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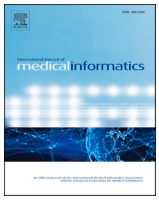

Review article

Digital applications to support self-management of multimorbidity: A scoping review

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ABSTRACT

Introduction: Multimorbidity, defined as the co-occurrence of two or more long-term conditions, is increasing rapidly and poses challenges for healthcare systems. Advances in digital technologies offer solutions by facilitating personalised, scalable care interventions that empower individuals to manage their conditions more effectively. These applications have potential to improve access to care, enhance patient engagement, and support tailored approaches to self-management.

Objectives: This scoping review aims to synthesise current evidence on the use of digital applications for self-management in adults with multimorbidity.

Methods: A scoping review was conducted, systematically searching PubMed, Web of Science, OVID, CINAHL, EMBASE, and additional manual searches. Boolean operators and targeted key terms were employed to retrieve relevant studies from database inception to 16th January 2024.

Results: The search yielded 1,974 articles, of which 31 met the inclusion criteria. Digital applications for self-management in multimorbidity demonstrated high acceptability and varying efficacy. Key benefits included improved communication, symptom tracking, and autonomy. Barriers included privacy concerns, additional patient burden, and engagement challenges. Socio-demographics, self-efficacy, and digital literacy influenced both barriers and facilitators to tool usage. Theoretical models underpinning digital applications were limited. Older adults and the working-age population were rarely included.

Conclusion: The current evidence base does not fully address the needs of older adults with low digital literacy or working-age populations with multimorbidity. Our model highlights the importance of broader contextual mechanisms in digital tool adoption. Future research should prioritise theory-driven tool development tailored to disease clusters and aligned with sociodemographic profiles, health risks, and social care needs. Addressing these gaps could improve self-management and health outcomes for high-risk populations.

1. Introduction

Multimorbidity, understood as the coexistence of two or more chronic conditions in an individual, is a growing challenge that places considerable strain on health and social care systems [1]. In the UK, around a quarter of the population lives with multimorbidity, driving increased demand for health and social care services, as well as posing complex care delivery challenges [2]. Multimorbidity is associated with higher mortality rates, more frequent hospitalisations, reduced quality of life, and places substantial physical, emotional, and financial burdens on patients and their caregivers [2,3]. Effective self-management, which involves the patient taking an active role in managing symptoms, medications, and lifestyle adjustments, is often promoted as a solution to addressing the challenges of multimorbidity [4]. However, adherence to self-management remains low, with many individuals requiring additional time and support to manage multiple conditions. It is estimated that 436,000 hospital admissions could be avoided in the UK if the most vulnerable populations were supported with their self-management [5].

Digital applications, particularly mobile applications, have significant potential for supporting the self-management of multimorbidity. These applications can facilitate remote monitoring, improve communication with care providers, promote treatment plan adherence, and address health and social care needs, etc [7]. Despite their potential, digital interventions have primarily focused on managing single conditions [8], with few addressing the unique complexities of managing multiple, interacting conditions. Existing reviews have either

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concentrated on older populations or grouped diverse technologies (e.g., web-applications, wearables, telecare) under a single category, limiting insights into the role of specific digital applications for multimorbidity self-management [9].

There is also a need to consider the heterogeneity of people living with multimorbidity. For example, disease clusters associated with multimorbidity vary considerably across age groups, with younger populations experiencing different combinations of conditions compared to older adults, and there are also differences between ethnic groups and socio-economic backgrounds [1]. Additionally, digital literacy varies by age and socioeconomic status, potentially affecting the usability and efficacy of digital applications in different demographic groups [10].

Addressing these gaps requires a more nuanced understanding of how digital applications can be designed to support the diverse clinical and non-clinical needs of people with multimorbidity. This scoping review aims to synthesise evidence on the use of digital applications for self-management in adults with multimorbidity, with a focus on identifying gaps in knowledge and informing future research and intervention design and implementation.

2. Methods

A scoping review methodology was used, based on the framework developed by Arksey and O'Malley [11]. This method was chosen as it allows for rapid collation of key evidence in underexplored areas, enabling the synthesis of emerging evidence and trends to identify research gaps and inform future practice, policy and research [12,13].

The review followed the PRISMA-ScR guidelines (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews) [14], with the checklist provided in Supplementary Table 1.

The methodology involved five key stages that are set out in detail below.

1. Defining the research question

Based on our preliminary literature searches and the identification of gaps in this field of inquiry, the following research question was addressed:

> *"What is the current evidence on the use of digital applications for self-management in multimorbidity, and what knowledge gaps remain to guide future research?"*

2. Identifying relevant studies

The search strategy was developed collaboratively, with a librarian reviewing previous studies focused on digital applications, self-management, and multimorbidity to inform the initial search terms [9,15]. A reflexive and iterative approach was employed to refine the search strategy. Preliminary searches were conducted on the OVID platform using title and abstract screening to evaluate the relevance of initial terms, enabling adjustments to optimise search outcomes. Both free-text and Medical Subject Headings (MeSH) terms were utilised, and the search terms were reviewed and refined in collaboration with all co-authors. Examples of terms used include:

multiple chronic conditions OR multimorbidit AND self-manage* OR self-care OR social care need* OR social support OR digital health OR digital app* OR mobile app* OR mhealth OR website*. The final search terms are presented in Supplementary Table 2.

Systematic electronic searches were carried out on PubMed, Ovid Medline, CINAHL, and Web of Science for articles published between the years of 1946 and January 16th, 2025. Additionally, manual searches of bibliographies and grey literature were conducted on BASE (Bielefeld Academic Search Engine), Google, and Google Scholar.

2.1. Inclusion and exclusion criteria

Articles were included if they met the following criteria:

1. Published in the English language.
2. Focused on adult populations with multimorbidity.
3. Examined digital applications designed for the self-management of multimorbidity (i.e., two or more long-term conditions).

In line with the exploratory nature of scoping reviews, quality assessment was not a criterion for exclusion. Studies were excluded if they:

- Focused on digital applications developed for a single chronic condition.
- Did not involve self-management.
- Were study protocols, books, or book chapters.
- Lacked full-text availability.
- The digital application was only a wearable device or telehealth.

We excluded studies investigating telehealth or wearable interventions to focus specifically on technologies providing guidance and support via web-based platforms, as these are potentially more accessible to the whole population. For example, wearable devices often involve higher costs compared to digital applications, and the installation and setup of telehealth requires an external provider.

3. Selecting relevant studies

All articles identified through the database and grey literature searches were uploaded to the Rayyan citation manager. Duplicates were removed, and titles and abstracts were screened by LS and GS, both of whom have expertise in multimorbidity research. To ensure accuracy, a subset of articles was also screened by SL and SH. Each article was assessed for relevance based on the inclusion criteria. Full-text articles were retrieved for those meeting the initial criteria. Data extraction was conducted independently by LS, GS and SH, with the final selection carried out by LS and GS. Any disagreements were resolved through discussion. In cases of unresolved discrepancies, a third reviewer (SH) made a final decision.

4. Data charting

To address the study's objectives, three data charting tables were used to organise and identify key characteristics of the included studies. These included the: study design, population characteristics, types of long-term conditions, geographic location, the digital application type, self-management targets, theoretical frameworks, outcome measurements, key findings, limitations, and recommendations for future research. Data charting was distributed across the team (GS, LS, SH). This process was iterative, with ongoing discussion within the research team regarding the relevance of data charting to our research question. Some studies focused solely on digital applications, allowing the full population of all three tables.

5. Methods for collating the data

Initially, data were synthesised through content analysis and frequency counts to summarise study characteristics across all three tables. Extracted data was then descriptively interpreted and structured and categorised in the results to align with the research question and enable identification of key themes and trends. This analysis was led by LS, with discussion and review by the wider team to ensure validation of this work.

3. Results

3.1. Screening, inclusion and exclusion of studies

The search of electronic databases and grey literature identified 1,960 articles. After removing 345 duplicates, 1,615 articles were screened. Fourteen citations were also found by hand, resulting in a total of 1,629 papers being screened. Taken together, 1,567 articles were excluded, leaving 62 articles eligible for full-text screening, and of these, 31 were included in the final analysis. The PRISMA flowchart summarising the screening process and reasons for exclusion is presented in Table 1.

3.2. Summary of study characteristics

Data on research methodology are in Supplementary Table 3. All 31 included studies were conducted in high-income countries, with twelve originating from the United States [19,21,23,25,29,31,33,35,41,42,46], four from Canada [22,28,34,40], three from Europe [20,30,36], two from the United Kingdom [17,18], two from South Korea [24,45], two from China [43,44], two from the Republic of Ireland [32,39] and one from Taiwan [27].

The timeline of publications (Fig. 1) indicates a notable increase in research on multimorbidity and digital applications in recent years.

Disease representation varied across the studies. Fig. 2 illustrates the distribution of six conditions explored in more than four studies. Across all studies, a total of 52 distinct conditions were mentioned (see Supplementary Table 4). Mental health and behavioural conditions were the most frequently referenced conditions (n = 23), followed by cardiovascular disease (n = 11), diabetes (n = 9), hypertension (n = 7), COPD (n = 6) and asthma (n = 4).

3.3. Objective and categories from included studies

The study objectives were grouped into three main categories.

3.3.1. Category 1: application development and study methodologies

This category included 17 studies focused on application development or feasibility trials. Methods used included: randomised controlled trials (n = 6) [19,22,23,28,42,45], qualitative studies (n = 2) [26,34], surveys (n = 1) [17] and combined usability/feasibility trials (n = 8) [7,20,29,30,31,33,38,39].

Qualitative methods were widely employed to gather feedback on issues such as the usability and user experience of applications, including stakeholder workshops, interviews, and think-aloud approaches. Innovative qualitative techniques, such as storyboarding and photo elicitation, were also reported in two studies. All studies recruited participants with multimorbidity, documenting specific diseases in the population retrospectively, and for trial studies, having at least a basic digital proficiency.

3.3.2. Category 2: patient experiences and perceptions

Twelve studies explored patient, caregiver, and healthcare professional experiences with digital applications [14,18,24,25,32,35,36,40,41,43,44,46]. Most employed qualitative methods such as interviews and focus groups, while two used surveys. Innovative techniques included storyboarding to depict daily life with multimorbidity and photo elicitation to document everyday activities.

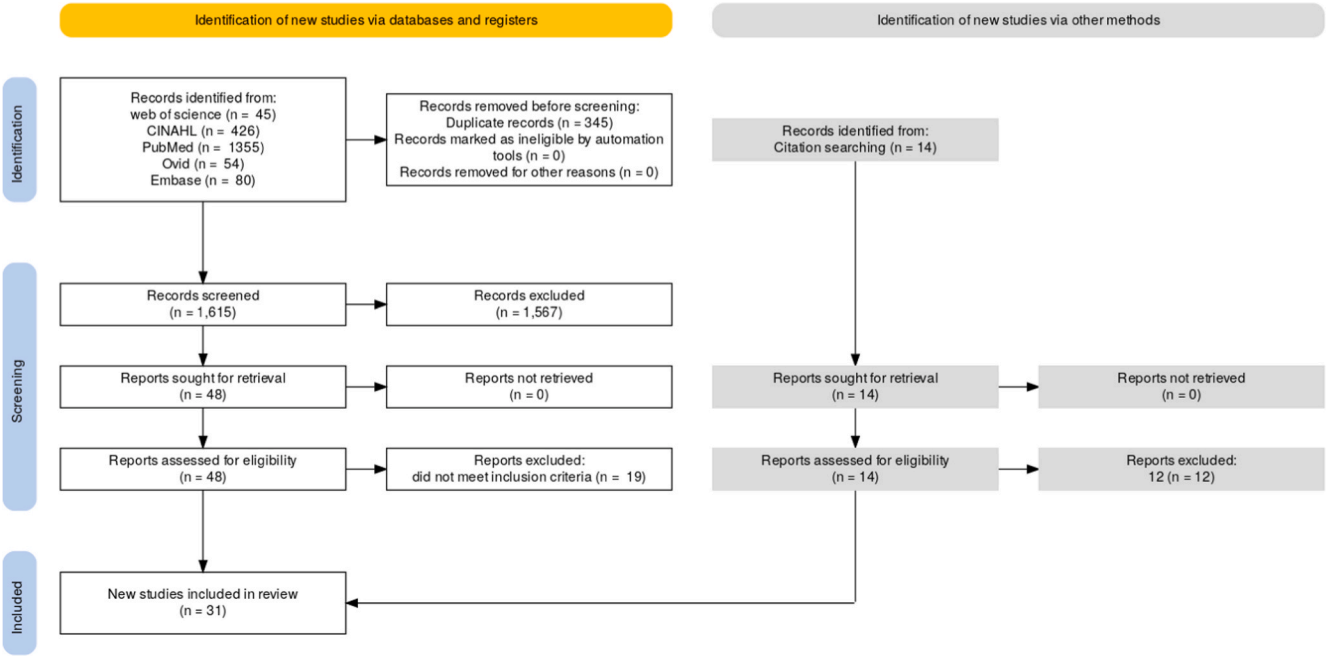
3.3.3. Category 3: systematic or scoping reviews

Two reviews published in 2021 and 2023 explored digital applications for self-management of multimorbidity. One review [9] included studies from 2009 to 2019, focusing on older adults (≥60 years) and excluding single-condition interventions, yielding 25 papers. The second review (2010–2020) [37] included 44 studies evaluating self-management support, care coordination, and algorithm-based applications for multimorbidity management.

3.4. Participant demographics

Demographic data were available in all of the 31 included studies. Twenty-five studies (80 %) focused on older adults (≥60 years), while six included mixed-age cohorts. None of the studies exclusively focused

Table 1
A PRISMA table showing the screening workflow.



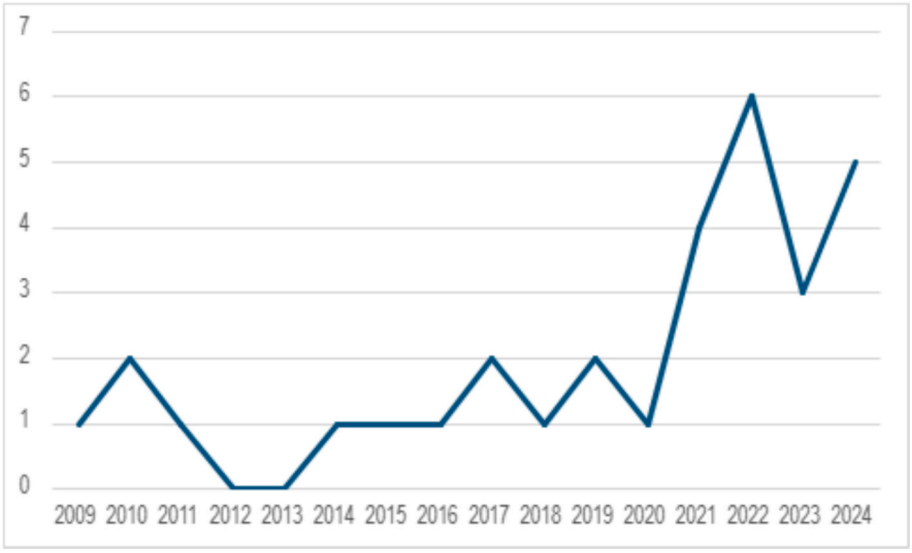


Fig. 1. The number of publications of multimorbidity and digital applications by year.

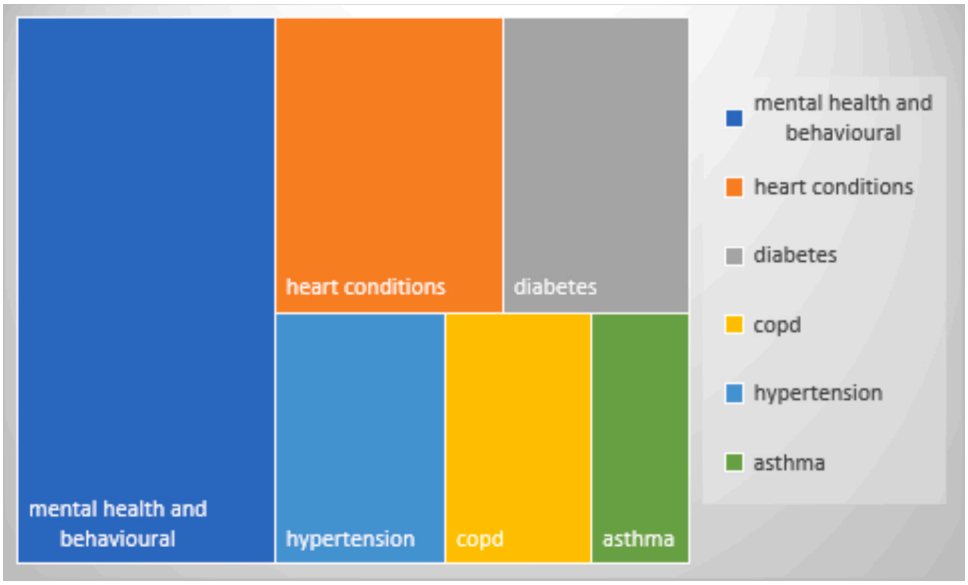


Fig. 2. Frequency of conditions within multimorbidity amongst included studies on digital applications.

on the working-age population [16–65]. Participants in Category 1 studies were often digitally literate and had higher education levels. Females were overrepresented, with one study exclusively including women [35]. Detailed figures are shown in Supplementary Table 3.

3.5. Type of digital technology used

Table 2 summarises the characteristics of the digital applications and websites in the Theme 1 studies, detailing the type of application, self-management functions, and any relevant theoretical frameworks. Nine studies focused solely on web-based applications, while seven combined web applications with wearable devices to collect biometric, sensory, or clinical data. Ten interventions included a dyadic component, involving healthcare professionals, certified peer mentors, online forums, or caregivers in user interactions or app-generated data.

Social support was the most common feature, present in 10 interventions with human involvement, while six provided digitally generated support via scripted responses, reminders, or reinforcements. Disease education and health improvement strategies were addressed in 11 studies, and symptom tracking was featured in 10, using either self-reported (16 interventions) or biometric (seven interventions) data. Health routine management, including appointment reminders, medication alerts, and sharing information with secondary care professionals, was reported in seven studies.

Stakeholder involvement was consistently integrated throughout the design process, though no study explicitly referenced a theory of change or logic model. Three studies mentioned theoretical frameworks, one was informed by a prior systematic review and another incorporated 23 health outcome variables relevant to various diseases.

3.6. Efficacy of the applications

The findings from the Category 1 studies (application trials) are summarised in Supplementary Table 3 and illustrated in Fig. 3. Six studies reported high levels of acceptability and usability. Four studies noted improvements in social well-being and health self-management

Table 2
The types of applications, content, theoretical underpinnings and self-management strategies for Theme 1 studies.

Author	Type of app	Self-management functions	Theoretical underpinnings	Self-management strategy
Balasubramann et al.,	Alexa (trialled for at least 2 months).	The tool supported activities of daily living, such as setting alarms to turn off the oven, reminders to do household tasks, suggestions for healthy recipes, info on their illnesses, exercise videos, appointment and medication reminders, social companionship, phone/video call function, helped with sleep.	Not provided in this paper.	Routine management Social support Education.
Degroot et al.,	Convoy Pal – 12-week intervention using a Routinary Platform, wearable device.	Patients use the app to set health and caregiver needs, and they are then assigned/choose their own goals. They self-monitor symptoms and biometrics from smart watches also feeds in the system. Each week they have a palliative assessment of symptoms, advance care planning, spiritual needs, anticipatory grief, health team needs and social support. The app then responds with messages of support and/or signposts the patient to the correct resource. Patient and carers share the information. Phone calls and Zoom were also on the app.	Not provided in this paper.	Goal settingSymptom tracking (self-report and biometrics) Social support Education Dyadic component
Dinsmore; Sheng	ProACT: digital app + wearable devices to capture biometrics, accessible to patient, informal carer, formal carer and health professionals.	Patient has wearable device to measure sleep, and biometric applications to measure glucose and blood to monitor vital signs. Alerts are sent if patient has symptoms of clinical concern or has not been on the app. Patient clicks on different 'petals' to set goals, access health tips and entering daily symptoms not trackable by wearable device. Informal carers can access the info and send messages. Formal carers cannot view health data, only wellbeing data, health professionals can view health data.	Not provided in this paper.	Symptom tracking (self-report and biometric) Dyadic component Alert system Education Social support
Fortuna	Peer Tech (made using Wellframe) Smartphone app + 1-hour weekly peer support session For patient with a serious mental illness/s + a chronic condition/s.	Certified peer specialist (CPS) allocated, and tablet needed. CPS meets with patients 1 x week for 1 h to assist with the learning of Emodules targeting psychoeducation and skills training over 3 months. The app supports the learnings from the Emodules, sets personalised self-management goas, allows for medication reminders, with a HIPA A − compliant chat feature.	Based on work from a previous systematic review, which advocated use of the integrated illness management and recovery (I-MR).	Education Psychosocial skills Goal setting Health Routine management Social support
Gray	ePros portal.	Enables both patients and healthcare providers to identify specific goals and monitor outcomes related to those objectives. Providers use techniques like motivational interviewing, counselling, and health coaching to support patients in managing their health at home between appointments. The Hospital CheckOut feature allows patients to notify their primary care provider when they have been discharged from a hospital visit. The provider portal enables healthcare providers to create care plans in collaboration with patients, outlining the goals they will focus on. Once a goal is included in a patient's Care Plan, it appears in their "My Goal Tracker." This allows patients to track their progress over time either through their mobile device or the patient portal.	The tool is intended to promote a transition to a person-centered care approach by facilitating the entire Goal-Oriented Care process, which includes identifying goals, continuous monitoring, and adjusting goals as needed.The development of the app was guided by the "Fit between Individuals, Task, and Technology" (FITT) framework.	Goal setting Motivational interviewing Routine management Education Social support
Gustafon	Eldertree – web-based application.	12-month trial, web page is a platform which provides information, connection to other elders, motivational services and applications for self-management, to improve quality of life.	Self-determination theory – targets competence, intrinsic motivation and autonomy.	Education Social support Health routine management

(*continued on next page*)

Table 2 (*continued*)

Author	Type of app	Self-management functions	Theoretical underpinnings	Self-management strategy
Kobekyaa	A self and symptom management app – Cancer + other MLTC.	- Make daily health reports - Learn weekly health trends - Schedule reminders through a digital health calendar - Share information - Clear data visualisations	Grey's self-management framework – needs to be holistic and consider family and patient needs.	Education Routine managementSymptom tracker (self-report) Dyadic
Lear	Chronic disease management app, manged by Nurse, wearable.	Two-year trial, based on co-ordinated care between the patient, nurse, doctor, dietician and exercise specialists. Complete symptom reports – self-report and biometric. This could trigger an alert algorithm for the nurse to respond in 1 day. Actions from this – continue with app only, contact doctor or hospital. Lifestyle questions completed every 8 weeks, which nurse could use to trigger referral to diet/ exercise support team. Public forum, action plan setting, external online resource access and graphical displays of biometric data.	Not referred to in this paper.	DyadicSymptom tracker (self- reported and biometric) Education Social support
Massoudi	Personal health record application (PHA) and wearable devices.	Delivers automated, evidence-driven suggestions for physical activity, minimizing the need for continuous oversight and direct engagement from healthcare providers. It monitors users' activity in relation to their set goals and encourages better communication between users and their healthcare providers about physical activity. Users enter data into the app, which also syncs with activity trackers and external services to improve tracking and support. .		Dyadic Education PA support Goal setting
Medinia-Garcia	TenDER technological tool – web-based platform and wearable devices.	The system includes a smartwatch to track physical activity, a sleep monitor to analyze sleep patterns, and a mobile app that displays the collected data. The app also provides self-management tools, such as appointment reminders	Not referred to in this paper.	Symptom tracking (all from sensory applications) Health Routine management
Monahan	Sym Track – tool for monitoring clinically actionable symptoms that are actionable for those with multimorbidity.	Focus is on 23 non-disease specific clinical symptoms, and separate physical and emotional symptoms for context. Carer report version is also used, for those with informal carers.	Not referred to, but 23 symptoms chosen predict health and economic outcomes independent of disease.	Symptom tracking Dyadic
Nambisan	myHESTIA – web based digital app.	The first prototype included 32 trackers, comprising both general trackers (such as for weight and diet, sleep, stress, mood, exercise, and medications) and specific trackers tailored to symptoms or diseases. Each tracker offered different sets of questions or prompts, and patients could choose the ones that were relevant to their conditions. Caregivers were also able to access and add information. The tool featured 9 core elements: (1) trackers, (2) a centralized platform, (3) sense-making applications, (4) gamification, (5) journaling tools, (6) community support, (7) a secure platform, (8) customization options, and (9) communication features, including caregiver involvement.	Not referred to in this paper.	Symptom tracking (self-report) Social support Education Dyadic Health routine management
Northwood	interRAI Check Up Self Report Digital app to support integrated health and social care for older adults and their care partners.	A tool to help with assessment of need related to cognition, mood, loneliness, pain, instrumental and basic activities of daily living, falls, cardiopulmonary risk, care partner stress, financial trade-offs, health stability, and frailty. Used with care providers to plan health and social care.	Not referred to in this paper.	Symptom tracking Dyadic Social support
Shaw	A technological infrastructure to collect and analyse mobile health data from multiple devices available to the public – platform to combine data from one diet app, and two data transmission	Track 11 daily health indicators over 4 weeks using devices including steps, physical activity, sleep quantity of sleep, blood pressure, pulse and oxygen saturation, weight and body mass index and fluid intake.	Not referred to in this paper.	Health behaviour tracking (biometric and self-report)

(*continued on next page*)

Table 2 (*continued*)

Author	Type of app	Self-management functions	Theoretical underpinnings	Self-management strategy
	applications from Fitbit® and iHealth®.			
Wicks	PatientsLikeMe web-based app online community platform.	Members voluntarily opt to share detailed, measurable data about their symptoms, treatments, and overall health to gain insights from others' experiences and enhance their outcomes. Members can interact through group discussions or private messages. The site's resources are aimed at helping members answer the question, *"Considering my current condition, what is the best possible outcome I can achieve, and what steps do I need to take to reach it?"*	Not referred to in this paper.	Education Social support Dyadic
Yoo	Ubiquitous Chronic Disease Care (UCDC) for patients with Type 2 Diabetes, Hypertension and Obesity.	Patients receive phone, glucose blood monitoring equipment, blood pressure equipment and weighing scales. Alarm goes off to take measures, followed by algorithm defined phrases, determined by clinicians, encouraging words following input related to their health outcomes. Reminders and recommendations also given based on data. Text messages sent to ask about physical activity and weight. 3 messages sent a day to give information about diseases and to advice on healthy eating, and exercise methods. Doctors able to access the programme and could send individualised recommendations to their patients.	Not referred to in this paper.	Symptom tracker (biometric and self-report) Education Dyadic Social support

Fig. 3. Main effects observed across studies which examined the efficacy of digital applications for the self-management of multimorbidity.

skills, while two observed enhanced quality of life, better symptom understanding, and reductions in hospitalisations. However, outcome measures varied considerably across studies, with little consistency in the measurement tools used. All outcome measures for papers which measured these are available in Supplementary Table 5. Negative outcomes were also reported, for example, one study indicated a non-significant decline in quality of life in the intervention group, another found no significant effects between intervention and control groups, one highlighted poor usability satisfaction, and several noted low adherence to device usage.

Findings from Category 2 (qualitative experiences and perceptions) and Category 3 (systematic/scoping reviews) were synthesised into three overarching themes: barriers, mediators, and facilitators, as shown in Fig. 4.

3.7. Barriers to use

The included studies discussed a range of key barriers to digital applications for self-management among people with multimorbidity. Barriers identified included: concerns related to privacy, security, and data use; the perceived additional burden on patients to manage their health independently; shifting responsibility from traditional healthcare settings; and fears about the potential loss of in-person care.

3.8. Facilitators of use

A number of facilitators were identified. An important factor discussed in a number of studies were the perceived benefits of digital applications over existing care models and practices. Key benefits identified included improved communication with healthcare professionals, access to personalised recommendations (e.g., early intervention based on symptom feedback), and the ability to tailor

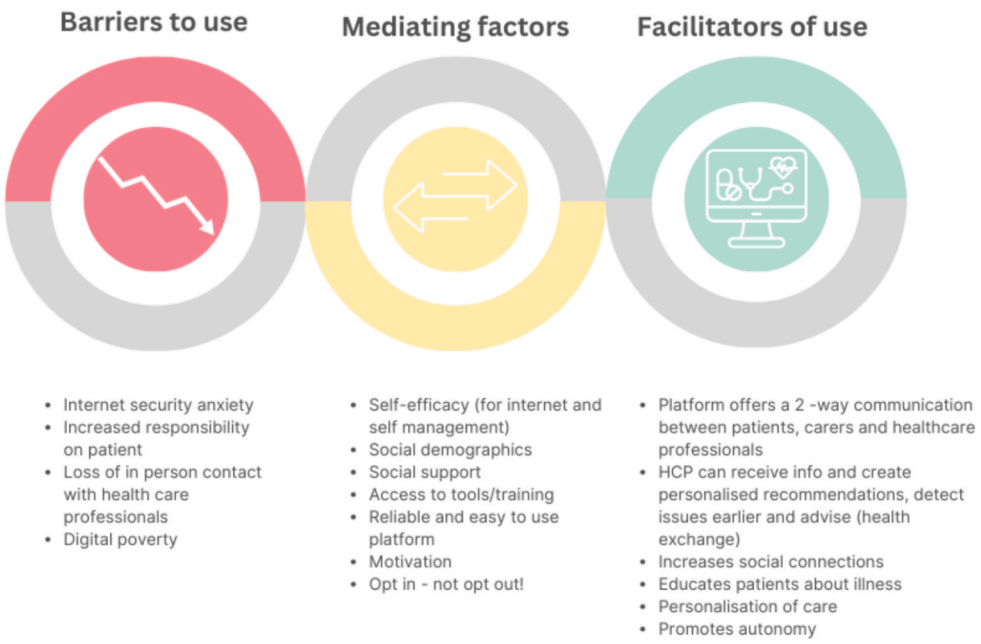


Fig. 4. Digital applications and self-management of multimorbidity.

applications to individual combinations of conditions and action plans, fostering autonomy and empowerment. Digital applications were also viewed as providing other benefits to patients, including facilitating social connectivity with healthcare providers and online patient and advice forums, and enabling access to reliable sources of health information and providing skills to support self-management.

3.9. Mediating factors of use

There were a number of mediating factors in the use of digital applications that were identified in the studies. An important mediator influencing both barriers and facilitators was socio-demographics. For example, older patients, those with lower education levels or experiencing greater deprivation were more likely to encounter barriers to use, whilst patients with internet access, higher education or digital literacy were more inclined to engage with digital applications.

Self-efficacy also played a key role in accessing and using these applications. Among those with lower self-efficacy, digital application use was lower, although there was evidence that training and support from carers or family members could enhance engagement. Further, engagement was reduced if patients felt coerced or pressurised into using digital applications.

4. Discussion

This scoping review aims to synthesise current evidence on the use of digital applications for self-management in adults with multimorbidity. The findings show that within the existing literature, there is limited evidence of how digital applications can be applied to address the complexities inherent in self-managing different combinations of chronic diseases, which is critical to efficacious care in multimorbidity [47,48]. Evidence on this topic focused on high-income states, whilst research on low- and middle-income (LMIC) countries was absent. This may partly reflect the limited rollout of digital applications in LMICs due to a lack of technical systems and delivery infrastructure, patient digital connectivity and implementation costs, etc, although this absence of research is surprising given that there has been significant work in some LMIC countries to leverage digitalise healthcare to enhance self-management and improve health outcomes [49–52]. Additionally, previous research has found that low levels of digital literacy in LMICs is an important barrier to the implementation of digital health applications [53]. This can be compounded further by negative perceptions towards the take-up and acceptance of digital applications, resulting from lay beliefs and cultures within some LMICs. For example, fears in some groups of women in Chile [54] that carrying a digital health device appears too medical-looking and may convey to others that they are unwell and/or financially poor. Consequently, culturally-driven perceptions may need to be factored into the design of digital applications to ensure they are culturally-sensitive in the context of both high and low-income states.

Further, no studies were found that included participants under 18 years old, indicating an important knowledge gap relating to the role of digital applications in supporting self-management in multimorbidity across the age spectrum. We also found that whilst common features such as symptom tracking, social support, and routine management were present, these applications often assumed user-motivation based on education about health risks. However, this overlooks key underlying psychosocial factors, such as self-efficacy, which is recognised as playing a crucial role in disease self-management [55].

We found that theoretical frameworks rarely informed application design. However, going forward, it is clear that new methods underpinned and driven by sophisticated big data analytics and artificial intelligence (AI) are increasingly likely to emerge, and combined with traditional problem-solving approaches, will have considerable potential to significantly advance healthcare research and its application to real-world care [56]. As Majanaric et al., argue, when applied to routinely collected electronic health data, these techniques offer an integrated framework for investigating multimorbidity, which includes addressing complex issues such as ‘prediction, correlation’, and ‘classification’ involving ‘multiple interacting factors’ [56]. This new approach to problem-solving will enable a reimaging of how services are accessed and delivered, in ways that are more targeted and personalised to the needs of patients and service users, whilst concomitantly, also leading to improved service efficacy, efficiency and care outcomes.

Fig. 5 provides practical recommendations which can be used to guide the development of future digital interventions.

Furthermore, our findings are consistent with previous reviews that highlight the lack of attention to the working-age population with multimorbidity and how digital applications can support both the clinical and non-clinical needs of this cohort [1,9]. Although age is an

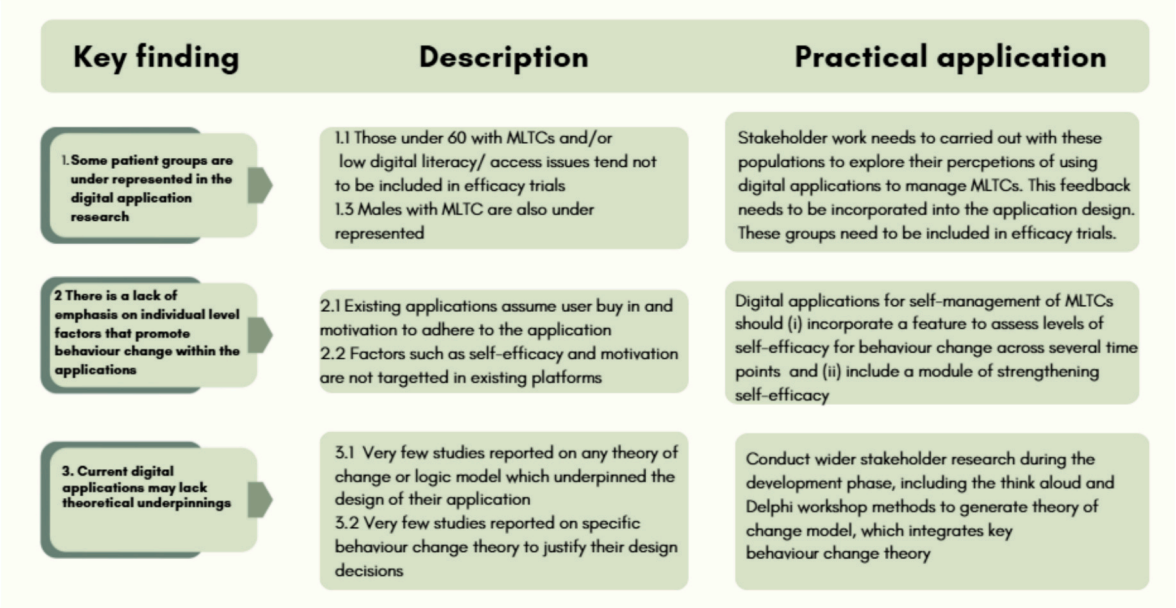


Fig. 5. Practical recommendations derived from the findings to guide future development of digital interventions.

important marker of multimorbidity, over half of the 'absolute burden of multimorbidity' is among the working-age population, adding a further layer of complexity for many individuals managing their conditions whilst continuing to be economically active [57]. The absence of this group is concerning given the heterogeneous nature of multimorbidity in this demographic and the need to more effectively support working-age people with chronic conditions to remain in the labour market for as long as possible [58]. This cohort may benefit from tailored digital interventions, which offer both clinical and non-clinical support (including employment assistance) at an early stage to prevent further deterioration in health or accrual of additional long-term conditions [59,60]. Previous research investigating perceptions of digital health applications in low-income working-age populations found a preference for internet searches and video-based narratives over dedicated health applications [61]. Other studies have shown that digital health preferences vary by age group, with older adults favouring digital applications focused on vital signs and self-management, while younger people preferred fitness and reproductive health applications [62]. The diffusion of innovations theory highlights that digital applications need to be tailored according to demographic variables, including user age, gender and education [63]. Therefore, future research should prioritise the development of tailored digital health solutions designed to meet the health needs of specific population cohorts, such as the working-age demographic. This will not only have potential to improve care outcomes among multimorbidity patients but also have wider societal benefits in terms of addressing high levels of economic inactivity among working-age populations, which has been a feature of labour markets in many high-income states over the last two decades [64]. The existing evidence base shows that high attrition rates were observed in many digital applications trials, suggesting that results are primarily reflective of digitally engaged participants, who are often White, highly educated, and from more affluent backgrounds [64]. This pattern mirrors the findings of Stone et al. [66], who noted that the efficacy of digital applications for individuals from lower socioeconomic backgrounds remains under-researched, despite these populations bearing the greatest burden of multimorbidity. The issue of digital inclusion has been described as the 'super social determinant of health' [65]. Like previous studies [9,67], this review found a lack of involvement in research of marginalised populations or those lacking digital literacy. For example, only individuals with internet access and the necessary digital skills were included in trials, which risks exacerbating the digital divide and producing biased and unrepresentative findings. This is particularly concerning, as underserved populations, who are more likely to be digitally excluded, face a disproportionate burden of multimorbidity [66,68]. These findings echo the concerns raised by earlier studies on the need for greater efforts to ensure that digital health interventions are accessible to all groups, particularly those most affected by chronic conditions [67].

Our finding that digital applications were generally well-accepted by participants is also consistent with previous research [69,70]. However, the complexity of self-managing across multiple chronic conditions was rarely addressed in the evidence, an issue highlighted in previous work [6]. This contrasts with the call for a more integrated approach to the management of multimorbidity. Most digital applications in our review targeted common physical health conditions like diabetes, cardiovascular disease and hypertension, with only one addressing mental health alongside physical conditions. This finding aligns with recent research [71,72], which highlighted that mental health challenges significantly increase the likelihood of physical multimorbidity, underscoring the gap in digital applications for individuals with both chronic physical and mental health conditions. Although psychosocial variables such as quality of life, and social well-being were commonly measured across Category 1 studies through self-reported psychometric questionnaires, only one digital application directly targeted psychosocial needs [21].

We found that most interventions focused predominantly on biological needs (such as blood pressure and glucose levels, symptom tracking and medication routines) rather than offering practical support for the broader psychosocial needs of individuals with multimorbidity. The biology or clinical dominance in existing digital applications overlooks the broader challenges faced by patients with multimorbidity, especially when individuals lack the capacity to self-manage [73]. This further highlights the risk of increasing the care burden on multimorbidity populations through the use of digital applications without the concomitant provision of appropriate user support. Our review also identified other important potential barriers to the use of digital applications, such as privacy concerns, the burden of managing health digitally, and fears about losing in-person care. These barriers have been identified in earlier research [69,70]. However, few studies have explored these within the context of multimorbidity or outlined specific measures to mitigate potential barriers to digital applications take-up among this cohort.

Research into potential strategies for supporting marginalised

populations to access digital applications in the specific context of multimorbidity is sparse, with a recent scoping review identifying a lack of effective interventions to target digital literacy [74]. These interventions were categorised into education and training (including online university courses and video-based online training) and social support (accessed through family, professionals and peers). Other research highlights the importance of user-centred designs, which incorporate stakeholder feedback and readability assessment tools [75]. The use of community-based approaches have also been advocated, especially if they address a broad variety of strategies [76]. These include improving digital access in rural areas, providing access to low-income groups, offering incentives for participation in digital training programmes, and creating engaging module content taught by well-trained instructors and supported by community leaders [76].

Additionally, future research could explore whether it is possible to integrate established theoretical frameworks and models such as the Technology Acceptance Model (TAM) and Self-Determination Theory (SDT). These approaches may have the potential to enhance user acceptance and sustain long-term use, which is vital to the efficacy of this technology [77,78] For example, TAM may provide insights to inform design features that improve user-friendliness and 'ease of use' [79] to increase adoption of new technologies, whilst integration of SDT approaches could encourage user acceptance by supporting 'autonomy', 'relatedness' and 'competence' in the use of technologies through improved psychological understanding of users' basic human needs and desire for self-determination [80]. Future developments in this field should consider whether to embed these concepts systematically in technology design to optimise usability of technologies and user adoption and acceptance [81,82].

This review has several limitations. While we employed a comprehensive search strategy, the exclusion of telehealth and wearable-only interventions may have restricted the breadth of our findings. Additionally, we limited our inclusion criteria to studies that explicitly referenced multimorbidity and multiple long-term conditions, potentially overlooking studies involving older adults with multimorbidity that did not specifically label their population as such. Furthermore, the value of this research would have been enhanced if stakeholder feedback had been embedded in the research design from the outset, allowing for a more iterative and informed approach to the review process.

Despite these limitations, the review possesses several notable strengths. We included a range of patient populations, with a particular focus on working-age adults, a group often under-represented in existing literature on multimorbidity. This focus helps address a significant gap in the current research, as working-age adults with multimorbidity have specific challenges that are less frequently explored. Additionally, we adhered to a rigorous scoping review methodology, ensuring an extensive and systematic search of both grey literature and peer-reviewed publications, which contributed to the comprehensiveness of the findings. This methodical approach strengthens the validity of the review by capturing a broad spectrum of evidence across diverse contexts.

5. Conclusion

Digital applications designed to support the self-management of multimorbidity are increasingly being developed. However, research in this field remains limited and fragmented, often neglecting to consider the complexities of managing both the clinical and non-clinical care needs of multimorbidity populations, which require a combination of healthcare, social care support and psycho-social interventions. Current evidence does not sufficiently assess the efficacy of these applications for underserved populations, including older adults with low digital literacy and working-age individuals with chronic conditions.

Our conceptual model highlights the importance of considering broader contextual mechanisms influencing digital tool uptake. Going forward, digital self-management interventions should integrate psychosocial factors such as self-efficacy, utilise standardised outcome measures, and incorporate evidence informed by long-term clinical trials.

Future research should focus on tailoring interventions to specific multimorbidity clusters and vulnerable populations to ensure greater accessibility and effectiveness, following theory-driven intervention development processes. By addressing these gaps, digital applications can become more accessible, inclusive, and effective in improving the self-management of multimorbidity across diverse groups.

CRediT authorship contribution statement

Lucy Smith: Writing – review & editing, Writing – original draft, Methodology, Formal analysis. **Glenn Simpson:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis. **Sian Holt:** Writing – original draft, Formal analysis. **Hajira Dambha-Miller:** Writing – review & editing, Conceptualization.

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Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Dr Glenn W Simpson reports equipment, drugs, or supplies was provided by University of Southampton. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary material

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Data availability

Data are available from the authors on reasonable request.

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