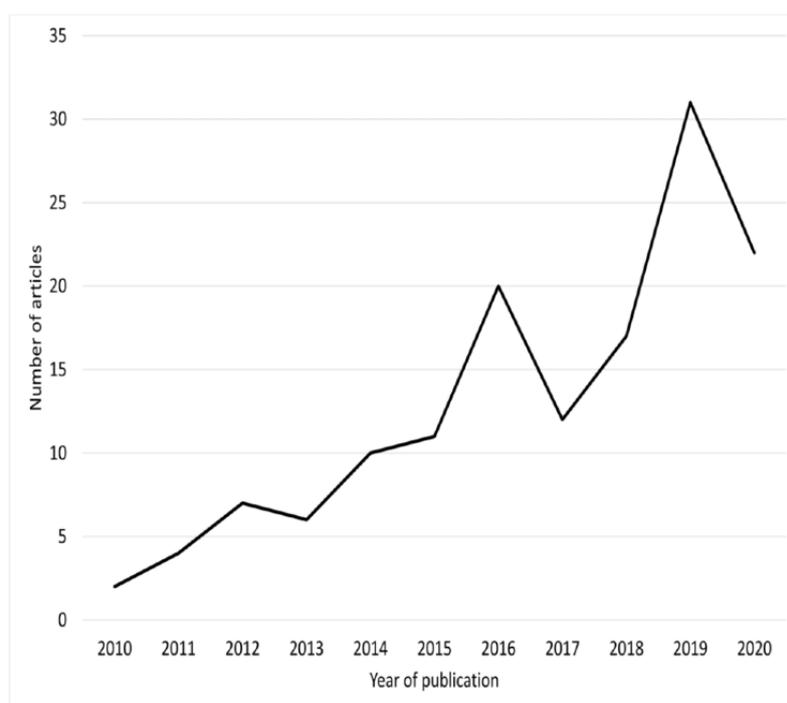
Study	Country	Medical condition and intervention details
Amir et al, 2017 [112]	Israel	Cardiac (heart failure)
Ammenwerth et al, 2015 [113]	Austria	Cardiac (coronary heart disease)
Amroze et al, 2019 [114]	United States	Non-condition-specific criteria
Andikyan et al, 2012 [115]	United States	Cancer (gynecologic cancer)
Arcilla et al, 2019 [116]	United States	Multiple chronic conditions (eg, congestive heart failure, chronic obstructive pulmonary disease, and diabetes mellitus)
Austin et al, 2012 [34]	United States	Cardiac (congestive heart failure)
Avery et al, 2019 [117]	United Kingdom	Cancer (major abdominal surgery, including surgery for esophageal, gastric, or hepatopancreato-biliary cancer)
Aziz et al, 2011 [118]	United Kingdom	Surgery (abdominal surgery)
Backman et al, 2020 [119]	Canada	Orthopedic (after hip fracture)
Barken et al, 2018 [120]	Norway	Respiratory (chronic obstructive pulmonary disease)
Barnason et al, 2019 [121]	United States	Cardiac (coronary artery bypass surgery or percutaneous coronary intervention)
Bednarski et al, 2019 [122]	United States	Cancer (colorectal cancer surgery)
Belarmino et al, 2019 [123]	United States	Cancer (radical prostatectomy)
Bernocchi et al, 2016 [124]	Italy	Neurological (stroke)
Bernocchi et al, 2012 [125]	Italy	Multiple conditions (chronic obstructive pulmonary disease, cardiac, dermatologic, diabetes, pulmonological, traumatic brain injury, and stroke)
Boeni et al, 2015 [126]	Switzerland	Diabetes
Book et al, 2013 [127]	Germany	Cancer (prostate, bladder, kidney, breast, or other types of cancer)
Bouwsma et al, 2018 [128]	Netherlands	Surgery (gynecological surgery)
Bouwsma et al, 2018 [35]	Netherlands	Surgery (gynecological surgery)
Campbell et al, 2019 [129]	United States	Orthopedic (total knee or hip arthroplasty)
Carrier et al, 2016 [130]	France	Cancer (colorectal surgery)
Chang et al, 2020 [131]	China	Cancer (esophagectomy)
Chen et al, 2010 [132]	Australia	Patients admitted to the aged care hospital ward
Chen et al, 2019 [133]	China	Cardiac (chronic heart failure)
Chiang et al, 2012 [134]	China	Cardiac (chronic heart failure)
Cox et al, 2018 [135]	United States	Medical and surgical intensive care unit patients (receipt of mechanical ventilation for >48 consecutive hours and successful extubation before discharge)
Cox et al, 2019 [136]	United States	Cardiac (cardiorespiratory failure)
Davis et al, 2015 [137]	United States	Multiple conditions (acute chronic disease)
Day et al, 2018 [138]	United States	Orthopedic (total joint arthroplasty)
Dendale et al, 2012 [139]	United States	Cardiac (severe heart failure)
DeVito Dabbs et al, 2016 [140]	United States	Surgery (lung transplantation)
DeVon et al, 2010 [141]	United States	Cardiac (coronary heart disease)
Dexter et al, 2013 [142]	United States	Orthopedic (total hip replacement)
Dorothy et al, 2016 [143]	United States	Cardiac (cardiovascular surgery)
Duncan et al, 2018 [144]	United States	Neurological (stroke and transient ischemic attack)
Dunn et al, 2015 [145]	United States	Patients on medical or surgical units on warfarin
El-Kareh et al, 2012 [44]	United States	Patients with positive and untreated or undertreated blood, urine, sputum, or cerebral spinal fluid cultures
Evangelista et al, 2015 [146]	United States	Cardiac (chronic heart failure)
Finn et al, 2011 [13]	United States	Patients on medical service

Study	Country	Medical condition and intervention details
Fitzsimmons et al, 2016 [147]	United Kingdom	Respiratory (chronic obstructive pulmonary disease)
Frail et al, 2016 [148]	United States	Patients taking ≥ 1 long-term medication
Gesell et al, 2019 [149]	United States	Neurological (stroke)
Gunter et al, 2018 [150]	United States	Surgery (vascular surgery)
Gurwitz et al, 2014 [40]	United States	Patients being discharged from an inpatient unit
Gustavell et al, 2019 [151]	Sweden	Cancer (pancreaticoduodenectomy)
Gustavell et al, 2019 [152]	Sweden	Cancer (pancreaticoduodenectomy)
Haynes et al, 2020 [153]	United States	Cardiac (decompensated heart failure)
Heaton et al, 2019 [154]	United States	Multiple conditions (acute myocardial infarction, pneumonia, congestive heart failure, chronic obstructive pulmonary disease, or diabetes)
Heiney et al, 2020 [155]	United States	Cardiac (heart failure)
Hewner et al, 2014 [156]	United States	Multiple conditions
Ho et al, 2016 [157]	China	Respiratory (chronic obstructive pulmonary disease)
Holleck et al, 2017 [158]	United States	Patients admitted to medical service
Holt et al, 2011 [159]	United States	Surgery (plastic surgery)
Hu et al, 2014 [160]	China	Cardiac (percutaneous coronary intervention)
Jayaram et al, 2017 [161]	United States	Cardiac (heart failure)
Jeungok et al, 2017 [162]	United States	Orthopedic
Jonker et al, 2020 [163]	Netherlands	Cancer (elective oncologic resection of a solid tumor)
Kamoen et al, 2020 [164]	Belgium	Neurological (ischemic stroke)
Kang et al, 2019 [165]	China	Neurological (stroke)
Karapinar-Çarkit et al, 2014 [166]	Netherlands	Patients discharged from the cardiology and respiratory wards
Katz et al, 2016 [167]	United States	Cancer (pancreatectomy)
Keeping-Burke et al, 2013 [168]	Canada	Cardiac (coronary artery bypass graft surgery)
Khan et al, 2018 [169]	Denmark	Cardiac (on- or off-pump coronary artery bypass graft or heart valve surgery)
Klement et al, 2019 [170]	United States	Orthopedic (total joint arthroplasty)
Kogut et al, 2014 [171]	United States	Chronic medical conditions
Lacson et al, 2018 [172]	United States	Respiratory (pulmonary nodules)
Lafaro et al, 2020 [37]	United States	Cancer (colorectal, gastric, pancreatic, and liver cancer surgery)
Lavu et al, 2019 [36]	United States	Surgery (pancreaticoduodenectomy)
Layton et al, 2014 [173]	United States	Cardiac (coronary artery disease or congestive heart failure)
Lehnbom et al, 2014 [174]	Australia	Patients discharged from a hospital unit
Lin et al, 2020 [175]	China	Cardiac (coronary artery disease)
Lindhardt et al, 2017 [176]	Denmark	Patients admitted to internal medicine units and at nutritional risk
Lowres et al, 2016 [177]	Australia	Cardiac (cardiac surgery)
Luo et al, 2019 [178]	China	Orthopedic (total hip arthroplasty)
Lyu et al, 2016 [179]	China	Cancer (head and neck tumor)
Madigan et al, 2013 [180]	United States	Cardiac (heart failure)
Markle-Reid et al, 2020 [181]	Canada	Neurological (stroke and multimorbidity)
Martirosov et al, 2020 [182]	United States	Patients admitted to hospital
Mathar et al, 2015 [183]	Denmark	Respiratory (chronic obstructive pulmonary disease)
McCloskey et al, 2015 [184]	Canada	Patients discharged from geriatric rehabilitation

Study	Country	Medical condition and intervention details
McGillion et al, 2020 [185]	Canada and United Kingdom	Cardiac and major vascular surgery
Melholt et al, 2018 [186]	Denmark	Cardiac (ischemic heart disease or heart failure, including patients who had undergone coronary artery bypass or valve surgery)
Meng-Yao et al, 2020 [187]	China	Neurological (stroke)
Metcalf et al, 2019 [188]	United States	Cancer (radical cystectomy)
Moffet et al, 2015 [189]	Canada	Orthopedic (total knee arthroplasty)
Moro Agud et al, 2016 [190]	Spain	Patients admitted to a hospital unit
Mousa et al, 2019 [191]	United States	Surgery (arterial revascularization with groin incision)
Moy et al, 2014 [192]	United States	Patients admitted to medical service
Nazar et al, 2016 [193]	United Kingdom	Patients on ≥ 4 medicines or had changes in medicines during the hospital stay
Newnham et al, 2015 [194]	Australia	Patients discharged from the acute general medical ward
Nielsen et al, 2020 [195]	Denmark	Surgery (kidney transplantation)
Nilsson et al, 2020 [196]	Sweden	Cancer (prostate cancer surgery)
Nundy et al, 2013 [197]	United States	Cardiac (heart failure)
Ong et al, 2016 [198]	United States	Cardiac (heart failure)
Ostrovsky et al, 2016 [199]	United States	Non-condition-specific criteria (medical fee-for-service patients)
Park et al, 2017 [200]	South Korea	Orthopedic (total knee replacement)
Pastora-Bernal et al, 2018 [201]	Spain	Orthopedic (arthroscopic subacromial decompression)
Pavic et al, 2020 [202]	Switzerland	Cancer (palliative cancer care)
Pavic et al, 2020 [203]	Switzerland	Cancer (palliative cancer care)
Pedone et al, 2015 [204]	Italy	Cardiac (heart failure)
Piau et al, 2019 [205]	United States	Cancer
Piette et al, 2020 [206]	United States	Patients admitted with an illness that is associated with increased rehospitalization risk
Ponce et al, 2016 [207]	United States	Surgery (neurosurgical or orthopedic)
Prince et al, 2019 [208]	United States	Cancer (hematologic malignancies)
Ramkumar et al, 2019 [209]	United States	Orthopedic (total knee arthroplasty)
Reed et al, 2020 [210]	United States	Diabetes
Reider-Demer et al, 2018 [211]	United States	Neurological (elective neurosurgery)
Requena et al, 2019 [212]	Spain	Neurological (stroke)
Ritchie et al, 2016 [213]	United States	Multiple conditions (heart failure and chronic obstructive pulmonary disease)
Sabir et al, 2019 [214]	United Kingdom	Non-condition-specific criteria
Saleh et al, 2014 [215]	Norway	Respiratory (chronic obstructive pulmonary disease)
Santana et al, 2017 [216]	Canada	Patients admitted to medical teaching units with multiple comorbidities and complicated medication profiles
Scheper et al, 2019 [217]	Netherlands	Orthopedic (joint arthroplasty)
Schneider et al, 2017 [218]	United States	Neurological (stroke)
Sinha et al, 2019 [219]	United States	Patients admitted to general medicine service
Smith et al, 2016 [220]	United States	Patients admitted to general medicine, geriatrics, or cardiology inpatient services; medically complex (≥ 2 comorbid conditions)
Sorknaes et al, 2011 [221]	Denmark	Respiratory (chronic obstructive pulmonary disease)
Sorknaes et al, 2013 [222]	Denmark	Respiratory (chronic obstructive pulmonary disease)
Sui et al, 2020 [223]	China	Cancer (surgical resection for non-small cell lung cancer)
Sun et al, 2017 [224]	United States	Cancer (major abdominal cancer surgery)

Study	Country	Medical condition and intervention details
Sun et al, 2017 [225]	United States	Cancer (lung cancer surgery)
Tamblyn et al, 2019 [226]	Canada	Patients admitted to medical and surgical hospital units
Tamblyn et al, 2018 [227]	Canada	Patients admitted to medical and surgical hospital units
Timmers et al, 2019 [228]	Netherlands	Orthopedic (total knee replacement)
Treskes et al, 2020 [229]	Netherlands	Cardiac (myocardial infarction)
van den Berg et al, 2016 [230]	Australia	Neurological (stroke)
Van der Meij et al, 2018 [231]	Netherlands	Surgery (intermediate-grade abdominal surgery)
Vest et al, 2015 [232]	United States	Non-condition-specific criteria
Vesterby et al, 2017 [233]	Denmark	Orthopedic (fast-track hip replacement)
Vianello et al, 2016 [234]	Italy	Respiratory (chronic obstructive pulmonary disease)
Villani et al, 2014 [235]	Italy	Cardiac (heart failure)
Wade et al, 2012 [236]	Australia	Frail older adults with multiple chronic conditions
Wang et al, 2017 [237]	China	Respiratory (chronic obstructive pulmonary disease)
Wang et al, 2018 [238]	China	Cancer (colorectal cancer or other digestive and urinary tumors and permanent stoma after surgery)
Wang et al, 2018 [239]	China	Orthopedic (hip replacement surgery)
Wan et al, 2018 [240]	China	Neurological (hypertensive ischemic stroke)
Whitehouse et al, 2020 [241]	United States	Diabetes
Wilcock et al, 2019 [242]	United Kingdom	Patients admitted to a hospital
Wolf et al, 2016 [38]	Sweden	Cardiac (acute coronary syndrome)
Zheng et al, 2019 [243]	China	Orthopedic (total joint arthroplasty)
Zhou et al, 2019 [244]	China	Cancer (breast cancer surgery)
Zhou et al, 2020 [245]	China	Cancer (breast cancer surgery)

Figure 2. Year of article publication.



Participants Targeted

Medical Conditions and Interventions Targeted

Digital health interventions were most frequently used to facilitate transitions for cardiac conditions (eg, cardiac surgery and chronic heart failure; 28/142, 19.7%) and cancer (eg, cancer surgery and cancer management; 26/142, 18.3%). Fewer digital health interventions targeted patients admitted to specific hospital units (eg, geriatric, medical, or intensive care unit; 19/142, 13.4%) and patients with multiple conditions (12/142, 8.5%), orthopedic conditions (16/142, 11.3%), neurological conditions (eg, stroke and brain tumor; 12/142, 8.5%), other surgical interventions (eg, after kidney transplantation; 11/142, 7.7%), and respiratory conditions (eg, chronic obstructive pulmonary disease management; 10/142, 7%). In addition, a small number of digital health interventions supported transitions for patients who had diabetes (3/142, 2.1%) or non-condition-specific criteria (eg, age group and medical health plan; 5/142, 3.5%).

Age Groups Targeted

In total, 15.5% (22/142) of the included interventions were conducted with samples of strictly older adults. Other interventions did not specify a targeted age range within their inclusion criteria (54/142, 38%) or had included participants aged 18 to 21 years or older (49/142, 34.5%).

Details of Digital Health Technologies

Intervention Type

Of the 142 interventions, 47 (33%) were classified into multiple categories of intervention types (N=193 intervention classifications). Of the 6 intervention-type characterizations, smartphone, tablet, or web-based interventions (91/193, 47.2%) were the most common than telemonitoring and wearables,

clinical documentation system (45/193, 23.2%), clinical documentation systems (29/193, 15%), automated telephone calls or automated SMS text messaging (14/193, 7.3%), email interventions (10/193, 5.2%) or other interventions (eg, television video; 4/193, 2.1%).

Provider Roles and Functions Involved in the Intervention

As shown in [Table 2](#), a total of 35.9% (51/142) of the interventions used multiple provider roles (n=202 provider roles identified) in the implementation of the digital health intervention, with nurses (64/202, 31.7%) and physicians (61/202, 30.2%) being the most common providers of digital health interventions. Discharge-specific personnel such as a transition coach, nurse care transition coordinator, discharge facilitator, advanced practice nurse, and systems navigator were less common (18/202, 8.9%).

Some interventions had designated a study-specific health care provider to carry out the digital health intervention activities, whereas others added the responsibility onto a provider's existing workload. The responsibilities of providers also differed based on the type and purpose of technology and whether communication between patients and providers was initiated by patient or provider. Among some interventions with patient-initiated communication, providers had to always be available for consultation during the intervention period.

The digital health interventions were most commonly used up to 7 days after discharge (29/142, 20.4%) or between 31 and 90 days after discharge (39/142, 27.5%). It was less common for the interventions to continue for 91 days to <6 months after discharge (18/142, 12.7%) or beyond 6 months after discharge (7/142, 4.9%).

Table 2. Provider roles and examples of involvement in technology intervention used to facilitate hospital-to-home transitions (N=202).

Provider role; providers, n (%)	Specific examples	Examples of provider role–technology interactions
Physician; 61 (30.2)	Community physician (eg, primary care physician, ambulatory physician, and community physician), hospital physician (eg, hospitalist, resident, and most responsible physician), and specialist (eg, cardiologist, surgeon, occupational physician, geriatrician, and pulmonologist)	Family physicians were alerted when patient data (eg, biometric or symptoms) fell outside predefined parameters and asked to visit or contact the patient [139]
Nurse; 64 (31.7)	Specially trained nurse (trained in device use), research nurse, cancer nurse specialist, telemedicine nurse, rehabilitation nurse, nurse tutor, nurse practitioner, registered nurse, chronic obstructive pulmonary disease nurse, clinical nurse specialist, and community nurse	They reviewed all transmitted biometric and symptom data, flagged patients whose data fell outside the predefined parameters, and communicated with or assessed patients using communication technology [153,168]
Clinician; 19 (9.4)	Discipline not specified	Clinicians were alerted when patient responses were outside predefined parameters, and they reviewed flagged responses [161]
Allied health; 19 (9.4)	Occupational therapist, physiotherapist, social worker, and psychologist	Conducted telehealth consultations or sessions [37,183]
Pharmacist; 18 (8.9)	Hospital or community pharmacist	Access information from other providers in the same facility or across facilities, settings or receive information from them and send information to them [214]
Navigation-specific roles; 18 (8.9)	Advanced practice nurse or provider, care manager, care or program coordinator, care transition nurse, case manager, discharge planner or facilitator or discharge planning nurse, nurse navigator, post-acute care coordinator, system navigator, and transition coach	Provided 24-hour consultation, which was accessible to patients through technology [175]
Other; 3 (1.5)	Physician's assistant, unit supervisor, surgical team's physician's assistant	Used to communicate with other providers and send and receive information [208]

Technology Functions

In terms of the technology functions that supported hospital-to-home transitions, most (116/142, 81.7%) of the technologies fell into multiple categories (ie, 57/142, 40.1%, fell into 2 categories and 59/142, 41.5%, fell into 3 categories).

Of the 317 total technology functions within the included interventions, 142 (44.8%) were related to *management continuity*, including following up, assessing, and monitoring patients' status after hospital discharge, as well as facilitating referrals. Some technologies could identify values outside a predefined range during follow-up, assessment, and monitoring of patients' status. However, others required human resources to review all data to identify abnormal values. In both cases, if values fell outside the range, a human resource (eg, provider or study personnel) had to follow-up and provide appropriate guidance and immediate treatment or the technology instructed a patient to initiate contact with a provider. *Informational continuity* was supported among 32.2% (102/317) of the identified technology functions, including facilitating communication (eg, between inpatient and outpatient providers or between patient and provider) and educating patients and caregivers. *Relational continuity* (eg, counseling and rapport building) was least supported by the technologies (73/317, 23%).

Outcomes of Interest

Of the total outcomes of interest (n=315) examined in the articles, more than half of the outcomes evaluated the effect of

the intervention on patient-level factors (eg, disease knowledge, quality of life, and changes in physical or psychological functioning) and technology-user interactions (eg, use of technology, patient satisfaction with technology, and the perceived value of technology) at 28.6% (90/315) and 28.3% (89/315), respectively. Of all outcomes, 17.5% (55/315) related to health care use, examined through health care–related costs and hospital readmission rates or emergency department visits at various time points (eg, 30, 60, 90, and 180 days after discharge). The intervention effect on provider-related outcomes (eg, changes in provider workflows, provider burden, and clinical documentation accuracy), implementation-related outcomes (eg, compliance; 9/315, 2.9%), and caregiver- and family-related outcomes (eg, caregiver stress; 3/315, 1%) were less commonly examined (23/315, 7.3%). *Other* outcomes (eg, documentation time, economic evaluations; 46/315, 14.6%) were measured.

Lessons Learned From Digital Health Interventions

The lessons learned from the interventions pertained to challenges (eg, researcher-identified limitations or challenges of interventions) and opportunities (eg, researcher-identified strengths of interventions and recommendations); these were categorized into two broad categories: (1) technology-related and (2) research process–related (Table 3).

Table 3. Summary of the lessons learned from implementation of digital health interventions.

Challenge and description	Examples
Technology-related challenges	
Usability issues	
Participants' physical, functional, and sensory function	<ul style="list-style-type: none"> • Low vision • Hand tremor
Patients' and providers' lack of technical skills and experience	<ul style="list-style-type: none"> • Forgetting log-in information or not remembering to charge the device • Accidentally disabling device features • Low technology comfort
Device-related technical issues	<ul style="list-style-type: none"> • Internet connectivity issues • Software updates affecting function • Immaturity of the prototype
Fit and compatibility issues	<ul style="list-style-type: none"> • Poor fit with patients' or providers' routine • Device incompatible with older devices • Not integrated into organization's electronic documentation system • Identifying provider functions rather than their roles may enable the technology to accommodate differences among jurisdictions and changing scopes of practice
Technology content and function	
Patient-facing content	<ul style="list-style-type: none"> • Hypertext links were distracting and confusing • Language too technical • Offensive tone and complexity of the wording • Symptom-reporting questions too specific or broad caused misunderstanding
Expectations of patient-initiated provider contact	<ul style="list-style-type: none"> • Not all participants were confident about the appropriate circumstances in which to contact the provider
Device notifications	<ul style="list-style-type: none"> • Excessive alerts caused "alert fatigue" and resulted in less attention being paid to the alert or ignoring it altogether
Technology-related opportunities	
Technology function and features	
Enhancing functionality	<ul style="list-style-type: none"> • Address and improve multiple components of the transition process
Accessibility, adaptations, and customization	<ul style="list-style-type: none"> • Low-vision adaptations • Adapt for participants with low technological literacy and no social support • Self-directed apps • Use of personal devices when possible and compatibility across multiple data and operating systems • Provision of the device when participants do not have access to a personal device
Training	<ul style="list-style-type: none"> • Technical setup • Training on technology use • Engage caregivers in the intervention when possible
Fit with workflows, workloads, and buy-in	<ul style="list-style-type: none"> • Participants, family, caregivers, and providers should inform the technology design and how technology could be integrated into the day-to-day practices of all stakeholders • Accounting for providers' ethical, legal, and professional responsibilities
Research process-related challenges	
Data collection	
Recruitment and retention challenges	<ul style="list-style-type: none"> • Lack of interest • High attrition
Small sample size	<ul style="list-style-type: none"> • Unable to explore the relationship between participants' profiles, participants' adherence and compliance to intervention or conduct subgroup analyses
Sampling bias	<ul style="list-style-type: none"> • Homogenous samples • Inclusion limited to those with technology comfort or access

Challenge and description	Examples
Missing data	<ul style="list-style-type: none"> • Impacting reliability of intervention results
Outcome measures	<ul style="list-style-type: none"> • Outcome measures such as rehospitalization and survival may not be sufficiently sensitive to determine intervention impact • Single-blinded evaluator could introduce measurement error
Interventions across settings or institutions	<ul style="list-style-type: none"> • Cross-setting coordination challenges
Research process–related opportunities	
Data collection	
Recruitment considerations	<ul style="list-style-type: none"> • Video of 10-to-15–minute duration describing the intervention (potential benefits and utility) during recruitment to reduce apprehension • Consideration of low compliance rates within sample size calculations • Comparing the characteristics of participants with those of individuals who declined can indicate selection bias and affect the intervention’s generalizability and acceptability
Outcomes	<ul style="list-style-type: none"> • Careful consideration of outcome measures (eg, objective or subjective) and end points
Missing data	<ul style="list-style-type: none"> • Begin intervention during hospitalization • Schedule follow-ups during routine patient visits to minimize data lost during follow-up

Technology-Related Challenges and Opportunities

Technology-related challenges and opportunities pertained to the use of the devices.

Technology-Related Challenges

Among digital health interventions, researchers reported usability issues with the technology because of patients’ physical condition [177], patients’ or providers’ lack of technical skills and experience [159,176,177,202], and the technology not fitting into patients’ or providers’ routine and workflow [119,173]. Regarding fit with workflows, researchers emphasized that health care providers operate within regulated environments; ethical, legal, and professional considerations related to providers’ roles and care settings had to be accounted for in the design of digital health technology interventions [148,159,227]. Technical issues such as internet connectivity issues, software updates, or immaturity of the prototype [148,152,177] also decreased usability and interfered with the technology’s function (eg, restricted data transfer and alert failure) [152,202]. In addition, some researchers encountered compatibility issues with older devices and other organizations’ electronic documentation systems, which created usability issues [44,145,148,150,192,210,212].

In terms of the technical content, researchers found that some participants perceived the patient-facing content as problematic because of the technical language, tone, or complexity [152,162], as well as hypertext links that caused confusion [39,152]. Patient-initiated technology functions also presented a challenge because not all participants could use the functions or follow the instructions as intended [196]. Researchers also found it challenging to set alerts that would be appropriate for all patients because excessive alerts caused “alert fatigue” and resulted in less attention being paid to the alert or ignoring it altogether [40,44,152,157].

Technology-Related Opportunities

A few researchers emphasized that designing digital health interventions to address and improve multiple components of the transition process may enhance functionality [119,145]. In addition, they indicated that technology accessibility, adaptations, or customization could accommodate individual preferences and increase applicability to different populations [39,140,205,227]. Researchers indicated that increasing accessibility could start with providing the technology to participants without a personal device to reduce disparities of access based on technology ownership [150]. Researchers suggested using participants’ devices to enhance usability when possible, which may require compatibility across multiple data and operating systems [122,167,212]. In addition, technical setup and training on using the technology and engaging caregivers in the intervention could support the usability and intervention quality, safety, and adherence [112,135,157]. Moreover, building self-directed functions might help overcome logistical barriers associated with scheduled interventions [136]. This finding extends to timely feedback because researchers found that participants wanted to be notified when providers had reviewed their responses [150].

To address the technology’s fit with workflows, workloads, and buy-in, some researchers believed that participants, family, caregivers, and providers should be engaged in helping to design the intervention [136,148,228]. Researchers found that interventions that placed high accountability and responsibility on health care providers and added additional work to their workload resulted in provider-related usability issues because providers “struggled to find time in their day” to carry out intervention activities [40,150,195]. Researchers noted that identifying functions rather than provider roles may enable the technology to accommodate differences among jurisdictions (eg, country and institution) and changing scopes of practice over time [227]. Alternatively, if human resources are limited, interventions using automated telephone calls or central

monitoring centers for multiple institutions could be considered to reduce the number of personnel and time required for monitoring [188]. Thus, understanding how technology could be integrated into the day-to-day practices of all stakeholders was an essential task for technology developers, along with helping providers envision ways to implement the technology in practice [119,181].

Research Process–Related Challenges and Opportunities

Challenges and opportunities within the reported research processes pertained to the recruitment process, data collection, and study and intervention designs.

Research Process–Related Challenges

Recruitment challenges and high attrition were commonly reported within the studies [135,246]. As several interventions had a small sample size, researchers acknowledged limitations, including being unable to explore the relationship between participants' profiles and adherence and compliance information or conduct subgroup analyses [112,135,157,205]. Researchers reported that sampling bias could have had an impact on the generalizability of their results because the samples were small [115,141,165] and homogenous (ie, primarily White) [150] and could have been exacerbated because inclusion was limited to participants with internet-enabled devices [201]. Missing data was another concern reported by researchers that may have affected the reliability of the intervention results [158].

Beyond data collection, researchers reported that interventions conducted at a single site may have reduced generalizability to other settings [160,181,218,226,241]. The study by DeVito Dabbs et al [140] indicated that outcome measures such as rehospitalization and survival may not be sufficiently sensitive to identify the impact of a technology intervention.

Researchers found that effectively integrating the technology in clinical environments would likely require early engagement with patients and providers, support from senior leadership, integration within existing electronic systems [119,144,148,166], and testing of technologies in real-world settings to identify implementation barriers [140]. Finally, researchers of a digital health technology intervention that operated across settings or institutions reported challenges with coordination among

providers in hospital, primary care, and community settings [148].

Research Process–Related Opportunities

Several researchers recommended more extensive and diverse participant samples in future digital health interventions [150,171,173,247] and consideration of low compliance rates within sample size calculations [173]. They believed that providing participants with an explanation of the potential benefits and utility of the technology may also enhance study participation [173]. In addition, comparing the characteristics of participants with those of individuals who declined participation gave researchers insight into selection bias and the intervention's generalizability and acceptability [151,169,231,237].

Regarding outcomes of interest, researchers advised carefully considering which outcome measures (eg, objective or subjective) [173,224] and end points to use [186,193]; multicenter studies with longer follow-up time (ie, >30 days after discharge) might be required to observe the intervention's effect on patient-clinician relationships [160,181]. Opportunities identified by researchers to improve data include analyzing technology log data for objective data on patients' and providers' use of technology [186,193], beginning the intervention within the hospital setting, and incorporating the follow-ups into routine patient visits to potentially minimize data lost during follow-up [141,148].

Discussion

Recommendations

This rapid review provides an overview of digital health interventions supporting hospital-to-home transitions and describes how the technologies have been used to support the roles and functions of health care providers in supporting these transitions. Consistent with the aim of a rapid review approach, we have compiled a set of recommendations (Table 4) to guide the design of new and existing digital health interventions such as Digital Bridge that support hospital-to-home transitions based upon the reviewed literature. Our review extends and complements the existing literature [41,42,248] by highlighting transition-specific considerations within the design and implementation of future digital health interventions that better support provider roles and functions during transitions.

Table 4. Recommendations to guide the design and implementation of digital health interventions to facilitate hospital-to-home transitions.

Recommendation	Description
Recommendation 1: align the design and delivery of digital health interventions to provider functions	<ul style="list-style-type: none"> • As roles and functions can differ based on several factors (eg, the organizations, jurisdiction, and care settings), technology functions should consider the roles and functions relevant to their target setting; alternatively, to increase generalizability, technology may need to support specific provider functions (ie, provider responsibilities) rather than outlining specific roles (ie, provider titles) • Address multiple functions within transitional care, including functions supporting informational, management, and relational continuity of care • Integration of technology with multiple organizations and across care settings • Added provider functions with technology use should be minimal (eg, automated and self-directed functions could be integrated into interventions to reduce provider functions) • Share functions related to technology use with patients and caregivers when possible • Begin before or immediately after hospital admission and extend care into the community
Recommendation 2: design for, and test with, older adults	<ul style="list-style-type: none"> • To ensure that technology functions effectively meet the transitional care needs of older adults, digital health interventions should be designed for, and tested with, older adults • Consider strategies to recruit and retain older adults with poor health • Consider how technology functions may affect inequities • Include caregivers, when possible, in digital health interventions because they play valuable roles in hospital-to-home transitions
Recommendation 3: examine multilevel outcomes	<ul style="list-style-type: none"> • Examine reasons for declining and dropping out of interventions • Examine multilevel outcomes • Provider-level outcomes may give insight into whether technology functions are perceived to support provider functions effectively • Evaluate specific technology functions

Recommendation 1: Align the Design and Delivery of Digital Health Interventions With Provider Functions

This review demonstrates that many existing technologies that support hospital-to-home transitions encounter implementation-related barriers. The health care system is complex, and the discharge process is often “busy, rushed and emotional” [249]. During hospital-to-home transitions, patients move from one setting to another and provider functions and responsibilities become unclear because communication often fails to cross boundaries [250]. Thus, a critical lesson from this review is that digital health interventions should emphasize the provider functions that the technology supports rather than focusing on how professional groups can use solutions because roles and functions can differ by organization and care setting.

We have highlighted that many providers involved in transitions tend to have overlapping functions. We have outlined specific provider functions that could be built into the design of digital health interventions to support transitional care workflows and potentially reduce provider burden. These functions may address the factors presently limiting uptake of digital health interventions, including poor fit with providers’ functions and provider perceptions of low degree of usefulness [41,42,248]. To meaningfully support hospital-to-home transitions, digital health interventions may need to address multiple functions involved in patient care beyond primarily supporting functions related to management continuity (eg, monitoring) and informational continuity. On the basis of the findings from this review, technology functions related to relational continuity warrant further exploration. These are the components that are appropriate for technology to address and support and the ones that rely on the interface between people and technology.

Moreover, technologies should be designed to minimize the burden on providers and be designed in such a way that they can support provider functions. Although technologies demonstrate their ability to support specific provider functions such as remote monitoring and patient education, they add functions and place high levels of accountability on single providers. For instance, remote monitoring technologies could yield large quantities of data that providers then become responsible for sorting through and acting on, adding another function to their workload [120,153]. Integration of such technologies in clinical practice could be unfeasible because the added provider functions are among the prominent barriers to the uptake of technologies [41].

Perceived usefulness may be improved by highlighting how the purpose and function of the technology fit with the functions of providers during hospital-to-home transitions and whether it could result in time savings and the workload reduction of providers and by outlining the responsibilities of providers in the delivery of digital health interventions [140]. Furthermore, as technologies integrate more advanced and automated functions, the burden on providers may be reduced. For instance, automated reminders may reduce demands on providers [34]. However, advanced technologies may not be suitable for all patients and these individuals may require training to recognize red flags and when to re-engage with providers [152]. Sharing responsibility with, and facilitating more active involvement of, patients and caregivers (when appropriate) or adding trained volunteers may be another way to reduce the added responsibility faced by health care providers [251].

Recommendation 2: Design for, and Test Digital Health Interventions Specifically With, Older Adults

Older adults have unique transitional care needs that the providers strive to meet through their functions. Provider

functions to achieve relational and informational continuity of care have been deemed necessary to achieve high-quality hospital-to-home transitions for older adults [22,252]. However, we identified these functions to be a gap in the existing digital health interventions supporting hospital-to-home transitions because these functions were least supported by technology. We believe that these should be integrated within technology functions of future digital health interventions.

Of note, this review revealed that digital health interventions were rarely designed to meet the unique needs of older adults or exclusively tested with older adults. Thus, we contend that future technology functions should be designed to meet these specific transitional care needs while also accounting for design considerations related to older adults' complex needs, including physical, cognitive, and sensory needs [253-255]. Moreover, new strategies may be needed to recruit and retain older adults with poor health status. Using human-centered design principles, including co-designing and testing with clinicians and older adults with complex care needs, may enhance the use and effectiveness of interventions [41,248] and could reveal how better to integrate relational management into the technology functions. Furthermore, critical investigations of how the functions of existing digital health interventions may have contributed to the exacerbation of inequities are necessary to highlight new insights and guidance for functions of future interventions to eliminate such disparities [255,256].

Recommendation 3: Examine Multilevel Outcomes

We recommend that those leading digital health interventions examine outcomes of interest at multiple levels, including the patient, provider, organization, and system levels. Most transitional interventions examined the impact of digital health interventions on patient-level outcomes. However, not all studies had examined why participants declined or dropped out of digital health interventions, which would have provided valuable insights for future work. Provider-, organization-, and system-level outcomes were less common but are essential to consider. Although patient-level outcomes are helpful, costs and benefits need to be assessed for health care organizations and health systems, including economic feasibility and quality measures [257]. In particular, exploring patient-level outcomes can provide insight into whether the technology functions effectively support the provider functions.

Moreover, evaluating specific technology functions may provide insights into which ones may need to be refined. Researchers may also further explore the feasibility and benefits of transition-specific roles to support digitally enabled transitions because these studies were limited. In addition, reporting research-level outcomes, including insights and reflections from the research teams, may contribute valuable knowledge that could guide future interventions.

Limitations

Several factors limit this review. First, the rapid review methodology (eg, single-reviewer title and abstract screening and limited number of databases searched) may have led to missing relevant articles. Title and abstract screening were initiated after a minimum interrater reliability among screeners

of $\kappa=0.80$ (ie, sufficient interrater reliability) was achieved to reduce the risk of missing relevant articles [258]. Second, there is a lack of standardized terminology and definitions for hospital-to-home transitions, provider roles and functions, transitional interventions, and digital health technologies. Thus, our inclusion criteria were difficult to apply and we had to create additional parameters to judge whether the studies related to these areas. For example, to be considered a *hospital-to-home transition intervention*, the intervention had to begin (ie, recruitment) at the hospital and extend to the community. It is also possible that some articles that failed to provide a detailed methodology could have been mistakenly excluded. However, this review was not intended to map the relevant literature entirely but rather to provide an overview of the landscape. Third, although we planned to conduct a quality appraisal using the Mixed Methods Appraisal Tool [259,260], we decided against a formal quality appraisal for two reasons: (1) the studies did not report sufficient details of their intervention design and methods for the team to appraise their quality confidently and accurately (eg, *Is randomization appropriately performed?* and *Are outcome assessors blinded to the intervention provided?*) and (2) this review intended to focus on critical lessons learned from the processes involved in designing, delivering, and evaluating the interventions rather than the interventions' effectiveness (eg, outcomes); thus, an appraisal was not critical to meet these objectives. We recommend that future digital health interventions report comprehensive details of their methods to enable future reviews to critically appraise them. Fourth, the inclusion criteria were modified to capture the most relevant literature and data during the review process. However, this led to deviations from the protocol (eg, excluding telephone-based interventions). Fifth, the purpose of phase 1 was to characterize typical roles and critical functions involved in transitions to create a general understanding of the context rather than to create an exhaustive list of all roles. However, we acknowledge that several roles, including the roles and functions of specialized health professionals, may not have been reflected in the results. In addition, roles and functions may also differ by factors such as the institution, country or region, and clinical setting. Thus, technology designers should consult with their intended users to ensure that the technology aligns with their roles and functions. Sixth, each article was reported as a single intervention because we could not link articles that reported a single intervention's outcomes within multiple articles. Finally, the findings are not limited to older adults because we included any study that included at least one older adult. Nonetheless, this review provides valuable information to guide the design and implementation of existing and new digital health interventions such as the Digital Bridge.

Conclusions

In conclusion, this review provides an overview of the landscape of digital health interventions that support hospital-to-home transitions and identifies recommendations for future studies based on the lessons learned. The findings from this review will serve as a valuable guide for the design and implementation of Digital Bridge and other digital health interventions to support hospital-to-home transitions.

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Conflicts of Interest

None declared.

Multimedia Appendix 1

Search strategies.

[\[DOCX File , 31 KB-Multimedia Appendix 1\]](#)

Multimedia Appendix 2

Phase 2 inclusion criteria.

[\[DOCX File , 19 KB-Multimedia Appendix 2\]](#)

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Abbreviations

PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses

PRISMA-S: Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Literature Search

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