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**mHealth applications prescribed alongside
pharmaceutical prescriptions to manage
adults' chronic diseases: a scoping review**

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Abstract

Managing chronic illnesses is one of the many costly problems the healthcare industry faces. Nearly 71 percent of deaths worldwide occur due to chronic diseases each year, which is why the World Health Organization (WHO) has called for urgent action. This calls for creative and economical solutions to support the efficient management of these chronic illnesses in addition to medication as a response to these novel challenges to the healthcare system. Smartphone interventions through mobile health apps (mHealth) have emerged as one solution to this and many are already being used currently. This study aims to create awareness of the mHealth application that can be actively incorporated alongside pharmaceutical prescriptions by healthcare professionals to manage chronic diseases in adults. The following research objective supports this aim: to identify the most common prescribed mHealth applications used to monitor chronic diseases in adults and the barriers to the prescriptions of mHealth applications. The study adopted a scoping review as the methodology supported by the framework created by Arksey and O'Malley. The study was reported following the guidelines provided by the PRISMA extension for scoping reviews and inductive content analysis was used to examine and interpret its findings. The findings revealed that there are various mHealth apps available for managing various chronic illnesses such as diabetes, asthma, HIV, obesity, depression, dementia and skin cancer diseases, among others. These apps include Short Message Service (SMS) and Multimedia Message Service (MMS), Bant app, WellDoc app, MyBehavior, Asthmahero, eSkinHealth app, SkinScan, SkinVision, NLR SkinApp, MyFitnessPal, SmartDiet, MyMealMate (MMM), Super-Better, iWander application, SMS and MMS, ITTM EasyWorlsand Twine Health App. This high number of mHealth apps available for chronic disease management may be attributed to the rapid technological advancements that have seen the development of these apps grow tremendously. These mHealth apps on smartphones or tablets facilitated the self-management behaviors of patients with chronic illnesses, hence the management of these diseases. Despite the significance of mHealth apps in helping to manage chronic illnesses, there are still several obstacles that appear to be impeding the adoption of mobile health (mHealth) in the healthcare industry. This study identified three types of barriers: those about the healthcare system, individuals and technology. Accordingly, the study recommended strategies to counter these challenges.

Keywords: mHealth applications, Chronic diseases, management of chronic illnesses, adults

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1 Introduction

People who suffer from chronic ailments frequently face dire repercussions. Chronic illnesses can cause major difficulties, health emergencies and even mortality, in addition to a decreased quality of life (Dadgar & Joshi, 2018). Consequently, one of the many costly problems the health care industry faces is managing chronic illnesses. Nearly 71 percent of deaths worldwide occur due to chronic diseases each year, which is why the World Health Organization (WHO) has called for urgent action. In addition, chronic illnesses exacerbate inequality because they disproportionately impact those from disadvantaged social backgrounds and obstruct efforts to reduce poverty. Therefore, enhancing the health of individuals suffering from chronic illnesses not only reduces the costly burden but help to address this inequality. Notably, how a chronic illness affects a patient's daily life determines how best to manage and treat it (Dadgar & Joshi, 2018). In this instance, it is acknowledged that the key to managing chronic disease at a societal level is to enhance individuals' capacities to self-manage their health and make informed choices. Numerous national health care plans, which emphasize customized medicine and disease self-management via innovations like mobile health (mHealth), reflect this key to managing chronic illnesses (Stampe et al., 2021).

Stahr et al. (2022) add that one of the biggest challenges facing our modern civilization is the prevalence of chronic diseases like autoimmune thyroiditis and type 2 diabetes. For instance, the proportion of the global population with diabetes has nearly doubled, from 4.7 percent in 1980 to 8.5 percent in 2021 (Stahr et al., 2022). Additionally, common cardiovascular illnesses cause 31 percent of all fatalities globally. Furthermore, because chronic illnesses have received little attention, millions of people are still affected by their prevalence and this number is expected to climb until comprehensive, patient-centered management strategies and policies for chronic diseases are implemented (Amdie & Woo, 2020; WHO, 2020). Thus, creative and economical solutions are crucial to support the efficient management of these chronic illnesses in addition to medication as a response to these novel challenges to the health care system.

Smartphone interventions through smartphone apps (mHealth) are one option; numerous initiatives have already been put in place in the mHealth sector to enhance care and save expenses in the healthcare system (Stampe et al., 2021). Additionally, as per Dang et al. (2020), the pharma business, academia and health-related regulatory authorities are dedicating their efforts to enhance, promote and create the greatest scientific instruments to revitalize drug research. Among these innovations is mHealth.

As a result, WHO defined mHealth in 2011 as the application of mobile phones, wearable technology, personal digital assistants and devices for monitoring patients for medical and public health procedures. According to Mahmood et al. (2019), mHealth refers to the provision of medical services and information through mobile technologies. They state that because these devices are portable, inexpensive, widely accessible and widely used, they have offered special advantages to meet the challenges and needs posed by chronic diseases. Notably, Kim and Lee (2017) claim that there has been a great deal of research on mobile health (mHealth) using cell phones for managing chronic diseases and numerous systematic reviews have found that this technology has improved clinical outcomes, such as tighter blood pressure control in hypertensive patients and better hemoglobin A1c (HbA1c) control for diabetics, but its effects have been modest.

In fact, well-being and health monitoring have changed from being activities only found in traditional healthcare settings to being more widely available through smartphone applications due to the rapid growth of digital health in recent years, as well as the invention and emergence of social media platforms, cloud-based data platforms, mobile applications, wearable devices, smartphones and real-world evidence, among other things (Dang A et al. 2020). Numerous research projects have tested mobile health interventions to treat long-term ailments like diabetes, osteoarthritis and Alzheimer's disease. The results of this research show that in the domains and systems examined, the application of mHealth treatments has the capacity to support the effective management of chronic illnesses and health behavior modification through the following: (1) enhancing patient self-management and self-monitoring; (2) creating patient social networks; (3) notifying healthcare providers about patients' health conditions; (4) facilitating interactions with indirect feedback; (5) customizing education and care to patients' requirements; and (6) enhancing communication between healthcare providers. This list is expected to grow infinitely given the current velocity of mHealth innovation. (Matthew-Maich et al., 2016).

The literature presently promoting the active usage of mHealth by medical professionals to assist with the management of chronic illnesses among adults is still limited, despite the fact that products linked to mHealth intervention are rising and the potential is promising. Furthermore, there are still obstacles that prevent medical practitioners from using and implementing these smart devices to manage chronic illnesses (Stahr et al., 2022). Therefore, there is a need to consolidate research activities and data surround-

ing smart device-based interventions in order to adapt to the larger features and widespread use of smart devices that may better support the management of chronic diseases in adults. By outlining the scope and makeup of the existing literature, this scoping review addresses this knowledge gap and offers recommendations for future developments in the field of mobile health treatments utilizing smart devices to help adults manage chronic illnesses. The purpose of this study is to investigate the prescribable mHealth application that can be integrated with pharmaceutical prescriptions to manage chronic diseases in adults.

2 Theoretical framework

2.1 Mobile health (mHealth)

According to Amdie and Woo (2020), the global population of individuals with one or more chronic diseases is still growing. People with chronic conditions now live longer thanks to advancements in treatment and living conditions, but their quality of life may suffer if their conditions are not managed well. It is essential to empower and involve people with chronic illnesses in taking charge of their own health care. The ability of patients and healthcare professionals to collaborate to support self-management has been found to be hindered by a number of factors (Amdie & Woo, 2020). In order to effectively manage long-term illnesses, prompt access to information, evaluation and treatment is essential. In this instance, by providing care and convenience in a natural setting and reducing the obstacles of cost, time and distance, mHealth interventions provide the ability to get over many of the traditional barriers. mHealth interventions provide the clinician with the capacity to assess a recommended course of action, track unfavorable outcomes and pinpoint areas in need of improvement (Whitehead & Seaton, 2016).

Istepanian originally used the word "mHealth" in 2003. He then went on to define the idea as mobile computers, medical sensors and communications technology for healthcare. Three fundamental building blocks are also indicative of the arrival of mobile health: computers, communications and sensing (Mao et al., 2020). The utilization of mobile wireless technology for health is referred to as mobile health or mHealth, according to the World Health Organization. Information technology usage for supporting health and health-related professions is known as digital health or eHealth and includes mHealth (World Health Organization, WHO, 2019). The WHO defines mHealth as the

use of personal digital assistants (PDAs), mobile phones, patient monitoring devices and other wireless devices to promote medical and public health practices. While a formal definition is still lacking, this description broadly covers the field (Mao et al., 2020).

Amdie and Woo (2020) claim that mHealth includes a wide variety of technological advancements. mHealth encompasses wearable, wireless and mobile technology (e.g., sensors, medicine pumps and activity tracker wristbands); it also involves the use of ICTs in healthcare settings, such as personal health records (PHRs) and electronic health records (EHRs). Thousands of mobile health apps are also a part of mHealth (Amdie & Woo, 2020). One of the main tenets of communication and information technologies for healthcare, which also includes telemedicine, telehealth, eHealth and mHealth, according to Duplaga and Tubek (2018), is mHealth. Many people consider mobile health (mHealth) technology to be the most inventive advancement in the fields of public health and healthcare. Studies have demonstrated that mobile health technology provides significant prospects for improving medical care, illness prevention and health promotion. Over the last twenty years mobile health has emerged as a game-changing idea for advancements in healthcare delivery on a worldwide level. Due to their widespread availability, multifunctional mobile devices are a clear choice for promoting people's daily health (Duplaga & Tubek, 2018).

The advent of smartphone technologies in 2007 has had a significant impact on how mHealth has developed. This role has both benefits and drawbacks. The benefits include increased awareness of mHealth due to technological advancements in mobile and Internet communications, but the drawback is the misconception held by many experts and laypeople alike that mHealth is only an application-focused field focused on smart phones. The simplest way to understand this is to use the m-Health telecom formula. A mobile (smart) phone plus healthcare delivery service equals mHealth. Nonetheless, the majority of researchers concentrate on the blessing, which has been demonstrated to be accurate (Mao et al., 2020). Duplaga and Tubek (2018) affirm that, compared to eHealth and telemedicine, which were the previous options, mHealth applications are now more widely accessible due to the broad accessibility and widespread adoption of smartphones. The number of people using smartphones is rising quickly in several countries and it now equals the number of people accessing stationary Internet (Duplaga & Tubek, 2018). The use of mHealth management mode has grown in popularity as technology continues to progress. These days, a growing number of people including those from lower socioeconomic classes own mobile phones and other electronics (Mao et al., 2020).

Kim and Lee (2017) support that. The boundaries of mobile health have been further pushed in recent years due to the quick development of technology and the integration of various sensors (e.g., accelerometers, pulse oximeters), multitouch screens and increased processing capacity. Above all, tablets and smartphones are powered by apps that offer functions beyond what they can do with their native programs (Kim & Lee, 2017). These developments have led to new uses for smartphones and tablets, including the use of decision-making algorithms, the collection of patient data using a variety of sensors and the display of longitudinal data that is interactive and visually enhanced (Mao et al., 2020). The two types of mHealth interventions nonconventional cellular phone-based interventions and contemporary smart device-based therapies should be distinguished due to their radically different purposes. Smart device-based mHealth interventions are those that use an interactive multitouch screen, high processing power, sophisticated app functions, the use of sensors, quick network speed and other special features of a smartphone, tablet or other peripheral device to provide health care services (Kim & Lee, 2017).

Over the past ten years, the delivery of healthcare has undergone significant change, thanks in part to digital health (DH), which includes mHealth initiatives. Chronic diseases have been the most significant environment for DH research and development, despite its broad applicability. This is explained by the fact that, in many nations, managing and treating chronic diseases entails substantial healthcare costs (80 percent) (Bashi et al., 2019). Utilizing digital, mobile and internet technologies, mHealth aims to improve health outcomes and treat specific medical diseases. The majority of mHealth technologies are geared toward illness self-management, wellness and health coaching (Kim & Lee, 2017). According to Mao et al. (2020), mHealth interventions may be an affordable means of assisting healthcare professionals in managing chronic illnesses and changing patients' attitudes, offering developing nations a workable approach to healthcare. The use of mHealth in the treatment of chronic illnesses is widespread.

The perspectives of users, available functions, medical specializations and public health domains in which they are employed can all be taken into consideration when evaluating mHealth applications (Mao et al., 2020). According to Duplaga and Tubek (2018), the primary functions of mobile technology in the fields of public health and healthcare are as follows: tracking the development of diseases, tracking epidemiological phenomena, tracking environmental conditions and assisting with the therapeutic process, corresponding between the patient and the healthcare provider or between

the healthcare providers; encouraging a wholesome way of life; battling addiction. The strongest trends in the mHealth applications development, according to the review by Sloninsky and Mechael (2018), are concentrated in areas such as emergency response, disease surveillance and control (including tuberculosis, HIV infection, malaria and chronic diseases), coordination, management and supervision of human resources, synchronous and asynchronous mobile telemedicine, support for clinician decisions at the point of care, remote monitoring and patient care, support for health, including community mobilization, monitoring and reporting of health services, sharing m-learning resources related to public health and assisting medical staff in their ongoing education (Duplaga & Tubek, 2018). Nonetheless, the use of mHealth-recommended apps to treat chronic illnesses in adults is the main topic of this study.

2.2 mHealth apps

The use of mobile apps to handle daily tasks is growing (Whitehead & Seaton, 2016). The increasing popularity of mobile solutions for promoting health and the delivery of health care can be partly attributed to the technology's accessibility, the degree of personalization it allows, useful location-based services and prompt access to data, video, or voice media (Matthew-Maich et al., 2016). Worldwide, there are about three billion smartphone users. An estimated one million of the 1.6 million apps that are accessible in the Google and Apple stores are dedicated to health, nutrition, fitness and overall well-being. There are over 700,000 apps in the Google Play Store (Googleandroid operating system) and over 900,000 apps in the Apple App Store (iOS operating system, Apple Inc.). On their phones, an estimated 500 million users have downloaded one or more mHealth apps. More than 300,000 apps for health are regarded as legitimate mobile health apps and some of these might be recommended to a patient for the purpose of diagnosing or treating a medical condition (Baxter et al., 2020).

Currently, major app stores have about 165,000 publicly available mHealth applications (apps) among these available apps. The top 2 categories are applications for managing wellness and diseases; additional categories include electronic patient portals, prescription reminders, self-diagnosis, mental health, well-being and disease management. These apps can offer high-quality evidence-based medical information at a reasonable cost and anytime of the day (Fan & Zhao, 2022; Wu et al., 2020).

According to Fan and Zhao (2022), interdisciplinary teams create mobile health applications (mHealth apps) with distinct functional modules to address a range of health issues. While some programs are multipurpose, others only carry out one primary function. For instance, the "skin app" for screening skin cancer online is a dermatologist-approved single-purpose smartphone application (Fan & Zhao, 2022). With features like education, medication reminders, monitoring and feedback and rehabilitation support, MHealth apps assist users in understanding and managing their conditions (Fan & Zhao, 2022; Wu et al., 2020).

People with chronic illnesses experience symptoms that interfere with their everyday activities and mental health, which lowers their quality of life (Song et al., 2022). It's critical to control these effects and stop their progression. Patients' habits must alter for effective illness care, which includes aspects of education, managing symptoms and physical activity (Kelly et al., 2022). Although practice guidelines support the adoption of successful self-management behaviors by patients and medical professionals through patient-centered approaches, their implementation is frequently subpar. The complicated social and emotional demands of patients, together with the time and resources that healthcare personnel have in limited supply, may contribute to inappropriate implementation (Song et al., 2022). As an alternative, mHealth apps are extensively accessible and could assist in removing these obstacles by enabling sufferers to consistently follow their long-term self-care regimen (Amdie & Woo 2020). Patients have shown interest in learning about and developing skills to manage their conditions through mHealth apps. Benefits of mHealth apps have been reported to include better quality of life, fewer hospitalizations and improved symptom control (Quach et al., 2023).

2.3 Mobile Software as a Medical Device (SaMD)

The International Medical Device Regulators Forum defines "software as a medical device" (SaMD) as software that is designed to be utilized for one or more medical purposes and fulfills these purposes independently of being a component of a physical medical device (IMDRF, 2013). Software falling within this definition is therefore regarded by the FDA, the Medical Device Regulations (MDRs) in Europe and other regulatory agencies worldwide as a medical device. These software programs can operate on general-purpose (non-medical) computer systems. In this context, "without being part" refers to the fact that software can operate independently of a hardware medical device; however, software that is designed to operate a hardware medical device does

not fulfill the definition of SaMD (Dang et al., 2020). SaMD can be interfaced with other medical devices, hardware, other SaMD software and software that is general-purpose. It can also be used in conjunction (e.g. as a module) with other goods, such as medical equipment. As an illustration, radiologists can use AI algorithms to identify images using radiological computer-assisted diagnostic software for lesions suggestive of cancer (FDA, 2020). While DTx is always a form of SaMD, it typically does not serve the primary preventive function (i.e. no identified ailment is presented, unlike general health applications) (Huh et al., 2022).

2.3.1 Digital Therapeutics (DTx)

A subset of digital health, known as digital therapeutics (DTx), is a combination of tools, supplies and services from the wellness and healthcare sectors. Evidence-based behavioral therapies offered online that can improve healthcare's efficacy and accessibility are referred to as "digital therapeutics" (Dang et al., 2020). This can be summed up as follows: According to its description, DTx has three main qualities. First, "software" is the foundation of DTx. These might be categorized by the US Food and Drug Administration (FDA) as examples of software as a medical device (SaMD). This indicates that the "software itself" is categorized as a medical device instead of the hardware it is installed on. Therefore, rather than needing to be installed specially on authorized medical equipment, DTx can be freely deployed on a standard smartphone or tablet (Huh et al., 2022). Furthermore, DTx are "therapeutic" measures. DTx are expected to have "therapeutic" effects, just like medications and conventional medical equipment. Huh et al. (2022) highlight a crucial distinction between DTx and other applications in general health care. Third, "evidence-based" DTx is what is needed. Being "evidence-based" means that, in accordance with the degree of risk associated with DTx, the necessary medical evidence is needed. For this reason, it is frequently necessary that real-world evidence and technology performance data be gathered and examined, as well as that clinical trial results be published in peer-reviewed publications and/or examined by regulatory bodies (Huh et al., 2022).

Providing evidence-based treatment strategies powered by software to patients in order to prevent, manage, or treat a medical condition or disease is what the Digital Therapeutics Alliance (DTA) refers to as the DTx. To enhance patient care and health outcomes, they might be utilized separately or in combination with drugs, equipment, or other therapies. The DTA goes on to say that DTx's products combine cutting-edge technology with industry best practices for usability, design, clinical support and data

security. Regulators examine and approve these products in order to support the product claims made by the manufacturer about their intended use, efficacy and risk (Dang et al., 2020).

As previously stated, evidence-based therapeutic interventions for the prevention, management, or treatment of a disease or medical condition are included in DTx. Digital sensors, wearable technology, some virtual reality (VR) systems and artificial intelligence (AI) gadgets are a few examples of DTx applications (Dang et al., 2020). Apps known as "digital therapeutics" digitize conventional therapies like cognitive-behavioral therapy to assist patients in managing their conditions on their own. According to Rowland et al. (2020), there were differences in effect sizes between the eight randomized controlled trials that examined the psychological outcomes of using mHealth apps to manage depression, acceptance of chronic pain, insomnia severity, stress, or PTSD symptoms. Higher engagement was linked to better outcomes.

DTx frequently targets illnesses like neurological problems and chronic ailments that the healthcare system does a terrible job of treating. A growing variety of DTx applications are being developed to address mental health conditions. In the treatment of anxiety and depression disorders, the digital application of cognitive-behavioral therapy (CBT) is demonstrating encouraging outcomes. By assisting patients in maximizing the advantages of traditional pharmaceutical therapy, DTx is also demonstrating encouraging outcomes in terms of drug adherence (Huh et al., 2022). One US-based DTx business, for instance, has created a robot that can remind patients to take their pills on schedule in an effort to combat the problems associated with pharmaceutical non-adherence. This robot customizes dialogues to keep users following prescribed dosage schedules for extended periods of time by utilizing artificial intelligence (AI) in conjunction with psychological modeling. As of right now, the company is working to adapt this robot for other therapeutic applications, including congestive heart failure, RA and renal disease (Dang et al., 2020).

2.4 Chronic diseases

WHO (2013) defined chronic diseases as long-term illnesses (LTIs) that progress slowly and are not communicable. According to Mahmood et al. (2019), chronic diseases are those that have existed or are expected to exist for at least three to six months and can only be managed at this time rather than cured. Chronic diseases can

last for several months and have long-lasting psychological, physical, or cognitive pathologic conditions. They can also have an impact on day-to-day activities and social interactions, medication dependency, personal assistance, medical technology, devices, or schemes and the need for medical or paramedical care, psychological support, adjustment, monitoring, or prevention with the help of a medico-social care pathway (Huard, 2018).

Heart disease, cancer, diabetes, stroke, rheumatoid arthritis and chronic lower respiratory disorders are a few examples of chronic diseases. These are chronic conditions that may not be curable, progress slowly and do not go away on their own (Quach et al., 2023). Although these illnesses take time to manifest, they can cause terrible side effects that cause early death and low life quality (Mahmood et al., 2019). In this instance, they are the world's primary causes of sickness, mortality, disability and a lower standard of living. As a result, 84 percent of global health spending and at least 65 percent of all deaths are related to chronic diseases. Furthermore, the largest health disparity gap globally between racial and ethnic groups is caused by chronic diseases. Despite being common, expensive and possibly fatal, chronic diseases and/or their aftereffects can be partially avoided (Reynolds et al., 2018). The complicated etiology of chronic diseases, which involves the interplay of genetics, accumulated behavior and the physical and social environments, makes prevention difficult. This is so because aging exacerbates the protracted, degenerative disease course that characterizes chronic diseases, which can also have an unclear origin and various risk factors. On the other hand a number of established risk factors for chronic illnesses, such as smoking, eating poorly and not exercising, can be altered by community- and individual-focused interventions (Huard, 2018).

According to Quach et al. (2023), the quality of life of millions of individuals is diminished by chronic illnesses, which also impose a significant financial strain on the healthcare system. These long-term health issues are serious and expensive for everyone involved, the system of health care and society at large. Sixty-four percent of global medical expenses are related to these disorders. The cost and utilization of healthcare are significantly impacted when a single person has several chronic illnesses (Quach et al., 2023). According to a Swiss study, elderly individuals with numerous chronic disorders had average overall healthcare expenses that were 5.5 times greater than those of senior patients with no multiple chronic conditions. A modest de-

crease in the prevalence of chronic disease has a significant positive impact on productivity and health, which can lead to significant cost savings and a real return on investment in a short amount of time (Maresova et al., 2019).

Long-term care is necessary for chronic illnesses, which alters the character of healthcare services and increases demand for them. A person's quality of life may deteriorate as a result of this requirement for long-term care. Healthcare systems will be under pressure from this phenomenon to change in order to satisfy these shifting needs (Maresova et al., 2019). According to Reynolds et al. (2018), managing chronic disease is a significant issue for global healthcare systems, which were primarily designed to handle acute episodic treatment rather than arrange care for individuals with long-term conditions. One feature of chronic illnesses is that they frequently call for extended periods of supervision, care or observation (Reynolds et al., 2018). However, in addition to medication, digital advancements like mHealth technology can be leveraged to deliver effective and efficient healthcare by enhancing patients' capacity for self-management (Mahmood et al., 2019).

Emerging and new technologies like DTx and mHealth apps are playing a bigger role in improving chronic disease self-management, which improves overall health outcomes, safety and quality of life. In order to optimize patient outcomes, chronic illness management programs have included telehealth components in recent years (Quach et al., 2023). Data suggests that roughly 40 percent of those over 44 have chronic disease multi-morbidity, rising to about 50 percent for those 65 to 74 years old and 70 percent for those 85 years or older. Chronic multi-morbidity is common in industrialized countries and rises with age (Reynolds et al., 2018).

2.5 Self-management of people with chronic diseases using mHealth

Since they are far more prevalent, chronic illnesses nonetheless provide a problem for public and clinical health (Stampe et al., 2021). Furthermore, although each common chronic condition like heart disease, diabetes and arthritis has its own special qualities and requirements, they still have similar management issues. Managing physical signs, controlling intricate drug schedules, keeping up appropriate levels of diet, exercise and nutrition; adapting to social and psychological demands, including challenging lifestyle changes; managing symptoms and disability; and having productive conversations with

healthcare professionals are a few of these. Cost-effective solutions to assist and facilitate patient care are receiving more attention due to the rising prevalence of chronic diseases and their impact on patients (Amdie & Woo, 2020).

Patients with chronic illnesses are typically the main providers of their own care; therefore, as would be anticipated of any health professional, they need training to better fulfill their role and guarantee that the care they receive is appropriate and efficient (Straub & Thekkekandam, 2023). Therefore, it has been demonstrated that self-management is useful in the treatment of chronic illnesses. A variety of self-management activities should be encouraged by an ideal and successful intervention. Unquestionably, using the mHealth app is a helpful tool, particularly in the present day (Khan et al., 2018). According to Straub and Thekkekandam (2023), there is a growing prevalence of chronic health disorders. Certain demographic groups, such as those with lower socioeconomic status (SES), are more likely to experience chronic disease and have worse prognoses. Since many chronic conditions are related to lifestyle choices, the patient's ability to manage their condition on a daily basis is crucial, especially given the long-term nature of these conditions (Straub & Thekkekandam, 2023).

In this situation, learning self-management techniques is essential to assisting those with chronic illnesses in slowing or stopping the illnesses' course (Khan et al., 2018). In the context of telehealth, self-management refers to the process by which people actively manage their chronic illnesses. Assisting people in managing their own health is a crucial tactic in lowering the cost of chronic illness. For those with chronic illnesses, self-management support (SMS) has improved health outcomes, including their quality of life in relation to their health (O'Connell et al., 2018). The discipline of self-management focuses on identifying and developing common patient-centric techniques to address these issues. The acquisition of a general set of skills has been shown to be helpful in enabling people to successfully manage their illness and enhance health outcomes, irrespective of the chronic condition (Grady & Gough, 2014).

Furthermore, it has been demonstrated that mHealth interventions may be affordable for supporting medical professionals in managing chronic illnesses and altering patients' behaviors, thereby offering a workable healthcare plan for nations with weak economies. Chronic condition management has made extensive use of mobile health (mHealth) (Mao et al., 2020). Previous research has demonstrated that patients with chronic conditions can be empowered to manage their own health through the use of

mHealth programs (apps) on smartphones or tablets. The potential for affordable, patient-centered tools to raise disease awareness, improve disease tracking, boost adherence, encourage healthy lifestyles and bring about beneficial behavioral changes is presented by mHealth technologies. Since there are fewer organizational, geographic and temporal obstacles to accessing health information through mHealth and related technologies, these technologies have the ability to completely reengineer many aspects of healthcare (Mahmood et al., 2019).

The results of the Amdie and Woo (2020) study have demonstrated that mHealth interventions can enhance diabetes patients' self-management and comprehension of their condition. A study conducted in New Zealand by Eyles et al. (2017) demonstrated that individuals with cardiovascular disease might dramatically cut back on their salt intake by using a mHealth app. O'Connell et al. (2018) further support that it has been shown that using mHealth to promote self-management initiatives can help lessen the difficulties that both patients and primary care physicians encounter. Through the use of educational materials, health behaviors, continuous health data tracking (such as blood pressure or glucose readings) and information sharing with primary care providers to facilitate collaborative chronic illness management, mHealth technology can help people incorporate self-management support into their daily routines (O'Connell et al., 2018).

Self-management support (SMS) strategies aim to provide people with the skills and information they need to take better care of their health. These interventions integrate behavior modification strategies with education to address the mental, emotional, social and physical problems related to chronic illness. Their objective is to help the person live a meaningful life while helping them adjust to their new circumstances (Hardman et al., 2020).

A wide range of platforms and technologies are used in research on treating chronic illnesses and mobile health. Wearables, social media sites and mobile apps are examples of technologies. Typically, one of two perspectives is employed while examining these technologies: both patients and medical personnel (Stampe et al., 2021). From the standpoint of a medical practitioner, mobile health technology facilitates patient self-management and offers medical services beyond geographic boundaries. Health services can be rendered in remote locations and patient data can be transmitted to medical experts via mHealth (Stampe et al., 2021).

Because mobile phones are so widely used and because mHealth technology allows data from multiple wearable devices to be integrated, patients can greatly benefit from it. Individuals may be able to attain their health goals by keeping an eye on their symptoms and health problems (Stampe et al., 2021). Furthermore, a variety of devices act as external memories to aid patients in recalling specific health information. Consequently, this aids patients in taking charge of their health and treating illnesses. Additionally, mHealth makes it possible for patients and medical providers to share information. Patients consequently gain more knowledge, which aids in their ability to self-manage chronic illnesses (Hardman et al., 2020). Nonetheless, research has shown issues, like constant reminder for patients chronic illness. Furthermore, patients frequently avoid technology because mHealth design disregards their wants and values. It is suggested that patient-centered technology, which amplifies the voices of the patients, is the answer. This is frequently described in the literature as a technology that encourages patient empowerment and self-management abilities (Stampe et al., 2021).

3 Purpose, aims and research objectives

The purpose of this study is to investigate the mHealth applications that can be integrated with pharmaceutical prescriptions to manage chronic diseases in adults. The aim is to create awareness of the mHealth application that can be actively incorporated alongside pharmaceutical prescriptions by healthcare professionals to manage chronic diseases in adults. This aim is supported by the following research objective:

To identify the most common prescribed mHealth applications used to monitor chronic diseases in adults and the barriers to the prescriptions of mHealth applications

Research questions

1. What are the most common prescribed mHealth applications used and in what areas they are used to manage chronic diseases in adults?
2. What are the barriers to the prescriptions of mHealth applications in adults with chronic diseases by healthcare professionals?

4 Methodology

4.1 Scoping review

A scoping review is an organized mapping of the body of knowledge on a particular subject. Key ideas, theories, evidence sources and research gaps are identified (Peters et al., 2020). It is a sort of knowledge synthesis that locates and synthesizes an existing or developing body of literature on a specific topic using a methodical and iterative process (Mak & Thomas, 2022). Even though they rank highest in the hierarchy of evidence, systematic reviews are not appropriate for all applications due to the nature of the research topics they address. A scoping review is more appropriate in many cases. For instance, to determine the scope and makeup of a corpus of literature, to create evidence maps and summaries, to guide further investigation and reviews and to pinpoint evidence gaps (Peters et al., 2020), as is the case with this particular study, Scoping reviews are especially helpful in situations when the evidence is new and not yet amenable to queries about efficacy or where the evidence is broad and widely dispersed (containing many distinct categories of evidence). Scoping reviews can be used to gather and report on diverse literature including both scientific and non-empirical evidence across different fields beyond and within health because they are agnostic with regards to the types of evidence they can draw upon (Mak & Thomas, 2022). This is crucial for the current study.

Additionally, as this current study focuses on examining, identifying, mapping, reporting, or discussing features or concepts across a variety of evidence sources. A scoping review is most effective when research objectives or review questions do just that (Peters et al., 2020). According to Sucharew and Macaluso (2019), scoping reviews are being utilized more frequently to address complicated issues when it might not be feasible or meaningful to compare interventions. When describing a subject qualitatively from the standpoint of prior research findings and identifying knowledge gaps, this approach is helpful in addressing large-scale research problems. Scoping reviews offer a comprehensive overview of the body of existing literature, making them an appropriate method for describing complicated and varied material (Sucharew & Macaluso, 2019). The scoping review approach turns out to be the most effective way to use the available data to sufficiently address the research objectives because this study does not

compare therapies. Furthermore, the search approach allows the inclusion of changeable resources in scoping reviews, such as conference papers, presentations and editorials, among others. When compared to traditional peer-reviewed articles, the use of gray literature that has been approved for scoping review also increases research prospects. This makes it possible to obtain thorough information regarding the study's main issue, which is under investigation (Peters et al., 2020).

Furthermore, Mak and Thomas (2022) state that although scoping reviews can be done for a variety of reasons, mapping the scope, diversity and character of the literature as well as identifying any potential gaps in the body of knowledge on a given subject are the primary motivations. Because it covers a wide range of study designs and diverse contexts, such as various technologies and applications, implementation milieus and chronic conditions without distinguishing between individuals with single conditions and those with multiple chronic conditions, scoping review methodology is therefore the appropriate methodology in this review. Because the smart device-based mHealth topic has emerged across a wide range of fields and involves a variety of chronic illnesses, the author of this paper decided to do a scoping review.

The framework created by Arksey and O'Malley (Arksey & O'Malley, 2005) was adhered to in order to finish this scoping review. This study was reported in accordance with the guidelines provided by the PRISMA extension for scoping reviews. To put the results of the quantitative research into context, the author synthesized the content of the qualitative investigations. The approach is pertinent to elucidating the often prescribed mobile health applications for managing chronic ailments in adults as well as the obstacles that prevent healthcare providers from prescribing mobile health applications to adults with chronic illnesses. The present study employed scoping review methodological framework that mandates several procedures in a typical scenario: 1) formulating research objectives; 2) locating pertinent studies; 3) defining inclusion/exclusion standards and choosing studies; 4) plotting the information; 5) compiling, condensing and reporting the findings (Sucharew & Macaluso, 2019), all of which are done in this investigation.

Step 1: Research question identification

The literature review that was previously mentioned was the first step then the knowledge gap was determined. This scoping review aimed to address two research objectives by providing a thorough mapping of the scope and what kind of smart device-based mHealth applications recommended for chronic disease management for

adults: to identify the most common prescribed mHealth applications used to monitor chronic diseases in adults and to determine the barriers to the prescriptions of mHealth applications in adults with chronic diseases by healthcare professionals. After the review of the literature and consultation with the researcher and other relevant parties, such as the librarian, the research question was determined. The review questions were justified by the lack of agreement in the academic literature on mHealth apps that can be used with prescription drugs to treat adult chronic illnesses, particularly those affecting adults.

Step 2: Identifying relevant studies or research strategies

In order to find pertinent publications that are particular to mHealth applications aimed at the management of chronic illnesses for young people, the researcher organized and carried out a search strategy. Research librarians were consulted in order to identify keywords and related subject headings and compiled an exhaustive list of possible sources. Three parts of the study issue were addressed through the identification and combination of keywords: adults, mHealth applications, barriers, prescribable mHealth apps, gaps, chronic disease management and adults with chronic diseases aged 18–65. Keywords were searched using boolean operators.

Figure 1: Search strings in the databases

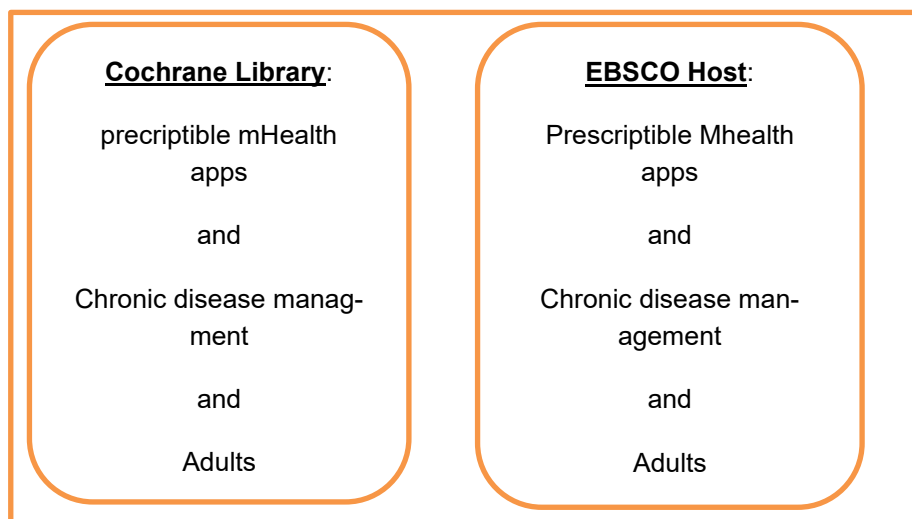


Figure 1 Cochrane Library and EBSCO Host (which includes CINAHL full, eBook collection, Medline ,OpenDissertation) were the databases searched using key words as illustrated above.

The following databases Cochrane Library and EBSCO Host (which includes CINAHL full, eBook collection, Medline and OpenDissertation) were used to find pertinent literature. The authors searched Google Scholar and Google for gray literature online. English-language articles released between January 2010 and March 2024 were looked for in databases. Furthermore, a manual search of key journals was conducted, along with a search of reference lists (Journal of Medical Internet Research). Reviews were only granted to articles published in peer-reviewed scientific journals.

For chronic illnesses, the search encompassed both general and particular terms related to chronic conditions, such as stroke, asthma, chronic heart failure, chronic obstructive pulmonary disease, diabetes, hepatitis, hypertension and mental illnesses.

Duplicate articles were eliminated from the total number of articles obtained after the search was completed. For inclusion, the remaining studies underwent screening. Moreover, research articles that did not meet the inclusion criteria were rejected based on how the title and abstract were interpreted. The complete texts of the remaining studies was read.

The table below represent the PPC (population, concept and context) framework that outlines the key words or texts and the combination of the key words that were used to search and identify the relevant articles for the study in the search databases (Cochrane Library and EBSCO) as well as in the Google Scholar.

Table 1. PCC framework

Population/participant	Adults with chronic diseases aged 18-65, adults
Concept (interventions, phenomena of interest, or outcomes)	Mhealth applications, Barriers, gaps, pre-scriptible mHealth apps
Context	Chronic diseases management

Step 3: Selecting appropriate articles for the scoping review (inclusion and exclusion criteria)

To determine which articles should be included in the review, a specific criterion that specifies which papers belong in it needed to be created. One of the previously mentioned review questions must have been directly addressed in the literature that was incorporated into the study. Inclusion and exclusion criteria, according to Patino and Ferreira (2018), are essential to secondary inquiry because they enable the researcher to ensure that the selected data sources contribute to the study's validity and dependability and support its objectives. These guidelines are crucial since they point researchers in the direction of reliable data sources, especially when they're searching the literature and choosing studies. Meline (2016) continues, "Retaining researcher's focus, improving quality control, offering consistency and lowering bias are the five primary reasons why inclusion and exclusion criteria matter." The literature chosen for the study had to answer one of the two review questions mentioned above. Consequently, the search phrases encompassed a wide range of subjects and keywords, such as mHealth applications, gaps, prescribable mHealth apps, adults, chronic disease management and persons with chronic diseases between the ages of 18 and 65. To choose the articles for the analysis, the following preset inclusion criteria were applied.

Consequently, the author employed an iterative method to define inclusion and exclusion criteria in this study in order to connect the selected studies with the goals of the scoping review. Smart device-based mHealth application studies that meet the following criteria were included: (1) specifically used in adults, or where the average participant age was 18–65 years old; (2) seek to support the management of chronic diseases; (3) published in 2010 or later; and (4) written in English. Articles released in 2010 or later were the only ones chosen to account for the advent of tablets and the widespread use of smartphones. Additionally, the references' titles were filtered and abstracts were read if there was even the remotest chance the title was pertinent to the topic. If the abstract appeared to be pertinent to the research topic, the full text were read.

The following were the criteria for exclusion: (1) publications produced in languages other than English (non-English publications); (2) did not explicitly address the management of chronic illness in adults between the ages of 18 and 65; (3) could not locate full-text copies; and (4) abstracts from conferences. The published articles' methodo-

logical quality were not used as a criterion for inclusion or exclusion. This made it possible to incorporate a wide range of information relevant to the study issue, in line with the procedures of scoping reviews.

After the study's final articles were selected, data was retrieved. Important data was extracted, including the design of the survey, the profile of the respondents, the analysis of the findings and important conclusions. The author did the complete review. The conclusions drawn from each study and the methods employed to obtain the findings determined the emphasis on data extraction. In order to determine which mHealth apps adults can use to manage chronic diseases, the author concentrated on the results and recommendations of studies that particularly target instructional strategies. An example of the data extraction process may be found below:

Identification of studies via databases and registers

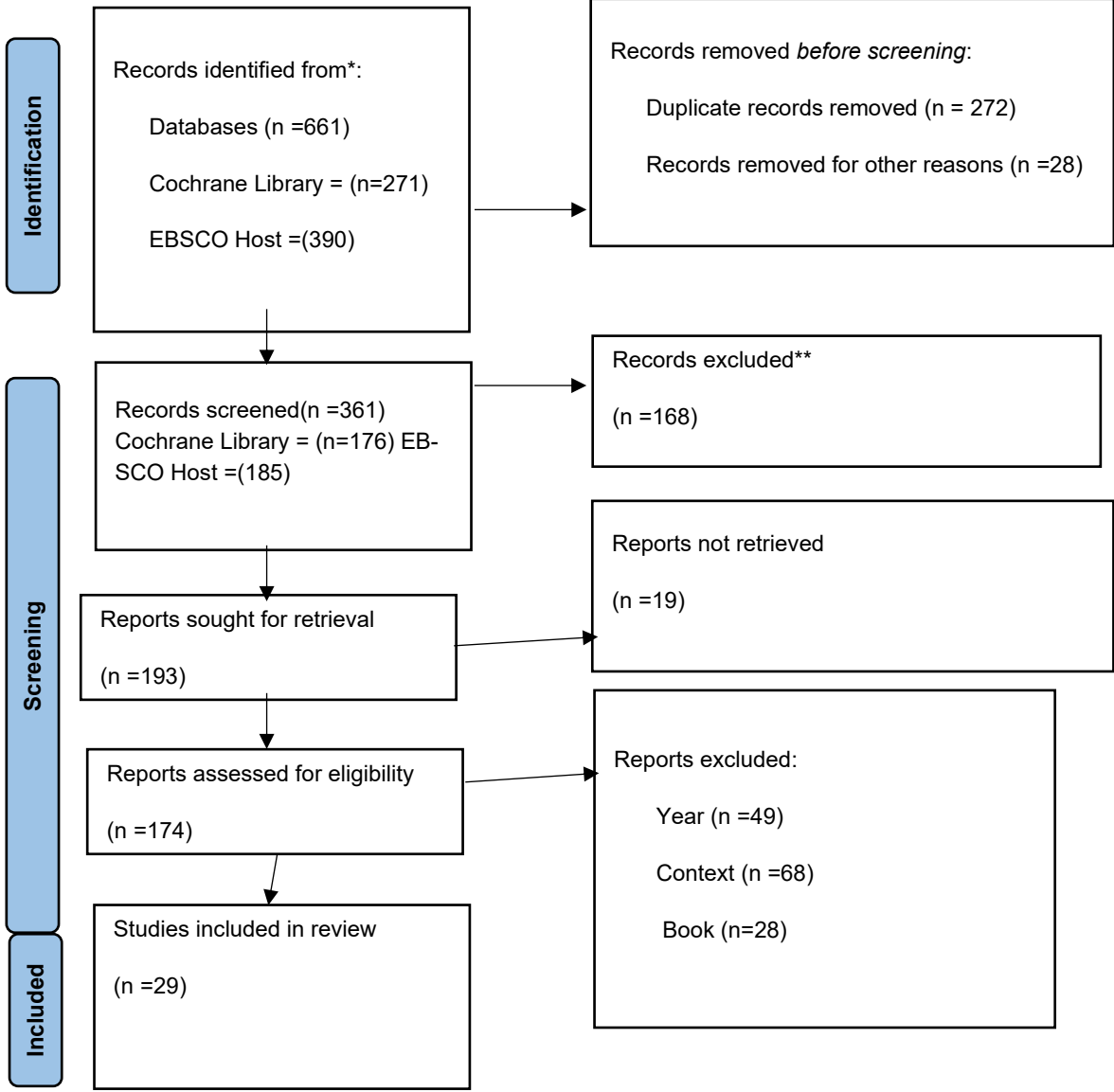


Figure 2: The PRISMA Diagram for reporting systematic reviews (source: Page et al., 2021).

Step 4: Charting data from the selected literature (articles)

At this point, the descriptive analytical approach was applied (Kemp et al., 2018). The author created a data charting form to help direct the data extraction process. Standard bibliographical data (ie. Authors, year publication year, publication source), the mHealth discussed, the health condition or disease that the app addresses and the obstacles or gaps to the healthcare professionals using these applications were input.

The goal of the study, the sample size and design, the year the work was published, the author(s) and the main results and output were gathered. Data was fixed in extraction form in conjunction with the evaluation outcome. The Joanna Briggs Institute (JBI) was used as Critical Appraisal Tool to carry out the study assessment (The Joanna Briggs Institute 2015). Each criterion was given a score of either 0 or 1 point in order to quantify quality. If the item was mentioned in the study, one point was given; if it is mentioned but not made clear, zero points were awarded. The chosen studies' overall quality was rated as good. The critical appraisal using JBI is shown in appendix 1.

A thorough text screening came next, which supported the JBI evaluation of the chosen studies. By assessing the validity of the source and the credentials of the authors, the entire procedure contributed to ensuring the caliber of the final articles that were added to the research. This thorough research design also has the benefit of supporting the methodology of the initial investigation. All of these were taken into account when assessing the degree of quality of the research articles that were included, along with the coherence and clarity of the conclusions. The findings of this quality rating affected the weight that each study receives in the overall analysis and conclusions drawn from this study. The methodological approach of this study ensures a systematic, exhaustive and objective assessment of the literature, which is crucial for understanding the mHealth apps that are prescribed in addition to drugs to help the management of chronic illnesses in adults.

Step 5: Collating, summarizing and reporting the findings

This phase was divided into three smaller phases: data analysis, outcome reporting and interpretation. To illustrate the features and distribution of the included studies, a descriptive numerical summary was performed for the first substage. As a qualitative research method, content analysis was used in this study to examine and interpret its findings. There are two main approaches that may be used in content analysis: One

can categorize them as deductive or inductive. Inductive content analysis is a technique used by researchers to create hypotheses and analyze the data by examining written and unwritten data, recordings and documents. Both deductive inductive approaches require data collection, interpretation and analysis group selection during the preparation phase (Elo & Kyngäs 2008). In this case, the data was organized using open code, allowing the researcher to make abstractions and classifications based on the information collected. By employing this technique, the author was able to identify the main topics in the field of interest in connection to the study topic (Drisko & Maschi, 2016).

In reporting, to identify the theme from the data in the selected articles, the thesis's author used inductive content analysis. In the first phase, the author reviewed the materials several times in order to extract the data that is crucial for the study. The next step in the analysis process involved assessing the data gathered and locating a few claims made in the text that are relevant to the thesis topic. The statements found were divided into more manageable groupings by highlighting similarities and differences. There were fewer subcategories when similar heads are combined to form primary categories. The researcher gained more knowledge and a deeper understanding of the data presented in the articles through this process. Consequently, information regarding the types prescribed and barriers to implementing mHealth apps for managing chronic diseases among adults was obtained from the text analysis. Lastly, the author pointed out potential gaps in the existing research and recommended techniques that are appropriate.

4.2 Ethical considerations

By not plagiarizing, the researcher made sure the study complies with ethical standards. Dhammi and Haq (2016) describe plagiarism as using someone else's words or ideas without properly citing the original author. The evidence-based material obtained from scientific sources guided the author while working on noteworthy area related to the chosen topic. The researcher made sure to paraphrase all the data obtained from the selected articles. In this case, the study's findings were presented by the researcher in their own words in an easy-to-read analysis and data conclusion. The review followed the responsible conduct of research as set out by the Finnish Advisory Board on Research Integrity (2012) , accordingly.

5 Findings

This chapter reports the findings of the study. This review's first section defines and describes prescribable mobile health apps that are used to treat adults' chronic illnesses. Within the framework of this research, "prescribable mHealth apps" refer to health applications that are currently on the market, have demonstrated efficacy and are ideally standalone. Stand-alone mHealth apps that can be "prescribed" by physicians (general practitioners) can be combined with other straightforward, inexpensive non-pharmaceutical interventions that are readily available and proven to be effective. These apps do not require specialized central servers or extra human resources, such as ongoing medical professional monitoring (Byambasuren et al., 2018). As per the study findings, numerous mHealth applications are available to help manage chronic conditions. However, this study reported the most common and proven effective mHealth apps for managing chronic diseases in adults. The obstacles to the prescription of mHealth applications to adults with chronic diseases by healthcare professionals are identified and explained in the second part.

Table 2. Summary of the mHealth Apps findings

Themes	Sub-themes (examples) MHealth apps
mHealth apps for diabetes management	Short Message Service (SMS) and Multimedia Message Service (MMS) Bant app WellDoc app MyBehavior
mHealth apps for HIV management	Short Message Service (SMS) and Multimedia Message Service (MMS)
MHealth apps for Asthma management	Short Message Service (SMS) and Multimedia Message Service (MMS) Asthmahero
MHealth apps for skin cancer/diseases	eSkinHealth app SkinScan SkinVision NLR SkinApp MyMealMate (MMM)
mHealth apps for depression management	SuperBetter
mHealth apps for dementia management	iWander application SMS and MMS ITTM EasyWorks
mHealth apps for general chronic disease management	Twine Health App

5.1 Chronic diseases mHealth management apps

5.1.1 Asthma mHealth management apps

Short Message Service (SMS) and Multimedia Message Service (MMS)

The findings of this review revealed that one of the prescribed mHealth apps used by healthcare professionals to monitor and manage chronic diseases in adults is the mobile phone messaging applications, such as Multimedia Message Service (MMS) and Short Message Service (SMS), as per the study by De Jongh et al. (2022). This study looked into how chronic disease self-management might be aided by mobile phone texting (SMS and MMS). The research evaluated the influence on health outcomes and patients' ability to self-manage their condition via mobile phone messaging programs intended to support self-management of long-term illnesses. According to this study, MMS and SMS offer accessible and affordable means of promoting self-management and enhancing patients' self-efficacy for example by sending supportive messages or reminding patients to take their medications. The results showed moderate-quality evidence that these kinds of applications might, in certain circumstances, improve asthma patients' health and capacity to control their illness; however, there was no discernible improvement in other outcomes (De Jongh et al., 2022).

Another study by Patel et al. (2022) confirmed the above finding and showed evidence of moderate quality from one study which showed, when compared to the control group, asthma patients who received a text messaging intervention improved more on peak expiratory flow fluctuations and the pooled symptom score, which included four items (cough, nighttime symptoms, quality of sleep and highest tolerated activity).

Asthmahero

Asthmahero targets asthma skills for self-management. This application is a mobile asthma action plan that aids patients in managing asthma symptoms and complications via alerts and reminders. This app provides guidance to medical professionals and families through a collection of a designed daily participatory plan that includes a detailed overview of how to recognize moderate-to-severe signs and symptoms of asthma attacks. The Asthma Hero reminds consumers of the measures that need to be taken

at varying levels of severity of symptoms, which include when to call 911 (Pérez et al. 2019). A study by Pérez et al. (2019) found that the Asthmahero app has an attribute that enabled the participants to interact and share their experiences with other people via social media to work alongside education and reassurance of shared real-life experiences. When utilizing this app instead of only taking medicine, the study's results demonstrated an improvement in asthma management. The software boosted users' confidence in their ability to control their asthma and served as a helpful medication reminder (Pérez et al., 2019).

5.1.2 HIV mHealth management apps

SMS and MMS

The breadth, efficacy, acceptability and practicability of using mobile phone texting for HIV infection treatment, prevention and care were evaluated in a study conducted in 2019 by Velthoven et al. The findings demonstrated the effectiveness of SMS texting on mobile phones for HIV care. SMS helped HIV patients take their medications more consistently.

5.1.3 Dementia mHealth Management Apps

iWander application

An mHealth app called iWander is used to manage chronic illnesses. It is aimed to partially ease stress and financial load and enable simpler remote monitoring for care providers by using the social network of users as a monitoring tool. It's an app that can run on any android-capable device with the right hardware. The program gathers information from the device's sensors, including the GPS, time of day, weather, dementia stage and user input, while operating in the background. The likelihood that the individual is roaming is then calculated by utilizing Bayesian network techniques to analyze this data. iWander can then automatically take action based on probability to help guide the patient to a safe location, alert caregivers, offer the patient's current location and call 911 (Sposaro et al., 2020).

The study conducted by Sposaro et al. (2020) concentrated on dementia in older persons who were 60 years of age or older. For these patients to complete everyday tasks, caregiver support is sometimes necessary. The study's author used the android app iWander, which tracks users' locations and offers help when needed, to track participants' whereabouts using GPS and smartphone communication features. It has

been demonstrated that the method increases dementia patients' functional independence while lowering caregiver stress (Sposaro et al., 2020).

ITTM EasyWorls

Another device, called ITTM EasyWorls, is based on a mobile phone and has balance sensors built in. If the system senses a sudden impact, it will automatically contact SOS numbers. This is a for-profit mobile health application that monitors safety for those with long-term conditions, including dementia and diabetes. According to a study, ITTM EasyWorls help identify and prevent falls, which makes them useful for controlling dementia in patients (Patel et al., 2022).

SMS and MMS

According to a study by De Jongh et al. (2022), MMS and SMS offer simple and affordable means of assisting patients with self-management and enhancing their abilities to self-efficaciously through messages that offer supportive messages, therapy modifications, or prescription reminders, among other things. The results showed a moderate quality of evidence that, in certain situations, these kinds of applications might actually have some positive effects on the health status and self-management skills of patients with diabetes; however, no discernible effect was seen for some outcomes (De Jongh et al., 2022).

5.1.4 Chronic skin disease mHealth management apps

Smartphone apps for skin cancer have been shown to offer a technical method to help individuals with questionable lesions determine whether or not to seek out additional medical care. Since most modern smartphones can now take excellent photos, a plethora of "skin" apps with various functions have been created. These skin care applications can serve as a source of information, help with self-skin examination, track skin issues and offer counsel or advice over when to contact a doctor. With the help of these apps, patients may learn more about their illnesses and the available therapies, as well as take control of their own dermatological health (Flaten et al., 2018). Among these apps are the eSkinHealth app, SkinScan, SkinVision, NLR SkinApp, DermaAI-Dand Dermion. However, this study only discusses the apps that have data supporting their efficacy when recommended by health professionals.

eSkinHealth app

This is a mHealth app that has been field-adapted to offer medical professionals in a remote location direct diagnostic and management support. The two primary purposes of the eSkinHealth app are to act as a mobile electronic health record and as a teledermatology platform for users who require assistance from an expert who is located far away. Six main screens comprise the current eSkinHealth app: photo list, evolution list, clinical notes, symptom list, basic symptomatic information and patient ID and demographics (Freeman et al., 2020). It has been discovered that these mHealth apps are useful for managing chronic conditions such as skin conditions and skin cancer (Freeman et al., 2020). The usability and efficacy of the eSkinHealth app, which is integrated into a monitoring system to enhance the management and detection of skin NTDs and other skin disorders, were demonstrated in a further study conducted by Yotsu et al. (2023).

SkinVision and SkinScan

Additional examples of skin apps are the SkinVision and SkinScan applications, which are designed to assist in the early identification of skin cancer or monitor moles over time in an effort to identify melanoma early in the course of the disease (Freeman et al., 2020). These two apps are the only two CE (Conformit Européenne)-designated apps that have been found to be presently available for downloading in various regions of the world, according to the results of Freeman et al. (2020). When they were used, the precision of skin cancer diagnoses gradually improved (Freeman et al., 2020).

NLR SkinApp

This is a smartphone application (app) designed to help frontline health workers (FHWs) identify, suspect and refer individuals with skin problems as soon as possible. The software covers skin problems associated with HIV/AIDS, neglected tropical diseases (NTDs) like leprosy and common skin diseases (Mwageni et al., 2024). Mwageni et al.'s study from 2024 tested the NLR SkinApp's supportive role by analyzing the third edition's diagnostic accuracy. According to the study's findings, FHWs utilizing the NLR SkinApp correctly diagnosed 45 percent of the patients. The results showed that the FHWs utilizing the NLR SkinApp had sensitivity values of 23 percent for skin disorders associated with HIV/AIDS to 76.9 percent for eczema and specificity values of 69.5 percent for eczema to 99.3 percent for tinea infections. The positive results for eczema diagnosis show the potential value of the NLR SkinApp for FHWs' dermatological and leprosy care (Mwageni et al., 2024).

5.1.5 Diabetes management apps

Bant app

One mHealth app used for diabetes management is called Bant. The goal of this app is to better manage type 1 diabetes. In addition to providing instruction and reassurance of shared lived experiences, this app's feature allows users to share their first-hand knowledge with peers through social media, according to a study by Pérez et al. (2019). The software also featured graphical representations of illness-specific control measures and gamification components. The mobile apps' gaming features were well-liked by the patients, who believed that accruing points encouraged consistent app use and medication adherence. This functionality would significantly advance the creation of future apps. Finding out what characteristics patients enjoy in applications could help to create a generic app that can be easily customized through "in-app" updates instead of creating one that is illness-specific and incorporates these common elements. In addition to self-management, the app could be a helpful resource for teenagers with type 1 diabetes. The results of the other four studies showed improved understanding of the illness and improved therapy compliance including improved medication compliance when daily chelation therapy participants used "selfie videos" to document their sessions (Pérez et al., 2019).

WellDoc

This is a diabetes management software solution that runs on a mobile device and is integrated with internet-based data analytics and therapy optimization capabilities. This software (the WellDoc app) integrated hypo- and hyperglycemia management algorithms, showed patients' prescription regimens, offered real-time feedback on blood glucose levels and requested more data (needed) to assess diabetes care in research by Quinn et al. (2018). The results showed that using WellDoc's software, people with type 2 diabetes saw statistically significant improvements in their A1c. The system's impact on patient satisfaction and healthcare professionals was statistically and clinically substantial (Quinn et al., 2018).

MyBehavior

MyBehavior is an application for smartphones that takes a distinctive approach in producing profoundly personalized health feedback. It blends cutting-edge behavior monitoring with algorithms that are utilized in systems for recommendation. MyBehavior instantly monitors the physical activity and food behavior of users and strategically advises modifications to those habits for a healthier lifestyle. The multi-armed bandit algorithm, an ordered decision-making technique, is utilized by the system to produce recommendations that optimize calorie loss while being user-friendly. Additionally, the system uses the Pareto-Frontier algorithm to consider user preferences in order to promote adoption (Zhao et al., 2019). MyBehavior was found to be beneficial in helping diabetes patients manage their illnesses, as evidenced by a 14-week study by Rabbi et al. (2019), which revealed statistically significant improvements in physical exercise and reductions in food calories when compared to a control condition.

SMS and MMS

Furthermore, a different study conducted by De Jongh et al. (2022) revealed that there was moderate quality evidence that showed diabetes patients getting the text messaging intervention improved on measures of self-management capacity and the pooled score from the Diabetes Social Support Interview but did not show improved diabetes knowledge. Evidence of the impact on adherence to treatment was of a modest caliber. Initially, diabetic individuals who received text message alerts also returned higher blood glucose values (46.0) than those who received email prompts (23.5) (De Jongh et al., 2022).

5.1.6 Obesity mHealth Management Apps

MyFitnessPal

MyFitnessPal is a popular smartphone software that helps patients lose weight in their primary care clinic. It depends on social-cognitive theory. The user's personalized daily calorie target is displayed by the MFP app. The app shows the user's daily calorie target in relation to their reported daily caloric consumption. Additionally, MFP provides users with real-time data that displays their weight trend, weekly calorie consumption and nutritional breakdowns of their meals (such as salt milligrams and grams of fat, carbs and protein). The software also has a social networking function that lets users discover friends and share their success, as well as a bar code scanner for meals purchased from stores (Laing et al., 2021). Laing et al. (2021) evaluated MyFitnessPal,

one of the most well-liked commercially accessible weight loss applications, for managing obesity. The results demonstrated that during a 6-month period, the app proved ineffective in assisting overweight individuals in losing weight in a clinical context. According to the study's findings, smartphone applications for weight loss may be helpful for those who are prepared to track their own caloric intake, but most patients are unlikely to see a significant decrease in weight after using them (Laing et al., 2021).

SmartDiet

SmartDiet is an mHealth app that examines regular exercise patterns and dietary intake. Using a diet game, it offers a customized diet profile and advances nutrition understanding (Lee et al., 2020). In case-control research published in 2020, Lee et al. assessed how well the SmartDiet app worked for obtaining dietary information, managing weight and ensuring user happiness. The study's findings showed that the intervention group's body mass index (BMI), weight and fat mass were all significantly lower than those of the control group. The results showed that the smartphone weight-management app SmartDiet appeared to help obese adults lose weight (Lee et al., 2020).

MyMealMate (MMM)

Using a behavioral strategy based on evidence, the study team created the MMM smartphone app intervention. Goal-setting, self-monitoring of food and exercise and weekly text message feedback are all included in the app (Carter et al., 2023). In their 2023 study, Carter et al. contrasted two control groups one that used an online food diary (MMM) and the other that used a paper-based food diary with an app intervention group that was developed using an evidence-based behavioral approach. When comparing the mHealth app group to the internet-based website group and the paper-based diary group over the course of the 6-month study period, there was a statistically significant increase in trial adherence. Moreover, the app intervention group had the largest changes in mean weight, BMI and body fat (Carter et al., 2023).

In another study by Byambasuren et al. (2018), the MyMealMate app revealed a statistically significant variation in weight reduction between the groups. The MyMealMate app featured goal-setting, automated text messaging and physical activity tracking, in addition to the calorie counts of 23,000 food brands exclusive to the United Kingdom. The app group shed a significant amount of weight and BMI when compared to a self-monitoring slimming internet site, but not when compared to the control group, which utilized a paper diary with calorie tracking (Byambasuren et al., 2018).

5.1.7 Depression mHealth Management Apps

SuperBetter

An app called SuperBetter for Chronic Disease Management (CDM) aids in enhancing mental wellness. This software offers easy workouts that users can perform whenever they need them, whether they are depressed, facing inner demons or just need some support. Every task corresponds with an objective they wish to reach and helps them take little steps in that direction. It also proactively acknowledges the person's successes. The "fortified" version of the SuperBetter app, which includes additional cognitive behavioral therapy (CBT) and positive psychotherapy content, was compared against the basic version of the app in research by Roepke et al. (2018), along with a waiting control group. The study's conclusions showed that both app groups' depression scores decreased similarly when compared to the control group, but during the course of four weeks, both app groups saw a high attrition rate of 80 percent (Roepke et al., 2018).

5.1.8 General chronic diseases mHealth apps

Twine Health App

Twine Health is a digital health startup that created a platform for managing chronic diseases on the cloud called the TwineHealth app. Patients having a diagnosis of a condition such as hypertension (high blood pressure) are assisted by this platform. Individual treatment plans are developed by patients in collaboration with their physician and a health coach. The health coach also oversees the patients' adherence to the treatment regimen. If a patient discontinued taking their prescriptions, for instance, a health coach could collaborate with them to come up with solutions (such as changing the timing of their dose). Research has demonstrated that using Twine Health lowers expenses and enhances health outcomes (Singh & Landman, 2018).

Following a diagnosis of a chronic illness, a patient's doctor can use the Twine app to create a comprehensive treatment plan that includes recommended diet, exercise, medication and regular patient monitoring of symptoms (such as blood pressure for patients with hypertension or blood sugar levels for people with diabetes). A management plan is created by the patient, doctor and health coach based on the patient's specific needs and health objectives. The patient receives reminders from the app when they have tasks to complete or information to enter. The patient and the coach communicate

on a frequent basis via the app. The coach checks in with the patient and responds to brief inquiries about the treatment plan or the patient's symptoms. The doctor is consulted when needed (Singh & Landman, 2018).

When utilized as intended, the app has shown promise in assisting patients in controlling their condition and lowering the frequency of in-person check-ups with doctors. For example, intervention subjects in a study by Moore et al. (2024) received apprenticeship support via the Twine Health tablet application from a nurse health coach. Patients used a wireless device to monitor their blood pressure and medication adherence and a coach used integrated messaging to support them while they changed their lifestyle and adjusted their medications. The same coach provided support to control subjects via standard office visits, phone conversations and emails. 42 of the 44 participants in the study finished it, according to the results. At 12 weeks, intervention individuals' systolic blood pressure decreased more than that of control subjects', suggesting that the use of the app improved the results, experience and cost of treatment for hypertension management (Moore et al., 2024).

Table 3. Summary of the findings to barriers into the use of mHealth Apps

Themes	Barriers
Technical barriers	<ul style="list-style-type: none"> the lack of existing technology User-friendliness Concerns regarding regulation and efficacy of application Compatibility with the workflow Security and privacy concerns Connectivity speed
Individual barriers	<ul style="list-style-type: none"> A lack of physician support Difficulty understanding the technology Resistance to change Human appeal Knowledge and limited literacy
Healthcare systems barrier	<ul style="list-style-type: none"> Legal barriers Economic and financial factors Reimbursement and accountable care organizations, Lack of standards Lack of health system policies

5.2 The barriers to the prescriptions of mHealth applications in adults with chronic diseases by healthcare professionals

The results of the study indicate that mHealth apps have a significant potential to improve chronic disease self-management. Even so, there are still several obstacles that appear to be impeding the usage of mobile health (mHealth) applications in the medical field. Three types of barriers were identified by this review: those pertaining to the healthcare system, individuals and technology. Eight variables were identified as technical barriers: the absence of current technology, worries about application efficacy and

regulation, workflow compatibility, security and privacy issues, ease of use, connectivity speed, lack of interoperability and system integration. Five individual barriers were identified: low literacy and expertise, unwillingness to change, difficulty comprehending technology, personal appeal and lack of support from physicians. Five reasons were identified as impediments to the healthcare system: lack of standards, absence of health system regulations, reimbursement and accountable care organizations, financial and economic factors and legal barriers.

5.2.1 Technical barriers

Lack of existing technology

The absence of current technology has been cited by medical professionals, particularly doctors, as one of the main obstacles to increased mHealth use. The term "technology" describes the assortment of methods, abilities, evidence, procedures and approaches that are applied in real-world situations to address issues. Currently, there are few evidence-based and targeted procedures to assist the adoption of new technologies, particularly mHealth applications like those for managing chronic conditions, despite the fact that technological advancements are pervasive (Zakerabasali et al., 2021).

Concerns regarding efficacy and regulation of applications

Although mHealth apps make attractive claims, their effectiveness is not supported by evidence-based studies in real-world settings. Healthcare practitioners are therefore worried about using these apps and complying with their rules (Laxman et al., 2019).

Concerns about security and privacy

When creating and delivering an innovative technology or application, several factors are typically overlooked. Privacy and security are among the most crucial factors to take into account, particularly in apps that handle patient data pertaining to their personal and medical state (Zakerabasali et al., 2021). Another significant obstacle to the expansion of the chronic illness management app market is the lack of trust that many users have in these applications due to concerns about their privacy and data protection. Moreover, one of the main problems facing app developers is the accuracy of the apps for managing chronic diseases. Patients continue to have serious concerns about the erroneous data these applications display, which is impeding the development of CDM apps (Ardito et al., 2023).

User-friendliness

If mobile health platforms are sufficiently useful, they can significantly enhance patient-physician communication and self-care. These applications are now a necessary component of the healthcare industry. Their ease of use is crucial to the satisfaction of healthcare professionals. Most reports on mobile health apps show that poor usability might result in app failure (Ardito et al., 2023).

Compatibility with the workflow

Healthcare professionals' workflows must be interoperable with the mHealth apps they utilize. In addition to improving their workflow patterns, this will help providers feel more comfortable utilizing this technology (Laxman et al., 2019). Nevertheless, a hurdle to the use and recommendation of these apps in conjunction with other interventions for patients with chronic diseases to manage their symptoms has been their incompatibility with the workflow of healthcare professionals (Kao & Liebovitz, 2018).

Connectivity speed

Although promising innovations may be developed, it is crucial to remember that their implementation typically calls for the right kind of infrastructure to support them. For optimal functioning, high-speed network connectivity is necessary for mHealth technologies. Both the performance and the acceptance of these technologies by healthcare practitioners may be hampered by the lack of high-speed network connectivity (Zakerabasali et al., 2021).

5.2.2 Individual barriers

Lack of physician support

The WHO research claims that the adoption of mHealth technology has altered perceptions of healthcare delivery globally. Nonetheless, doctors have paid little attention to the advancement of mHealth in the healthcare sector, despite the fact that healthcare professionals' knowledge of and use of mHealth technology positively impacts the technology's growth and success (Laxman et al., 2019). It is difficult for doctors to promote these mHealth apps to patients in addition to medical therapies because many of them are still unfamiliar with them (Zakerabasali et al., 2021).

Resistance to change

Although a lot of healthcare organizations are keen to adopt new technology, doctors are quite reluctant to do so because they are afraid of losing patients, they are not trained to use mobile devices and they have medical responsibilities (Laxman et al., 2019). According to Triantafyllidis et al. (2019), putting these technologies into practice particularly mHealth requires altering organizational structures and procedures, which frequently run into resistance. One major obstacle preventing healthcare practitioners from utilizing new technologies is their resistance to change. Organizational, individual and technical issues are a few typical obstacles (Triantafyllidis et al., 2019).

Difficulty understanding the technology

Many senior doctors worry that they are "getting it wrong" when using and comprehending mHealth apps, which causes them to struggle greatly (van Heerden et al., 2022). This makes it difficult for them to suggest these apps to patients in order to help with the management of chronic illnesses, even if there is strong evidence that these apps improve the management of self-care (Zakerabasali et al., 2021).

Human appeal

Mobile technology is transforming the way people engage with each other. Health care professionals and their patients can communicate more effectively thanks to mobile health technologies, particularly mHealth apps. However, a significant barrier to the adoption of mHealth technologies is the absence of in-person human connections (van Heerden et al., 2022).

Knowledge and limited literacy

Despite having no obvious cognitive or physical barriers, healthcare workers with minimal computer literacy are unwilling to complete their jobs using mHealth applications. Hence, they are less likely to adopt mHealth technology (Kao & Liebovitz, 2018).

5.2.3 Healthcare system barriers

Legal barriers

The trust difficulties surrounding healthcare professionals are intimately linked to legal issues. Physicians in most countries do not embrace and cooperate with mHealth applications because they lack confidence in them due to a lack of legislation (Laxman et al., 2019). Due to a lack of matching regulation, Zakerabasali et al. (2021) identified

health data exchange and distribution via mobile devices as the primary concerns of physicians.

Reimbursement and accountable care organizations:

Healthcare professionals are also concerned about reimbursement when utilizing emerging technologies, including mHealth applications, for care that is provided via these devices. To get past some of the current obstacles and constraints, appropriate reimbursement would necessitate making certain adjustments to procedures and regulations (Zakerabasali et al., 2021).

Economic and financial factors

These elements speak to the monetary means required to extend mHealth in developing nations' rural areas. In order to prepare and employ these new technologies, financial resources and economic assistance are required for the provision of the necessary equipment, tools and technological infrastructure (Laxman et al., 2019).

Lack of health system policies

A society's decisions, strategies and activities aimed at achieving particular healthcare objectives are referred to as health policy. When it comes to the usage of mHealth, healthcare providers are concerned about the lack of mHealth sector rules and plans (Kao & Liebovitz, 2018).

Lack of standards

An accepted method of doing anything is called a standard and standards are essential to the interoperability of healthcare technologies and systems. Furthermore, according to healthcare experts, the advancement of mHealth technology is hampered by the absence of standards for things like identifiers, messages, structure and content, clinical terminology and classification, security and access control. As a result, mHealth technology standards must be created (Zakerabasali et al., 2021).

6 DISCUSSION

6.1 Summary of the findings, contribution and implications

This scoping review aimed to determine the scope and kinds of smart device-based mHealth applications research activities recommended for chronic disease management for adults. The research objectives were to identify the most common prescribed mHealth applications used to monitor chronic diseases in adults and to determine the barriers to the prescriptions of mHealth applications in adults with chronic diseases by healthcare professionals.

6.1.1 The most common prescriptive apps for chronic disease management

The study found that there are various mHealth apps available for managing various chronic illnesses such as diabetes, asthma, HIV, obesity, depression, dementia and skin cancer diseases, among others. These apps include Short Message Service (SMS) and Multimedia Message Service (MMS), Bant app, WellDoc app, MyBehavior, Astmahero, eSkinHealth app, SkinScan, SkinVision, NLR SkinApp, MyFitnessPal, SmartDiet, MyMealMate (MMM), SuperBetter, iWander application, SMS and MMS, ITTM EasyWorks and Twine Health App. This high number of mHealth apps available for chronic disease management may be attributed to the rapid technological advancements that have seen the development of these apps grow tremendously. This finding concurs with Wang et al.'s (2021) finding, which revealed that the creation and utilization of mHealth apps to manage health and wellness have surged as a result of the internet's and mobile platforms' quick development. The study found that the younger persons with higher incomes and educational levels had a higher likelihood of using mHealth apps for the behaviors of self-management under investigation (Wang et al., 2021). The result is further consistent with Duplaga and Tubek's (2018) assertion that the broad accessibility and widespread use of smartphones have led to the increased accessibility of mHealth applications in comparison to the earlier options of eHealth and telemedicine. In a number of nations, the number of people using smartphones is rapidly increasing and has surpassed the number of individuals using stationary Internet (Duplaga & Tubek, 2018).

The results also showed that there are differences in the development of mHealth apps. Certain apps, like the Bant app for diabetic management and Astmahero for asthma management, are made with a single function in mind, while others, like the

Twine Health App, SMS and MMS for managing many chronic diseases, are made with a wide purpose in mind. For example, the results demonstrate that SMS (messaging apps) can be used to manage a variety of chronic illnesses (due to their multipurpose nature), including HIV, diabetes and asthma. The results also demonstrate the effectiveness of SMS in improving the management of these conditions, for example, by assisting patients in adhering to medication regimens through text reminders. This finding aligns with Fan and Zhao's (2022) assertion that to address a variety of health challenges, interdisciplinary teams develop mobile health applications, or mHealth apps, with diverse functional modules. Certain programs serve multiple purposes, whereas others are limited to a single main goal. For example, the "skin app" for online skin cancer screening is a specialized smartphone application that has been approved by dermatologists. MHealth applications help people understand and take care of their ailments by providing features including education, prescription reminders, tracking and feedback and support for rehabilitation. (Fan & Zhao, 2022).

The study findings revealed that mHealth apps on smartphones or tablets facilitated the self-management behaviors of patients with chronic illnesses, hence the management of these diseases. The findings showed that using mHealth apps is effective at improving the self-management behaviors of individuals with chronic conditions compared to using traditional education methods given by physicians alongside medications. Using these apps alongside medication for patients with chronic conditions was found to improve adherence to treatment, medication and self-care activities and improve functional independence among dementia patients while decreasing the stress put on caregivers (iWander app). Overall, using these apps improves their ability to manage their own chronic conditions. This finding is in agreement with Moyano et al. (2019), who found that the cornerstones of managing chronic diseases are patient involvement and self-management. Self-management assistance is the intentional, frequently continuous supply of information and encouraging interventions to improve an individual's capacity and self-assurance in managing their health issues. One of the defining elements that contributes to the chronic disease trajectory's meandering course is poor adherence. Conventional educational treatments are important for increasing knowledge, but they are rarely enough to alter behavior. Globally, mHealth technologies are extensively employed for a wide range of chronic conditions to provide information and patient education. mHealth technology can be used to inform, inspire and prepare patients and their families (Moyano et al., 2019). This finding further concurs

with Wang et al. (2021), who assert that using mHealth apps is a somewhat simple approach to increasing one's knowledge about diseases and health, which aids in making the right decisions one of the six areas of self-management behavior.

Song et al. (2022) and Amdie and Woo (2020) assertions further support this study finding that using mHealth apps is effective at improving the self-management behaviors of individuals with chronic conditions compared to using traditional education methods given by physicians alongside medications. According to Song et al. (2022), while patient-centered approaches facilitate the adoption of successful self-management habits by both patients and medical professionals, the execution of practice guidelines is often inadequate. Inappropriate implementation may result from patients' complex social and emotional demands as well as the resources and time that healthcare professionals have in short supply (Song et al., 2022). Alternatively, mHealth apps are widely available and may help to eliminate these barriers by empowering patients to regularly adhere to their long-term self-care routine (Amdie & Woo 2020). Furthermore, Bashi et al. (2018) agree with this finding, as they point out that self-management programs based on mobile health have a lot of research supporting their increased efficacy and efficiency. For example, web-based diabetes education showed a noteworthy improvement in nutrition, physical activity, blood pressure and blood glucose levels. Technologies for mobile health that are person-centered and contextually designed can also help to empower and activate patients. mHealth technologies can help with the development and implementation of self-management programs as well as the creation of social support networks. The creative use of social media could increase access to healthcare (Bashi et al., 2018).

Thus, due to the vast evidence from this study of the importance of mHealth apps in helping patients manage their conditions, this implies that there should be an increase in adoption of these apps through increased availability and accessibility of these apps among healthcare professionals and patients. Healthcare professionals should increasingly recommend these apps for long-term medication and therapies to enhance patients' capabilities to manage their chronic conditions through improving their self-care skills, such as medication and treatment adherence and other self-care activities essential for their illnesses.

6.1.2 The barriers to the prescriptions of mHealth applications in adults with chronic diseases by healthcare professionals

The results of this study showed that mHealth apps are being used more frequently and have a large potential to enhance chronic disease self-management. In addition to reducing stress on caregivers, using these applications in conjunction with medication for patients with chronic diseases has been shown to enhance adherence to treatment, medication and self-care tasks. It has also been shown to promote functional independence in dementia patients. All of them emphasize how crucial mobile health apps are for young adults' chronic illness management. However, there are still several obstacles that appear to be impeding the adoption of mobile health (mHealth) in the healthcare industry, even in spite of the field's expanding use of mHealth and its importance in managing chronic illnesses effectively.

Three types of barriers were identified by this study: those pertaining to the healthcare system, individuals and technology. The absence of existing technology, worries about regulations and the effectiveness of apps, security and privacy issues, ease of use, workflow compatibility, connectivity speed, lack of compatibility and system integration were the seven technical impediments. Five individual barriers were identified: low literacy and expertise, unwillingness to change, difficulty comprehending technology, personal appeal and lack of support from physicians. Five reasons were identified as impediments to the healthcare system: lack of standards, absence of health system regulations, reimbursement and responsible care organizations, financial and economic factors and legal barriers.

This finding of privacy and security concerns (technical barriers) is in line with Steinhubl et al. (2015), who assert that concerns about mHealth technologies' privacy and security are on the rise. Relevant healthcare data may be lost owing to cybersecurity vulnerabilities, despite its promising capacity to preserve and retrieve patient information (Steinhubl et al., 2015). The results of Agarwal et al. (2015), who discovered that usability is another barrier to the adoption of mHealth applications because it requires enhancing the interoperability of digital platforms, which can be frustrating, are further corroborated by the finding of a connectivity speed barrier and a lack of interoperability and integration with other systems (under technical barriers). Certain mHealth technologies can call for extra hardware, including patient devices, specialized secure computer gear and internet access. When internet connectivity is restricted, the efficacy of

internet-dependent technologies (such as mHealth applications) may be reduced (Agarwal et al., 2015).

The barrier regarding user-friendliness, knowledge and limited literacy is in agreement with Steinhubl et al.'s (2015) findings that, due to the increased complexity of utilizing these apps, low literacy and language difficulties have been identified as significant obstacles to the adoption of mHealth. The authors go on to say that the prevalence of erroneous and unconfirmed information is another drawback of mHealth technologies and that information correctness and dependability are linked to inadequate knowledge. Certain mobile applications and web-based mobile health technologies might include inaccurate information that puts patients' health at risk (Steinhubl et al., 2015). To address this issue, mHealth technologies, such as mobile apps, should be closely monitored by authorities and professionals through the establishment of a robust support system (Gurupur & Wan, 2017). Complexity could also be decreased by providing the option to translate written and audiovisual content and matching the language used by consumers and service providers. Thus, avoid using medical terminology but using polite and non-coercive language (Steinhubl et al., 2015).

Overall, to overcome these barriers, the available literature made several significant solution suggestions. The results show that a major obstacle to the adoption and use of mHealth is the shortage of infrastructure. In this context, "infrastructure" mostly refers to the resources surrounding mobile health, like the Internet and mobile device access. Therefore, as the studies have shown, a Wi-Fi or service outage is a real impediment. Since almost every individual has a mobile device and access to the Internet, it is vital to ensure a strong national digital infrastructure in order to enable adoption. Increasing the availability of hotspots with free Wi-Fi is one method to make this happen. Having a mobile device that is both user-friendly and technically sound to use for mHealth purposes is another facilitator. However, a significant hurdle seems to be the cost of mobile phones and phone services, particularly for individuals with low socioeconomic status. Reimbursement coverage, as indicated by the findings, is therefore required. Governments and non-governmental organizations should form partnerships in order to provide finance, leadership and the necessary infrastructure. To guarantee that the population with phones keeps growing, collaborating with the commercial sector (e.g., equipment suppliers) is also advised (Agarwal et al., 2015).

Therefore, long-term policy and regulatory adjustments are required to guarantee widespread mobile phone coverage among individuals, particularly those with low socioeconomic levels and to ensure that mHealth is integrated into national and worldwide strategies. Since a lack of policies was frequently mentioned as a barrier to the integration of mHealth, the telephone service ought to be given priority within these policies to guarantee access to mHealth. Overall, robust governance ought to be implemented for this (Gurupur & Wan, 2017). Furthermore, Bashi et al. (2018) propose that mHealth should be simple to use and comprehend in order to break through the barriers of user friendliness and literacy. This is one of the evidence-driven design guidelines. Therefore, the hardware, software and services should be straightforward, simple to use easily accessible and reliable. Using interactive animated computer avatars in mHealth apps is one approach to getting around this. These avatars replicate social contact and make content easier to understand by using non-verbal cues like rudimentary speech and hand gestures. In order to encourage users to use these apps to assist them in managing their chronic diseases, this may also involve gamification and variation features (Bashi et al., 2018).

Lastly, instruction on texting and receiving messages, as well as using mobile apps and smartphones, would boost mHealth's acceptance among users and medical professionals, in addition to increasing its performance. Because participants cannot read and understand these messages, special care must be given to the illiterate while using SMS. The health system must also be designed with strategies to manage text messaging schedules, mobile network variations and phone turnovers in order to enhance treatment compliance and follow-up visits for infectious diseases, chronic illnesses, maternity care and birth defects (Gurupur & Wan, 2017).

6.2 Recommendations for further research

Reviewing the most popular prescription mHealth apps for young adults' chronic illness management was the main goal of this study. The assessment of the obstacles to healthcare professionals' use of these apps was another major topic of the study. The results were broad and addressed various contexts and locations, with a particular emphasis on managing chronic conditions. As technology develops, it is crucial to modify and rethink new interventions. It is anticipated that mHealth will flourish in both wealthy and developing nations, with new inventions appearing in the healthcare sector on an

exponential basis. To enhance each nation's health care system, it is critical to evaluate the discrepancies by country. Thus, future research should focus on evaluating the effectiveness of these apps on the management of chronic illness and assessing the barriers by country or region to understand the specific barriers that can help determine the specific facilitators that can be adopted to overcome the barriers and enhance access and adoption of mHealth apps to help in managing chronic illnesses.

6.3 Limitations

Limitations were identified despite the scoping review's careful mapping of the body of current material. Because one search strategy does not offer a thorough topic description, the search strategy's key terms are varied. The inclusion requirements restricted the outcomes. Examining articles only in the English language provides certain gaps in the analysis because of regional variations and the difficulties in providing breast cancer treatment. The emphasis was further limited by the exclusion criteria applied. This evaluation does not provide a thorough list of the most popular prescribable mHealth apps for managing chronic disorders. Furthermore, due to the time constraints of the articles that were examined, the obstacles and recommendations for remedies might not be all-inclusive. The reason for this is that there is a growing body of research on mHealth apps for managing chronic diseases and the obstacles to their adoption. As a result, the selection and inclusion of article samples in this review may not be exhaustive. As a result, it's possible that some potentially relevant research was overlooked during the thorough literature search that was done in the databases for this investigation. Additionally, a single person's search may be biased due to a lack of cross-checking. Nonetheless, the most representative cases revealed the key adoption trends for the apps as well as the obstacles. Furthermore, the relevant papers that were discovered to have been published earlier than 2018 that is, outside the study's restricted time frame were employed to strengthen the discussion chapter

7 Conclusion

Chronic illnesses lower millions of people's quality of life and put a heavy financial strain on the healthcare system. The protracted and incurable nature of chronic illnesses, coupled with the requirement for constant observation of signs and symptoms, have spurred and will continue to spur technological developments aimed at optimizing the management of chronic illnesses and the identification of signs and symptoms to

avert death, exacerbations, emergency room visits, unplanned hospital stays and disability. Advances in technology, like mobile health, are being used more and more to support the management of chronic illnesses for communication, data gathering, patient monitoring and provider and patient education in a range of healthcare settings, including clinics, out-of-clinic facilities and in-patient care. Evidence from this study suggests that by assisting patients with self-care management, digital technologies like mobile health (mHealth) technology can be leveraged to deliver effective and efficient healthcare to those with chronic illnesses. According to the findings, mHealth apps can be recommended and used in conjunction with medications and therapies to help patients adhere to treatment plans, take their medications as prescribed and take care of themselves. They can also help dementia patients become more functionally independent while reducing the stress on caregivers. This demonstrates how important it is to use mHealth apps. Thus, in order to guarantee that solutions are developed to overcome these constraints and open the way for widespread use of mHealth apps in the management of chronic illnesses, all stakeholders including healthcare providers, patients, healthcare professionals and app developers need to work together.

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APPENDICES

Appendix 1

Critical appraisal of the selected articles using JBI

Number	Study authors, year	Purpose	Study design Sample and sample size Data collection methods	Critical appraisal (JBI)
1	Zhou et al., 2019	To ascertain the connection between users' privacy and security concerns and their characteristics, as well as to pinpoint desired security features in mHealth apps that may allay these worries.	Questionnaires and interviews were used. The questionnaire was used to determine the privacy and security concerns of mobile apps users concerning their personal health data in mHealth apps while the interview was used to identify the facilitators of and barriers to adopting mHealth. The study had a total 117 participants and data was analyzed using thematic analysis method.	9/10
2	Zakerabasali et al., 2021	to investigate the mHealth-related barriers that medical practitioners have reported	A systematic review that used 18 articles to derive data for analysis	9/10
3	van Heerden et al., 2022	To get a deeper comprehension of the perceived mHealth advantages and barriers for HIV testing, counselling and other services provided at home.	A qualitative study Used focus group discussions to collect data from a sample of 32 participants	9/10
4	Zhao et al., 2019	To assess the quality of the published research and the efficiency of mobile phone apps in changing health-related behavior in a wider range of treatments	Qualitative study that used literature review method to collect data from 23 articles	9/10
5	Kao & Liebovitz, 2018	To examine consumer-facing applications' present situation, obstacles and potential future paths (mHealth apps)	Qualitative study that used literature review method to collect data from 32 articles	8/10
6	Gleason, 2018	To look at mHealth adoption barriers and their opportunities for transforming international health care	Qualitative study that used literature review method to collect data from 27 articles	8/10
7	Laxman et al., 2019	To explore the obstacles that prevent CHI applications from being used effectively for health self-management from the patient perspective	Qualitative study that used literature review method to collect data from 36 articles	9/10

8	Velthoven et al., 2019	To evaluate the extent, efficacy, acceptability and practicality of using text messaging on mobile devices for HIV infection prevention, treatment and care	mixed method systematic review that used 21 articles to derive data for analysis	9/10
9	Yotsu et al., 2023	The purpose of this research is to assess the eSkinHealth app's usability and efficacy for identifying and treating skin NTDs and other skin disorders in rural Côte d'Ivoire.	A 2-arm trial with local health care providers and patients with skin diseases was implemented over a 3-month period. Used interviews to evaluate the system usability scale A total of 8 nurses and 16 community health care workers participated in the study	9/10
10	Triantafyllidis et al., 2019	The study's goal is to provide an overview of mobile health (mHealth) in the management of chronic diseases by highlighting the characteristics, results and related difficulties of mHealth interventions in this quickly developing field.	Systematic review that used 5 reviews, which examined 30 mHealth interventions as the articles to derive data	9/10
11	Sposaro et al., 2020	To describe a tool (iWander) that uses mobile applications to enhance the standard of care for dementia patients through helping in fall prevention	Quantitative study that used uncollected data from iWander app, which is evaluated using is evaluated using Bayesian network techniques	9/10
12	Singh & Landman, 2018	To investigate the potential to reshape healthcare delivery in the future including the barriers to their adoption such as privacy concerns and lack of integration	Qualitative research adopting literature review	8/10
13	Roepke et al., 2018	To assess whether the smartphone app SuperBetter (SB) or the SB website is a more effective way to relieve depression symptoms.	Randomized-controlled trial that recruited 283 adults to participate in the study	9/10
14	Rabbi et al., 2019	To look into the MyBehavior smartphone app, which uses a unique method to provide highly customized health feedback.	Qualitative 14 weeks study	8/10
15	Quinn et al., 2018	To evaluate the effects of using web-based data analytics and therapy optimization tools in conjunction with a mobile phone-based diabetes management software system (Welldoc) on A1c. Secondary objectives is evaluate how well health care providers (HCPs) implemented the technology and how closely they adhered to prescribing recommendations.	Randomized control trial using 33 diabetic patients	9/10
16	Pérez et al., 2019	To assess the usefulness and efficiency of Web- and mobile-based health applications that aid in transition and self-management for young patients suffering from long-term physical health conditions.	Systematic review using 6 articles selected to derive data for analysis	8/10

17	Patel et al., 2022	To provide an overview of recent advancements in wearable sensor and system technology that have bearing on the field of rehabilitation.	Systematic review using 21 articles to derive data for analysis	8/10
18	Mwageni et al., 2024	To evaluate the NLR SkinApp's supporting function by assessing the third edition's diagnostic precision	Cross-sectional study with 443 patients	9/10
19	Nguyen et al., 2024	Utilizing design thinking to develop a mobile application for digital health that is responsive to context and helps older folks take their medications as prescribed	Qualitative study using mixed methods of data collection including persona and scenario ideation, interviews, evaluations of existing solutions, prototypes and consultations with subject matter experts	9/10
20	Moore et al., 2024	To assess how well Massachusetts General Hospital's technology-enabled hypertension management apprenticeship compares to a successful coaching model	Randomized controlled trial using 128 hypertensive patients for a period of 12-weeks	9/10
21	Laing et al., 2021	To examine the impact of providing a free weight-loss smartphone app to primary care patients	Randomized, controlled trial using two academic primary care clinics	9/10
22	Lee et al., 2020	To assess the SmartDiet application's efficiency in obtaining dietary knowledge, managing weight and ensuring user satisfaction	Case-control study using 19 people in the intervention group and 17 people in the control group	9/10
23	Flaten et al., 2018	To analyze changes in dermatology mobile apps number since 2014 and discuss the drawbacks and benefits of mHealth growth to dermatology	Literature review using 19 articles	8/10
24	De Jongh et al., 2022	To evaluate the impact of mobile phone messaging reminders for attendance at healthcare appointments.	Systematic review using 8 randomized controlled trial studies	9/10
25	Freeman et al., 2020	To investigate the reliability and conclusions of research on the efficacy of algorithm-based smartphone applications (or "apps") in determining the likelihood of skin cancer in worrisome skin lesions	Systematic review of 9 selected diagnostic accuracy studies	8/10
26	Cruz-Ramos et al., 2022	To assess mobile health applications for managing CVD between 2014 and 2021	Scoping review 38 articles were analyzed	
27	Carter et al., 2023	To gather data on the viability and acceptability of a smartphone app-delivered self-monitoring weight control intervention (My Meal Mate (MMM)) as opposed to a website and paper diary.	Randomized control trial 128 overweight individuals	9/10
28	Byambasuren et al., 2018	To identify such apps, evaluate the evidence supporting their efficacy and highlight the gaps	Systematic review using 6 articles to derive data for analysis	9/10

		and constraints in mHealth app research by conducting an overview of systematic reviews		
29	Ardito et al., 2023	Employing the Consolidated Framework for Implementation Research (CFIR), a theory-guided implementation science paradigm, to investigate the enablers and barriers to the adoption of mobile health solutions by cancer patients receiving treatment.	A scoping literature review using 91 articles	9/10

Appendix 2

Assessment table

Code	Sub-theme	Theme
"The app gathers information from the device's sensors, including the GPS, time of day, weather, dementia stage, and user input, while operating in the background. The likelihood that the individual is roaming is then calculated by utilizing Bayesian network techniques to analyze this data. iWander can then automatically take action based on probability to help guide the patient to a safe location, alert caregivers, offer the patient's current location, and call 911" (Sposaro et al., 2020).	iWander application	Dementia mHealth management app
"This is a for-profit mobile health application that monitors safety for those with long-term conditions, including dementia and diabetes" (Patel et al., 2022).	ITTM EasyWorls	
"Offer simple and affordable means of assisting patients with self-management and enhancing their abilities to self-eficaciously through messages that offer supportive messages, therapy modifications, or prescription reminders, among other things. Enhance the self-management skills of dementia patients" (De Jongh et al., 2022).	SMS and MMS	
"This app provides guidance to medical professionals and families through a collection of a designed daily participatory plan that includes a detailed overview of how to recognize moderate-to-severe signs and symptoms of asthma attacks. The Asthma Hero reminds consumers of the measures that need to be taken at varying levels of severity of symptoms, which include when to call 911" (Pérez et al. 2019).	Asthmahero	Asthma mHealth management apps
"MMS and SMS offer accessible and affordable means of promoting self-management and enhancing patients' self-efficacy, for example, by sending supportive messages or reminding patients to take their medications. Showed moderate-quality evidence that these kinds of applications might, in certain circumstances, improve asthma patients' health and capacity to control their illness" (De Jongh et al., 2022).	MMS and SMS	
"It has been discovered that these eSkinHealth apps are useful for managing chronic conditions such as skin conditions and skin cancer" (Freeman et al., 2020)	eSkinHealth app	Chronic skin disease mHealth management apps
"These apps are designed to assist in the early identification of skin cancer or monitor moles over time in an effort to identify melanoma early in the course of the disease" (Freeman et al., 2020).	SkinVision and SkinScan	
"The results showed that the frontline health workers utilizing the NLR SkinApp had sensitivity values of 23 percent for skin disorders associated with HIV/AIDS to 76.9 percent for eczema, and specificity values of 69.5 percent for eczema to 99.3 percent for tinea infections. The positive results for eczema diagnosis show the potential value of the NLR SkinApp for frontline health workers' dermatological and leprosy care" (Mwageni et al., 2024).	NLR SkinApp	
"The findings demonstrated the effectiveness of SMS texting on mobile phones for HIV care. SMS helped HIV patients take their medications more consistently" (Velthoven et al., 2019).	SMS and MMS	HIV mHealth management apps
"The goal of this app is to better manage type 1 diabetes. In addition to providing instruction and reassurance of shared lived experiences, this app's feature allows users to share their first-hand knowledge with peers through social media" (Pérez et al., 2019)	Bant app	
"This is a diabetes management software solution that runs on a mobile device and is integrated with internet-based data analytics and therapy optimization capabilities. This software (the WellDoc app) integrated hypo- and hyperglycemia management algorithms, showed patients' prescription regimens, offered real-time feedback on blood glucose levels, and requested more data needed to assess diabetes care" (Quinn et al., 2018)	WellDoc	
"MyBehavior instantly monitors the physical activity and food behavior of users and strategically advises modifications to those habits for a healthier lifestyle. MyBehavior was found to be beneficial in helping diabetes patients manage their illnesses, as evidenced by a 14-week study which revealed statistically significant improvements in physical exercise and reductions in food calories when compared to a control condition" (Rabbi et al., 2019).	MyBehavior	
"A study revealed that there was moderate quality evidence that showed diabetes patients getting the text messaging intervention improved on measures of self-management capacity and the pooled score from the Diabetes Social Support Interview but did not show improved diabetes knowledge" (De Jongh et al., 2022)	SMS and MMS	

		Diabetes management apps
"A study evaluated MyFitnessPal, and the results demonstrated that during a 6-month period, the app proved ineffective in assisting overweight individuals in losing weight in a clinical context" (Laing et al., 2021)	MyFitnessPal	
"The study's findings showed that the intervention group's body mass index (BMI), weight, and fat mass were all significantly lower than those of the control group. The results showed that the smartphone weight-management app SmartDiet appeared to help obese adults lose weight" (Lee et al., 2020).	SmartDiet	
"The MyMealMate app revealed a statistically significant variation in weight reduction between the groups. The MyMealMate app featured goal-setting, automated text messaging, and physical activity tracking, in addition to the calorie counts of 23,000 food brands exclusive to the United Kingdom. The app group shed a significant amount of weight and BMI when compared to a self-monitoring slimming internet site" (Byambasuren et al., 2018)	MyMealMate (MMM)	Obesity mHealth Management Apps
"SuperBetter aids in enhancing mental wellness. This software offers easy workouts that users can perform whenever they need them, whether they are depressed, facing inner demons, or just need some support. Every task corresponds with an objective they wish to reach and helps them take little steps in that direction" (Roepke et al., 2018)	SuperBetter	Depression mHealth Management Apps
"Twine Health is a digital health startup that created a platform for managing chronic diseases on the cloud called the TwineHealth app. Patients having a diagnosis of a condition such as hypertension (high blood pressure) are assisted by this platform. Individual treatment plans are developed by patients in collaboration with their physician and a health coach" (Singh & Landman, 2018).	Twine Health App	General chronic diseases mHealth apps

Code	Sub-theme	Theme
"When it comes to the usage of mHealth, healthcare providers are concerned about the lack of mHealth sector rules and plans, limiting their interest in adopting these mHealth apps" (Kao & Liebovitz, 2018).	Lack of health system policies	Healthcare system barriers
"The trust difficulties surrounding healthcare professionals are intimately linked to legal issues. Physicians in most countries do not embrace and cooperate with mHealth applications because they lack confidence in them due to a lack of legislation" (Laxman et al., 2019)	Legal barriers	
"These elements speak to the monetary means required to extend mHealth in developing nations' rural areas. In order to prepare and employ these new technologies, financial resources and economic assistance are required for the provision of the necessary equipment, tools, and technological infrastructure, and lack of these limit their adoption" (Laxman et al., 2019).	Economic and financial factors	
"The advancement of mHealth technology is hampered by the absence of standards for things like identifiers, messages, structure and content, clinical terminology and classification, security, and access control. As a result, mHealth technology standards must be created" (Zakerabasali et al., 2021)	Lack of standards	
"Healthcare professionals are also concerned about reimbursement when utilizing emerging technologies, including mHealth applications, for care that is provided via these devices, calling for appropriate reimbursement" (Zakerabasali et al., 2021)	Reimbursement and accountable care organizations	
"Healthcare workers with minimal computer literacy are unwilling to complete their jobs using mHealth applications. Hence, they are less likely to adopt mHealth technology" (Kao & Liebovitz, 2018).	Knowledge and limited literacy	Individual barriers
"Although a lot of healthcare organizations are keen to adopt new technology, doctors are quite reluctant to do so because they are afraid of losing patients, they are not trained to use mobile devices, and they have medical responsibilities" (Laxman et al., 2019).	Resistance to change	
"Doctors have paid little attention to the advancement of mHealth in the healthcare sector, despite the fact that healthcare professionals' knowledge of and use of mHealth technology positively impacts the technology's growth and success" (Laxman et al., 2019)	Lack of physician support	
"There is a significant barrier to the adoption of mHealth technologies, which is the absence of in-person human connections" (van Heerden et al., 2022).	Human appeal	
"Many senior doctors worry that they are "getting it wrong" when using and comprehending mHealth apps, which causes them to struggle greatly. This makes it difficult for them to suggest these apps to patients in order to help with the management of chronic illnesses" (Zakerabasali et al., 2021)	Difficulty understanding the technology	
"Currently, there are few evidence-based and targeted procedures to assist the adoption of new technologies, particularly mHealth applications like those for managing chronic conditions, despite the fact that technological advancements are pervasive" (Zakerabasali et al., 2021).	Lack of existing technology	Technical barriers
"Although mHealth apps make attractive claims, their effectiveness is not supported by evidence-based studies in real-world settings. Healthcare practitioners are therefore worried about using these apps and complying with their rules" (Laxman et al., 2019)	Efficacy and regulation of applications concerns	
"When creating and delivering an innovative technology or application, several factors are typically overlooked. Privacy and security are among the most crucial factors to take into account, particularly in apps that handle patient data pertaining to their personal and medical state" (Zakerabasali et al., 2021)	Concerns about security and privacy	
"Some apps are difficult to use hence limiting their adoption as patients cannot effectively utilize them" (Ardito et al., 2023)	User-friendliness	
"For optimal functioning, high-speed network connectivity is necessary for mHealth technologies. Both the performance and the acceptance of these technologies by healthcare practitioners may be hampered by the lack of high-speed network connectivity" (Zakerabasali et al., 2021).	Connectivity speed	

<p>"A hurdle to the use and recommendation of these apps in conjunction with other interventions for patients with chronic diseases to manage their symptoms has been their incompatibility with the workflow of healthcare professionals" (Kao & Liebovitz, 2018).</p>	Compatibility with the workflow	
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