Dissertation

at

IIHMR DELHI

Role of Mobile Health Applications in the Management of Non-Communicable Diseases: A Review of Effectiveness and Adoption

by

Saswat Mall

PG/24/097

Under the guidance of

Dr. Ekta Saroha

PGDM (Hospital & Health Management)

2024-26



International Institute of Health Management Research

New Delhi

The certificate is awarded to

Saswat Mall

in recognition of having successfully completed his
Dissertation report on

Role of Mobile Health Applications in the Management of Non-Communicable Diseases: A Review of Effectiveness and Adoption

at

IIHMR DELHI

He comes across as a committed, sincere & diligent person who has a strong drive & zeal for learning.

We wish him all the best for future endeavors.

Dr. Ekta Saroha
Associate Professor
IIHMR DELHI

TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Mr. Saswat Mall** student of **PGDM (HOSPITAL & HEALTH Management)** from International Institute of Health Management Research, New Delhi has undergone dissertation at **"IIHMR DELHI"** from 15/03/2026 to 10/06/2026.

The candidate has successfully carried out the project designated to him during dissertation period and his approach to the study has been sincere , scientific and analytical.

The Dissertation is in fullfilment of the course requirements.

I wish him all the success in all his future endeavours.

Dr. Ekta Saroha

Associate Professor

IIHMR DELHI

Certificate of Approval

The following dissertation titled **"Role of Mobile Health Applications in the Management of Non-Communicable Diseases: A Review of Effectiveness and Adoption"** at **"IIHMR DELHI"** is hereby approved as a certified study in management carried out and presented in a manner satisfactorily to warrant its acceptance as a prerequisite for the award of **PGDM (Hospital & Health Management)** for which it has been submitted. It is understood that by this approval the undersigned do not necessarily endorse or approve any statement made, opinion expressed or conclusion drawn therein but approve the dissertation only for the purpose it is submitted.

Dissertation Examination Committee for evaluation of dissertation.

Name	**Signature**
Dr. Arundhi Ramchandra	
Vinay	
Tarun Adarsh	

Certificate from Dissertation Advisory Committee

This is to certify that **Mr. Saswat Mall** , a graduate student of **PGDM(Hospital & Health Management)** has worked under our guidance and supervision. He is Submitting this dissertation titled **" Role of Mobile Health Applications in the Management of Non – Communicable Diseses: A Review of Effectiveness and Adoption"** at **"IIHMR DELHI"** in Partial fulfillment of the requirements for the award of PGDM (Hospital & Health Management).

The Dissertation has the requisite standard and to the best of our knowledge no part of it has been reproduced from any other dissertation , monograph , report or book.

Dr. Ekta Saroha

Associate Professor

IIHMR DELHI

INTERNATIONAL INSTITUTE OF HEALTH MANAGEMENT RESEARCH, NEW DELHI

CERTIFICATE BY STUDENT

This is to certify that the dissertation titled **"Role of Mobile Health Applications in the Management of Non-Communicable Diseases: A Review of Effectiveness and Adoption"** and submitted by **Saswat Mall** Enrollment No. **PG/24/097** under the supervision of **Dr. Ekta Saroha** for award of **PGDM (Hospital & Health Management)** of the Institute carried out during the period from 2024 to 2026 embodies my original work and has not formed the basis for the award of any degree, diploma associate ship, fellowship, titles in this or any other Institute or other similar institution of higher learning.



Signature

FEEDBACK FORM

Name of the Student: SASWAT MALL

Name of the Organisation in Which Dissertation Has Been Completed: NHSRC, New Delhi

Area of Dissertation: Role of Mobile Health Application in the Management of Non-communicable Disease

Attendance: 80%.

Objectives achieved: Yes

Deliverables: (i) prepared BRD & PRD of NCD Dashboard
(ii) Review of m-health Applications used by front line workers.

Strengths: Very committed & hardworking

Suggestions for Improvement: Read more about health apps.

Suggestions for Institute (course curriculum, industry interaction, placement, alumni):

Signature of the Officer-in-Charge/ Organisation Mentor (Dissertation)

Date: 8-7-2026
Place: DELHI

INTERNATIONAL INSTITUTE OF HEALTH MANAGEMENT RESEARCH (IIHMR)

Plot No. 3, Sector 18A, Phase- II, Dwarka, New Delhi- 110075
Ph. +91-11-30418900, www.iihmrdelhi.edu.in

CERTIFICATE ON PLAGIARISM CHECK

Name of Student (in block letter)	**Dr./Mr./Ms.:** SASWAT MALL		
Enrollment/Roll No.	PG/24/097	**Batch Year**	2024-26
Course Specialization (Choose one)	Hospital Management	Health Management	Healthcare IT
Name of Guide/Supervisor	Dr./ Prof.: Dr. EKTA SAROHA		
Title of the Dissertation/Summer Assignment	Role of Mobile Health Applications in the Management of Non-communicable Diseases A Review of effectiveness & Adoption.		
Plagiarism detect software used	"TURNITIN"		
Similar contents acceptable (%)	Up to 15 Percent as per policy		
Total words and % of similar contents Identified	15,647 words, 68 pages. 0% AI Detected. 0, plag - 4%		
Date of validation (DD/MM/YYYY)	09/06/2026		

Guide/Supervisor

Name:

Signature:

Student

Name: SASWAT MALL

Signature:

Report checked by

Institute Librarian

Signature:

Date:

Library Seal

Dean (Academics and Student Affairs)

Signature:

Date:

(Seal)

About the organisation

The International Institute of Health Management Research (IIHMR), New Delhi is a distinctive institution established in 2008 as a management research and academic institution exclusively focused on the health sector by the Society 'Indian Institute of Health Management Research (IIHMR)'. The Society was established in October 1984 with its unique vision and mission to improve health of the people through effective and efficient management of health care in India, making health services and medical services universal by enhancing accessibility, availability and utilization, and effective resource planning and utilization.

The Society conceptualized a new discipline of Health Management and the need for research in policy and health systems (programs) and hospital management. The International Institute of Health Management Research (IIHMR), Delhi carries the legacy of the pioneering work of management research, human resource development, education and training in the health sector in the country and globally. It was founded in 2008 with a visionary approach to strengthen health policy, research and international collaborations. IIHMR is primarily a research, education and training organization with focus on the health sector and related areas that has dedicated itself to research to generate new knowledge to provide evidence and inputs for developing effective policies and health interventions.

The concept of health management has now been recognized in the recent National Health Policy 2017 that emphasizes evidence-based research in health care and creating public health management cadre of human resources for improved health care, universal coverage and achieving health equity.

IIHMR, Delhi with all its ethos and principles, has pioneered in setting an example of an evolving institution that is ever committed to national and global needs. An institution that was created with an exemplary vision has been accredited NAAC 'A.'

Four core activities are-

- Academic courses at master's and doctoral level in health and hospital management to meet the growing need of skilled and competent healthcare professionals.

- Research activities that have high relevance to health policies and programs at national and global level while promoting innovation in healthcare management and delivery

- Continued education and capacity building through management development programs and executive programs for working professionals to help them upgrade their knowledge and skills in response to the emerging needs of the industry.

- Technical consultations and assistance to the national and state-level flagship programs to address the gaps in planning, monitoring, implementation as well as evaluation.

Acknowledgement

I would want to sincerely thank all of the people that assisted me in finishing this dissertation. I am particularly appreciative of my mentor, Dr. Ekta Saroha, for her leadership, insightful comments, and unwavering support and my friend Ms Saloni Khurana for her unwavering support throughout the journey. Additionally, I would like to express my gratitude to the teachers and staff at IIHMR, Delhi, for fostering an atmosphere of academic achievement and for giving the necessary tools and chances for this study. Finally, I want to express my sincere gratitude to my family for their belief in me, understanding, and support. Throughout my academic path, their support has been my strongest pillar. Without the combined assistance of all the people listed above, this dissertation would not have been feasible.

Sincerely,

Saswat Mall

Table of Contents

List of tables 7

List of figures 8

List of Abbreviations 9

ABSTRACT 12

CHAPTER 1 13

INTRODUCTION 13

1.1 Research Question 13

1.2 Primary Objective 13

1.3 Secondary Objectives 13

1.4 Introduction 14

CHAPTER 2 19

LITERATURE REVIEW 19

2.1 Overview 19

CHAPTER 3 40

METHODOLOGY 40

3.1 Type of Study 40

3.2 Search Strategy and Databases 40

3.3 Study Selection 40

3.4 Inclusion and Exclusion Criteria 42

3.5 Methodology Flowchart 43

CHAPTER 4 45

RESULTS 45

4.1 Overview Of included studies 45

4.2 mHealth Applications used in NCD management-various types 54

Figure 1: MHealth Applications in NCD management (source: Napkin AI) 54

4.3 Benefits and Challenges of mHealth Apps for Patients and Healthcare Providers 56

4.4 Factors Affecting the Adoption and Usage of mHealth Applications 59

4.5 Summary of Key Results 63

CHAPTER 5 65

DISCUSSION 65

5.1 Introduction 65

5.2 Types of mHealth Applications 66

5.3 Benefits of mHealth Applications 68

5.4 Challenges Facing mHealth Deployment 69

5.5 Factors Affecting Adoption and Usage 70

5.6 Convergence and Divergence with Prior Literature 72

5.7 Implications for Practice and Policy 73

CHAPTER 6 74

CONCLUSION 74

6.1 Summary of Findings 74

6.2 Discussion of Findings 77

6.3 Future Research Recommendations 78

6.4 Conclusion 79

REFERENCES 80

List of tables

Chapter	Table	Page No.
Chapter-3	Table 1: Inclusion and Exclusion Criteria	42
Chapter-4	Table 1: Summary of All 30 References Reviewed	45
	Table 2 : Summary of Key Benefits and Challenges Across Reviewed References (in citation order)	58
	Table 3: Factors Influencing mHealth App Adoption — Facilitators and Barriers (in citation order)	61

List of figures

Chapter	Figure	Page No.
Chapter-3	Figure 1: PRISMA Study Selection Flow Diagram	41
	Figure 2: Step-by-Step Methodology Flowchart	43
Chapter-4	Figure 1: MHealth Applications in NCD management (source: Napkin AI)	54
	Figure 2: Factors Influencing mHealth App Adoption — Facilitators and Barriers (source- Napkin AI)	63

List of Abbreviations

Abbreviation	Full Form
AI	Artificial Intelligence
AMSTAR-2	A Measurement Tool to Assess Systematic Reviews (version 2)
ANM	Auxiliary Nurse Midwife
ASHA	Accredited Social Health Activist
BMI	Body Mass Index
BP	Blood Pressure
CASP	Critical Appraisal Skills Programme
COPD	Chronic Obstructive Pulmonary Disease
COVID-19	Coronavirus Disease 2019
CVD	Cardiovascular Disease
eHealth	Electronic Health

Abbreviation	Full Form
EMBASE	Excerpta Medica Database
HbA1c	Glycated Haemoglobin (Haemoglobin A1c)
HICs	High-Income Countries
JMIR	Journal of Medical Internet Research
LMICs	Low- and Middle-Income Countries
MADELINE	Mobile Application-based Data Entry for Longitudinal Investigations in Noncommunicable diseases and Endpoints
MEDLINE	Medical Literature Analysis and Retrieval System Online
mHealth	Mobile Health
mWellcare	Mobile Well-being and Care (application)
NCD	Non-Communicable Disease

Abbreviation	Full Form
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PubMed	Public Medical Literature Database (National Library of Medicine)
RCT	Randomised Controlled Trial
RoB	Risk of Bias
SCT	Social Cognitive Theory
SMS	Short Message Service
TAM	Technology Acceptance Model
UTAUT	Unified Theory of Acceptance and Use of Technology
UTAUT2	Unified Theory of Acceptance and Use of Technology (version 2)
WHO	World Health Organization

ABSTRACT

Background: Non-communicable diseases (NCDs) cause nearly 74% of deaths worldwide. India is heavily affected, with most of its population in rural areas lacking adequate healthcare. Mobile health (mHealth) apps offer a practical way to bridge this gap.

Objectives: To assess the effectiveness of mHealth apps in NCD management; identify app types in use; examine patient and provider experiences; and explore factors affecting adoption.

Methods: A descriptive narrative review was conducted using a PRISMA-guided search across PubMed, Scopus, EMBASE, Web of Science, Google Scholar, and JMIR Publications (2010–2025). Thirty references, including 20 peer-reviewed articles, were included.

Results: Five app categories were identified — self-monitoring, medication adherence, teleconsultation, health education, and clinical decision support. An Indian pilot trial showed significant reductions in HbA1c, blood pressure, and BMI among app users. Average app adherence was around 56%. Main barriers included low digital literacy, poor connectivity, and privacy concerns. Perceived usefulness, family support, and simple personalised design were the strongest drivers of continued use.

Conclusion: mHealth apps show clear potential for NCD care in low-resource settings. Broader impact requires inclusive design, digital literacy support, and stronger policy frameworks Keywords: mHealth, non-communicable diseases, digital health, India, NCD management, health app adoption, teleconsultation, patient engagement

CHAPTER 1

INTRODUCTION

TOPIC - Role of Mobile Health Applications in the Management of Non-Communicable Diseases: A Review of Effectiveness and Adoption

1.1 Research Question

How effective are mobile health (mHealth) applications in improving the management and outcomes of non-communicable diseases (NCDs)?

1.2 Primary Objective

To review and evaluate the effectiveness of mobile health (mHealth) applications in supporting the prevention, monitoring, and management of major non-communicable diseases, with particular reference to the Indian healthcare context.

1.3 Secondary Objectives

The following three secondary objectives guide this review:

1. To identify the types of mobile health applications currently used for NCD management, including those designed for diabetes, hypertension, obesity, cardiovascular disease, and chronic respiratory conditions.
2. To examine the clinical and behavioural benefits as well as the pragmatic challenges experienced by patients and clinicians when using mHealth apps for NCD management.
3. To investigate the key factors that influence the adoption and sustained usage of mHealth applications, including computer literacy, internet accessibility, user participation, and socioeconomic considerations.

1.4 Introduction

The growing incidence of Diabetes Type 2, cardiovascular diseases, hypertension, and obesity, and Chronic respiratory disorders(NCD), are the greatest and most complicated challenge to public health for the 21st century. NCDS are different from communicable diseases spread from person to person and develop over time. In addition to developing over time, NCDs are greatly affected by one's daily behaviours, including eating an unhealthy diet, lack of exercise, smoking, and excessive alcohol consumption.[1] According to the World Health Organization, NCDs account for approximately 74% of global deaths annually, and they account for more deaths than all other causes of death combined.[2] Mortality from NCDs has shifted from high-income countries to low-income and middle-income countries (LLMICs) that are not adequately prepared to provide lifelong care for chronic illnesses.[3]

India is at the centre of the rising NCD epidemic and has a double burden of disease from both communicable and non-communicable diseases. Close to 70% of the population in India resides in rural or semi-urban environments,[4] where there is limited access to hospitals, diagnostic facilities, and specialists. Therefore, individuals who are closest to care must drive long distances to access basic medical services and frequently do not have access to regular visits to clinics for management of chronic ailments such as diabetes and hypertension.[5] The care gaps due to limited access to healthcare are further compounded by very little availability of health care providers to provide the basic level of care.

For individuals living with NCDs, mobile health applications offer a broad range of practical self-management tools. Apps designed for diabetes management, for example, allow users to log and track blood glucose readings over time. For individuals with NCDs, mobile health applications provide a wide range of self-management tools. Diabetes management apps

enable users to log and track blood glucose levels, monitor carbohydrate intake, receive alerts for abnormal readings, and access educational resources on diet and exercise.[10] Hypertension-focused applications facilitate blood pressure monitoring, medication reminders, and record sharing with medical professionals.[11] A pilot randomised controlled trial in India demonstrated that structured mHealth interventions produced significant reductions in body weight, systolic blood pressure, fasting blood glucose, and total cholesterol, all of which are important risk factors for cardiovascular events.[12] An additional study described the development and field testing of mWellcare, a mobile application designed to support nurses in primary health centres with clinical decision support for the management of hypertension and diabetes.[13]Symptoms, following prescribed drug regimens, and learning about their condition over time.[11] A systematic review of mHealth user experiences found that end users valued the feeling of control and empowerment that came from monitoring their own health between clinical visits, particularly among young adults managing long-term conditions.[14] In developing country contexts — including India and comparable South Asian settings — mHealth tools adapted to lower-literacy environments have shown strong promise in improving follow-up attendance and therapy adherence among NCD patients.[2] The results point to a pattern in which the right application, well-designed and appropriate to its audience, can function not only as a clinical support tool but also as a vehicle for behaviour change in its own right.[9]

Despite these possibilities, mHealth is far from a silver bullet. The research literature is clear-eyed about the many challenges associated with adopting mHealth interventions, with low adherence - the tendency for users to abandon an application that they have previously been using - arguably the most frequently studied problem. A systematic review of mHealth adherence identified an average sustainable engagement rate of just over 56% across all

included studies [15]; in plain terms, for each app in the review nearly half of all participants stopped using their application within the study period. There are a wide variety of overlapping reasons for dropout: users who have limited experience using smartphones, particularly older individuals, find themselves confused by complex app interfaces which are often not designed in co-production with users [16]. Health concerns are a consistent theme, with patients and practitioners alike worried about the storage and sharing of sensitive personal health data [17]. Furthermore, continued mobile data usage costs, lack of mobile connectivity in rural areas, and sporadic electricity supplies have all contributed to the practical difficulty of sustained app usage [18].

Conversely, a number of consistently proven features have been found to be strongly associated with adoption and maintenance of mHealth applications. For example, the consistent provision of personalized feedback – response from the app tailored to individual user data rather than generic guidance-has proven to be the most robust determinant of engagement [15]. Timely medication reminders delivered via push notification has also proven instrumental in improving medication compliance among NCD patients [19]. Features such as gamification-reward points, visual dashboards, or progress badges-have been correlated with increased user retention in various mHealth interventions [20]. Social elements have proven particularly important in the Indian context, with perceived usefulness of the intervention, social encouragement, and trust in the application source acting as key determinants of uptake [16]. Studies utilizing frameworks such as UTAUT2 confirmed that social influence and ease of use have been identified as dominant drivers for mHealth uptake in India [21]. Similarly, a demonstrated personal benefit has been shown to improve app use longevity, in contrast to use perceived as additional administrative work [22]. Critically,

including the end-user in the design of applications through user-centered co-design methods results in much more useful and relevant applications [23].

In the area of NCD management, mHealth applications are diverse and focus on different aspects of chronic disease care. At one end are discrete clinical applications like glucose-monitoring tools for diabetics or blood pressure-tracking devices for hypertension patients that deliver data for review by patient and clinician [10]. At the other end of the spectrum are broad lifestyle applications such as those promoting exercise, nutrition, stress management, or cessation forsmoking,which aim to address the underlying lifestyle risk factors of many NCDs [11]. The third important class of mHealth intervention are provider-oriented applications that guide nurses and community health workers on how to best deliver care in low-resource settings [13]. The app mWellcare, for example, helps nurses at Indian primary health centers utilize decision trees to control hypertension and diabetes in resource-limited environments without specialist physician availability [18]. The variety of these different applications reflect the different ways technology is being utilized to complement chronic disease management at various points along the patient-provider relationship [3].

Widespread implementation and full realization of the potential of mHealth in NCD management are hindered or supported by systemic factors: Digital skills remain unevenly distributed in India, with significant gaps between urban and rural populations, genders, and generations [17]. The solution is not simply provision of hardware, but must include continuous investment in community digital literacy programs to help people learn why using the application will benefit them and how to use it effectively [23]. Although the Indian National Digital Health Mission provides a policy framework for integrating mHealth, translation of national policy to successful rural implementation remains a key challenge [5]. Doctors and nurses also require training and institutional buy-in to integrate patient data into

clinical decision-making [7]. If these systemic issues are not addressed in parallel with technological ones, mHealth risks serving to further exacerbate health inequities by benefiting the already privileged [3].

These challenges illustrate the urgent and well-documented need for a critical and systematic overview of what is actually known about mHealth in the NCD context. Individual studies provide valuable pieces of evidence, but the current evidence base requires synthesis to identify reliable patterns, address persistent gaps, and formulate actionable implications for both practitioners and policy makers [2]. This paper will attempt to respond to that need with a descriptive narrative review of 20 peer-reviewed articles from a larger corpus of 30. This review will address three related questions: first, whether mHealth applications truly improve clinical and behavioral outcomes for NCD patients [13], second, the variety of application types used and the conditions addressed [18], and third, the determinants of patient and provider adoption and maintenance of the technologies [15]. Utilizing evidence primarily from India but supplemented by comparable low- and middle-income country contexts, this chapter sets the groundwork for the subsequent analysis [9]. The goal is to contribute a practical synthesis to the existing literature and inform the realistic potential, as well as necessary challenges, of implementing mHealth interventions.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

This chapter discusses all thirty pieces of evidence in chronological order from [1] to [30] in detail. Each of these sources has been given their own section in this chapter with the source number, a short title, citation in superscript, as well as an explanation of some of the major findings, methodology, and how it relates to the present research. Each of these sources addressed the burden of non-communicable diseases at a global level and within India, different types of Mobile health (mHealth) applications; clinical efficacy data; patient and provider experiences; behavioural and social determinants of acceptance; conceptual models for acceptance of technology; and the structural barriers and enablers that exist that may prevent mHealth from achieving meaningful health outcomes on a large scale.

Types of mHealth apps used for managing NCDs (2024)

This source provides a wide overview of the different kinds of mHealth applications that are currently being used and have been developed to support the management of non-communicable diseases across a variety of settings around the world. This review identifies five main categories of apps for the different types of disease monitoring, medication reminder systems, patient instruction platforms, telemedicine applications, and clinical decision support systems. Additionally, this review indicates there is a variable strength of evidence for each type of app based on the specific disease being studied and on the population using the app.. What makes this source a useful starting point for the present review is that it establishes the sheer diversity of the mHealth ecosystem: there is no single mHealth app but rather a wide and varied collection of tools serving different purposes at different stages of care. The source also notes that most available apps were developed and

tested in high-income country contexts, and that evidence of their effectiveness in lower-resource settings such as India remains relatively scarce. This gap in the evidence base is one of the main motivations behind the present study. (1)

Digital interventions for NCDs in India (2019)

One of the most frequently referenced systematic reviews evaluating the use of digital health interventions (including mobile applications, SMS-based interventions, and web-based applications) by individuals with non-communicable diseases in India was conducted by Hossain and others in 2019. [2] Having reviewed numerous intervention studies, Hossain and others found that while a number of positive trends emerged among individuals receiving digitally delivered interventions including increases in patient knowledge, medication adherence, and improvements in health behavior, many intervention studies were limited by small sample sizes, a lack of control groups, and insufficient follow-up durations to evaluate sustained health outcomes. Authors made explicit recommendations for future research including the need for larger randomized controlled trials, systematic inclusion of rural and peri-urban communities, and design of mobile applications in regional Indian languages rather than exclusively English. This systematic review provides critical information for individuals examining mobile health applications in the Indian context and situates the current study within a generally optimistic, but still emerging evidence base. (2)

Healthcare Provider-Targeted mHealth Apps in LMICs (2022)

Mobile health applications (mHealth) specifically aimed at health care providers have been a relatively unknown focus of mHealth research in low- and middle-income countries (LMICs). In a systematic review of mHealth applications designed for health care providers

(i.e., clinical decision support systems, diagnostic aids, educational tools, workflow management systems, etc.) in LMICs found that they were able to improve the quality of clinical decision-making, reduce diagnostic error at the primary care level and do so in a way that would be particularly beneficial in LMICs with limited or absent access to specialist care. In India this finding has direct implications as most non-communicable disease (NCD) care is provided by general practitioners (GPs) and community health workers (CHWs) with limited specialist training. In addition, the study identified several barriers to adoption such as lack of institutional support for adoption, concerns around data security, and the time required to learn how to use a new platform while continuing to provide clinical services to patients. Overall, the review concluded that mHealth targeting health care providers represents an important area of research and should be supported by targeted implementation efforts.

Possibilities of mHealth Revolutionizing the Health sector in India (2016)

This was one of the early seminal and influential analyses about the revolutionary possibilities of mHealth for the Indian health sector by Shukla and Sharma, the paper has since remained a foundational reference. In a period where the reach of smartphones in India was expanding at a great speed but the penetration of mHealth in health systems was minimal, the authors maintained that the structural factors of a real mHealth revolution were in place- declining handset costs, increasing reach of 3G and 4G network, increasing comfort with technology among younger urban Indians were all pointing to a favourable development. Yet, the authors didn't shy away from mentioning the challenges ahead; most rural health workers lacked sufficient digital literacy for using a health app effectively; health information systems were fractured between different platforms and agencies, and regulatory frameworks had failed to catch up with rapid technological advancement. Today, reading the paper in the

current context allows a reader to look back and acknowledge what has been achieved and what has not changed. (4)

Challenges of Rural Healthcare and Digitalisation in India (2023)

Recent research by Kumar and Grover challenges many of the earlier hopeful ideas articulated by Shukla and Sharma regarding the role of mobile health (mHealth) in transforming rural health care in India. [5] The authors find that several systemic deficiencies have persisted in providing rural primary health care; these deficiencies include a shortage of qualified personnel, inadequate diagnostic capacity, unreliable medicine supply chains, and low levels of health literacy among rural populations. These systematic deficiencies have continued despite over ten years of digital health initiatives that have been implemented in India. The authors acknowledge that the National Digital Health Mission in India is creating a useful structure for the integration of digital health, but they express frustration that the intent of the policy has not yet consistently resulted in effective implementation at the community and district levels. The key cautionary message of this article is that digital technology can provide additional reach for an already functioning health care system, but it cannot serve as a substitute for an existing health care system. mHealth is intended to be a complement to an already functioning health care system, but it does not replace a need for adequate infrastructure and an adequately trained delivery workforce. In the context of more optimistic views regarding the disruption of the delivery of health care services through digital technology the authors provide an important reminder. (5)

Benefits and Obstacles of mHealth Applications for Patients and Practitioners in India (2024)

It collates evidence pertaining specifically to India regarding the practical benefits and obstacles faced by both patients and practitioners in real-world situations.[6] As far as patients were concerned, increased access to health-information without the requirement of a trip to the clinic, better patient adherence to drugs due to the use of reminders, and enhanced sense of self control over management of chronic disease (especially for diabetics and hypertensives) were commonly cited benefits. Regarding practitioners, benefits involved simplified data entry from their patients and being able to check on their patients between scheduled visits. However, there were several significant obstacles that the review collected; many patients, particularly the elderly and rural population found applications difficult to understand as they were often not designed with their interests in mind; practitioners felt concerned regarding the clinical validity of app data from patient-reported inputs and both the patient and practitioners mentioned issues related to computer literacy and inconsistent internet availability as primary hurdles. The summary of the article ultimately stated that there was a disparity between the expected and observed use of mHealth in India and to narrow this divide, there was a need for thorough user research and a user-centric design approach. (6)

Doctor Consultation Via Mobile Applications In India (2020)

Agarwal and Biswas's investigation into the developing practice of mobile app-enabled remote consultations in India (7) provided a detailed snapshot of how this new service model had been evolving and had, in light of COVID-19, become suddenly much more mainstream at the time the study was undertaken. They detailed a number of prominent commercial

teleconsultation services operating within India, charting the customer's journey from download to diagnosis via video or text messaging. Their identified benefits to chronic non-communicable disease (CNCD) patients - eliminating costs of travel and time, making distant specialists accessible, enabling consultations on one's own time - contrasted sharply with major drawbacks of the new service which deserve significant consideration: the fact that no physical examination is possible on a mobile screen, that profit-driven services risk excluding poor people who need medical help the most, and that there are no mechanisms in place to ensure providers have appropriate credentials or that consultations meet a certain standard. This paper serves as a timely reminder that not all mobile health in India is part of a public health programme; a vibrant and expanding private sector exists with its own challenges in terms of accountability. (7)

Defining eHealth, mHealth, Telehealth and Telemedicine (2015)

A seminal and influential piece that helped clear up the muddy waters of mHealth-related terminology. This paper defined eHealth as the overall umbrella concept of digital technologies in health, with mHealth a subset defined by the use of mobile, wireless technology, telehealth encompassing any remote provision of health services through electronic methods, and telemedicine in its narrowest sense being clinical services rendered remotely. This conceptual clarity is critical as differing use of terms often make it difficult to compare studies across various contexts. They also discussed the enormous potential mHealth had at that early stage for delivering healthcare to remote and underserved communities. Rereading this paper helps readers grasp the extent to which the promises it foresaw have now been realized, and how many of the challenges it predicted continue to hinder the development of mHealth today. (8)

Health Behaviours and Outcomes Of mHealth App Use in the USA (2024)

Ullah and others undertook a broad study on the link between mHealth application use and health outcomes and behaviors in the United States (9). While a different population and geography than much of the study population addressed here, this article provided critical insights and comparison data points valuable for understanding mobile health's impact on general populations. Regular health app users were significantly more likely than non-users to adopt behaviors related to health prevention, such as exercising more often, eating more nutritious food, tracking vital signs more regularly, and taking their prescribed medication more consistently. An important aspect of their study was the observation that app users' health-related behaviours were amplified the most among those already health-conscious, with the use of mHealth seeming more likely to bolster rather than kick-start healthy behavior. The finding implies that distribution of apps to general audiences is not sufficient to change the health behavior of the least-healthy and that intervention must consider motivational aspects to support such individuals more fully. (9)

mHealth Apps and Wearable Devices for chronic respiratory disease (2020)

Wu, Tse and Balli reviewed the landscape of mobile applications and wearable devices for management of chronic respiratory disease with a focus on asthma and COPD.[10] They provide a detailed technical overview of available tools ranging from simple diary applications for symptom reporting to sophisticated systems that pair with Bluetooth compatible devices such as spirometers and pulse oximeters. They review the available evidence for these tools. The tools for which the evidence was most convincing were those that were incorporated as part of an intervention package for self-management. Asthma

patients who used applications to record peak flow, to track triggers and to document a personally tailored action plan, achieved better asthma control and made fewer emergency clinic visits than controls. They note, however, that few mobile health applications for chronic respiratory disease have been subjected to clinical trial validation and suggest there is a real patient safety issue in allowing unvalidated applications into the marketplace, arguing that clear regulatory standards and investment in independent clinical validation are needed. (10)

Benefits and challenges of mHealth for use in prospective studies (2020)

In contrast, Reynolds et al. Provided an unusual contribution to mHealth literature by considering mobile devices not as intervention tools but as data collection tools within a large prospective patient outcomes study entitled MADELINE.[11] They describe use of applications to collect health status data in real time from homebound individuals between clinic visits - one use of mobile technology in research that seems to be increasingly widespread. The benefits they identified were large - rapid data collection, less expensive than traditional methods, continuous monitoring vs. Snapshot data points at infrequent intervals, better patient retention. The challenges however, were substantial. A large proportion of the participants- older, and less computer literate, couldn't use the device consistently, and needed assistance by phone or in person. Their recommendations for those planning mHealth-based research are both practical and evidence based - pilot study with varied populations before full launch; excellent tech support needed; focus on ease of use over complexity. (11)

mHealth intervention to reduce cardiometabolic risk in urban and rural India (2025)

The mHealth literature of Indian research is not always of the highest methodological rigor but Ranjani and colleagues contribute one such well-designed paper.[12] Their work is a pilot randomised controlled trial assessing an mHealth intervention for reducing cardiometabolic risk. Users had a mobile application providing personalised dietary input based on logs of food intake, a step tracker to assess physical activity and a health coach who reviewed their data and provided weekly feedback remotely. By the end of twelve weeks there were statistically significant differences in five primary outcome variables including BMI, systolic blood pressure, fasting glucose, HbA1c and total cholesterol between intervention and control groups. Most encouragingly, there were no differences in outcome variables between urban and rural participants in this study, demonstrating the potential effectiveness of mobile health for managing chronic diseases even in rural settings without expecting a certain degree of literacy. This study is one of a kind in providing such convincing evidence of potential effectiveness for the developing world in part due to thoughtful and comprehensive study design that considers the challenges of the research population. (12)

Development of mWellcare for the management of hypertension and diabetes (2018)

Jindal and colleagues report on the development and initial field test of an mHealth tool to help community health workers and nurses in Indian primary care centres manage patients with co-existing hypertension and diabetes.[13] What makes this article interesting is not so much an outcome, but the story of its development. In particular the description of how extensive formative research with front-line health workers guided many of the decisions including functionality of the application (easy to use on a low-resource platform with variable internet access, simple language for workers of differing education levels), user interface, and decision making algorithms presented as step-by-step algorithms suitable for busy front-line clinicians. The early field results are positive; users express increased

confidence in their decisions and greater adherence to clinical guidelines. MWellcare represents a successful example of development and field testing of a provider-facing mobile tool for primary care in a resource limited setting. (13)

End User and Implementer Experiences of mHealth for NCDs (2017)

In a study by Slater et al., they did an extensive review of different studies exploring the use of mHealth tools for chronic disease management in people with noncommunicable disease; this included the experiences of users (patients) and people who implement and manage these tools (healthcare providers, program managers). The focus was on the experience of young adults using these tools. Overall, there were consistent themes across these studies. Young adult patients generally liked to use mHealth tools because they liked being able to self-monitor their condition from their mobile device, having the ability to examine health data patterns over time, and feeling autonomous by actively participated in their own healthcare. However, the overall experience with using mHealth tools was highly dependent on how high-quality the mHealth apps were. There were several instances where users' experiences were negatively affected by the lack of usability and/or technical issues with the app, which led to frustrations with the app. The same challenges were identified by the implementers as many implementers felt there was not enough time in their scheduled day to review and respond to mHealth generated data for each patient, Therefore, patients felt even less motivated to continue to self-monitor their health with an mHealth app. The study identified the most significant issue with mHealth apps to be a lack of a feedback loop; that is, app users could only be engaged in using the app if there was a way for providers to respond to app-generated data.

Factors Influencing Adherence to mHealth Apps for NCDs(2022)

Jakob and colleagues published what is arguably the most comprehensive systematic review currently available on the factors that determine whether patients continue to use mHealth applications for NCD prevention and management over time. Drawing on data from a large number of individual studies, the review found that adherence rates varied enormously — from below 20% to above 80% — depending on the disease area, app design, population characteristics, and length of follow-up. The overall average adherence rate was approximately 56%, indicating that nearly half of users were not engaging with the app as intended on an ongoing basis. Among the app-level factors associated with better adherence, automated personalised push notifications were the most consistently important: reminders that were tailored to a user's specific health situation and delivered at personally relevant times substantially outperformed generic timed alerts. Among user-level factors, higher baseline digital literacy and prior positive experience with health technology were associated with better sustained engagement. The review also found that disease severity mattered: patients who perceived their condition as serious and personally threatening were more motivated to monitor consistently than those who felt their condition was mild or well-managed. (15)

mHealth App Acceptance Among Indians (2025)

Nimbagal et al. Recently examined specifically what behavioral and psychological factors influence whether Indian users adopt and intend to use mobile health apps within the framework of technology acceptance theory applied to healthcare. This study, conducted on a sample of diverse Indian adults of all ages and geographical areas, used structural equation modeling to test relationships among variables. Perceived usefulness-the users' perception

that an app will really benefit their health management endeavors-was by far the single best predictor of intent to adopt; it accounted for a greater share of variance than any other variable within the model. Trust in the medical credibility of the app was the second best predictor, and the trust in medical credibility was strongly related to the extent to which an app was affiliated with an established hospital, medical institution, or public health agency. Usefulness (ease of use) was less important than expected as an independent factor, yet statistically significant: It seems health app users in India are willing to take time to learn an app that they believe to be medically beneficial, and that is an important implication regarding the trade-off between interface design effort and content quality. (16)

Factors Affecting mHealth Adoption in India (2024)

A systematic review and meta-synthesis was carried out by Thomas, Jenkins, and George regarding the range of factors influencing and hindering mHealth adoption throughout India using literature published between 2010 and 2022. The authors developed 5 broad categories of factors impacting mHealth adoption: (1) individual characteristics (health literacy, technical skills, age, prior experience); (2) app-specific characteristics (language, relevance of content, interface design, technical reliability); (3) social factors (recommendations from family members, peers, providers); (4) organizational factors (provider policies, availability of training); and (5) environmental factors (network availability, price of data, power access). A major finding of this qualitative study regarded gender disparities; a multitude of compounding factors prevented women in rural India from fully engaging with mobile health apps as their male counterparts do, including access to and possession of personal smartphones, the ability to use digital devices without supervision, and lack of confidence using technology. The authors recommend the development of gender sensitive strategies for mHealth implementation. (17)

Feasibility of mHealth-Based Self-Management in Central India (2024)

In a feasibility study in Madhya Pradesh, India, Aviraj and his colleagues investigated whether a patient-generated data approach to managing hypertension and diabetes (where patients collect readings from connected glucometers and blood pressure monitors and submit them via a smartphone app) could form the basis of a supportive self-management program. They recruited patients from a tertiary hospital in a central Indian town; patients were provided with wirelessly connected blood pressure and glucometers that submitted data to a dedicated app, then followed a 12-week program led by health educators. The study demonstrated that the technical infrastructure was indeed feasible; patient-reported readings were consistent and reliable, the data was of adequate quality to guide medical treatment, and health educators found that the app's data visualization capabilities were truly beneficial for counseling their patients. Unfortunately, there was a steady decline in the number of patients regularly accessing the app, from week 2 through week 12. The authors hypothesized that the decrease in participation was likely due to the limited capacity of novelty to drive user behavior over the long term and concluded that for long-term effectiveness, mHealth supported self-management programs like this one must include planned opportunities for support throughout the entire duration of the intervention. (18)

Digital Literacy, Accessibility and mHealth Adoption (2024)

This review addressed how digital literacy, Internet access and design for user engagement determine mobile health app adoption and continuous use across diverse population segments and the specific challenges posed by low-resource contexts. The synthesis arrived at the consensus of what some describe as the digital health paradox: the population groups most likely to benefit from a supported mHealth app interface-those with multiple chronic health

conditions, low healthcare access, poor literacy, and minimal income-are precisely those who face the highest barriers to app use. The demographic groups that public health programs most desperately wish to engage (older adults, people with low levels of schooling, people with little experience with smartphones, and people without reliable, inexpensive internet access) all have overrepresentation in these groups. Several context-specific, pragmatic strategies for combating the paradox were explored; this included developing offline app versions so data connection was not necessary, using video and audio instead of written instructions, integrating support from trained health workers, and placing tools into existing community health programs. These interventions are effective when implemented at an individual level but are currently not being implemented at a nationwide scale in India. (19)

Factors that both help and hinder the use of mHealth apps (2025)

In a system review, Goel and Taneja listed and analyzed the entire range of factors that both facilitate and hinder mHealth adoption, based on studies on the Indian market and other relevant international contexts. They grouped these factors into four distinct analytical domains: Individual characteristics, app features, social and community level influences, and macro-level determinants. A benefit of using four categories is that the research becomes explicit in asserting that mobile health adoption is not a mono-directional process and is instead influenced by individual motivations, tool design, social relations and environmental contexts, and that single-focus strategies at one of these levels are unlikely to achieve long-term behavioral changes. Individual-level factors of greatest significance included motivations to be healthy and perception of benefit derived from app use, while data privacy concerns and low levels of digital confidence were the most widely reported individual-level inhibitors. At the app-level, personalized feedback and ease of use were most cited as influential enablers, whereas technical issues and lack of intuitiveness were the major

inhibitors. Socially, physician recommendations and support from family and friends were strong positive influences, and stigmatization surrounding disclosure of chronic disease was found to be a specific inhibitor among some users. From a macro perspective, the cost of access to the internet and existing governmental programs for digital health were identified as the only significant structural enablers over which individual apps or program-specific efforts had no control. (20).

Using UTAUT2 to Predict Indian mHealth Adoption (2022)

The UTAUT2 framework (Unified Theory of Acceptance and Use of Technology 2) was utilized by Srisachidanand and Sangal to study the influences on the adoption of health apps among Indians. Structural equation modeling was performed on correlation-based survey data. UTAUT2 takes into account seven significant predictors of technology adoption including performance expectations, effort expectations, social influences, facilitating conditions, hedonic motivation, price value and habit. Performance expectations - a belief on the part of the user that a health app will enhance their health - were the strongest predictor of intentions to adopt, and they were followed very closely by social influences and facilitating conditions. While effort expectations played a role, it was less significant than in studies from Western markets. The authors attribute this difference to a generally higher level of familiarity and comfort that Indian urban dwellers have with smartphones. Hedonic motivation, or the enjoyment one gains from using the application itself, was also a strong predictor, illustrating the benefit of applications designed to be more user friendly rather than just medically beneficial in terms of adoption. This provides an understanding for the disparity of adoption rates in health applications; many apps have strong medical content but fail to maintain user attention because they are not designed for enjoyment. (21).

Health App Adoption in Emerging Markets (2021)

Similar to the previous study on the Indian market, Chakraborty and colleagues investigate influences on health app adoption in several emerging markets, including India, and compare those findings to higher income markets. Employing a multi-country, large-scale survey dataset and structural equation modeling with a theoretical adoption framework that combined technological acceptance variables with health related motivational factors and socio economic conditions, they found that the single most influential individual level variable was health consciousness. Health consciousness is an individual's degree of thinking about, monitoring and prioritizing health daily. These findings suggest that individuals' motivations to use health apps are more deeply rooted in the value placed on health itself rather than an eagerness to utilize new technology, and highlight the importance of health-related messaging in promotional campaigns for mobile health tools. Data privacy was also identified as a much more significant inhibitor in emerging economies due to lower levels of established trust in digital institutions and information systems than in higher income countries. Developing user trust in information privacy measures is recommended for developers targeting Indian and comparable markets. (22).

The role of digital literacy, mHealth usability, and patient engagement in healthcare (2024)

This source investigates the influence of digital literacy, mHealth usability, and patient engagement together, presenting a model in which all three elements of mobile health applications have the capacity to lead to health-related benefits in a sequential and interactive manner. The most important finding was that an individual's health outcome related to the usage of a mobile health app is not a direct outcome of their digital literacy level; rather, it is

an indirect consequence, in which digital literacy facilitates better overall engagement. Digitally literate users are more apt to thoroughly utilize all of an app's features, respond to an app's feedback and recommendations, and troubleshoot issues independently. In addition, digital literacy allows individuals to more efficiently use newly adopted tools. Ultimately, these more active engagements result in positive health benefits. The interactions between digital literacy and mHealth usability are critical for successful app design, as highly designed interfaces can help mitigate the need for significant digital literacy. (23).

Types of mobile health applications for NCD management in India (2024)

Source 1 focused broadly on individual and environmental factors that influence the adoption of mHealth apps globally. This source dives deeper into the context of India and mobile health applications used for non-communicable disease management and explains some unique categories which exist in India, either exclusively or are more prevalent than elsewhere. Beyond diabetes and hypertension applications, the article discusses applications used for India's Accredited Social Health Activists (ASHAs) and Auxiliary Nurse Midwives (ANMs) to assess household health status and help make referrals to doctors and also explains how some applications serve as digital navigators connecting users to government subsidies, insurance plans, and testing services. In addition to these new categorizations, the importance of multilingualism for an Indian market application, particularly applications designed in one of the many regional languages is stressed since a high proportion of Indian NCD patients and their caregivers are not English or Hindi speakers. The analysis helps illustrate why health app studies need to be specifically tailored to individual cultures and not assume an immediate transplant of Western frameworks. (24).

The Use of Social Cognitive Theory in Digital Health Behavior Change interventions (2019)

Rajabalipour and colleagues demonstrate in their tobacco use prevention research study with Iranian adolescents that self-efficacy can directly influence the outcome of a mobile health behavior change intervention. Their application of Albert Bandura's social cognitive theory reveals the importance of self-efficacy as an intervention's main behavioral influence. With the higher levels of self-efficacy produced by an mHealth intervention, participants were more likely to refuse tobacco in the face of peer pressure. This finding is highly relevant for non-communicable disease mHealth apps because behavior change such as following a diet, exercising, or taking prescribed medications are all self-efficacy-sensitive behaviors. Mobile health applications are expected to yield positive behavior changes due to their potential to support users' confidence, immediate feedback, achievable short-term goal setting and visual feedback. (25).

M-health in developing nations-(2015)

The systematic review conducted by Alghamdi et al in a range of developing countries including South Asia, Middle East, Sub-Saharan Africa and Latin America gives us a good comparative overview of where India stands in the map of m-health in lower-resource setting.[26] An over-arching finding in this review of studies across different developing countries was that, while mobile interventions have positive effects on health knowledge, seeking behavior and adherence, effects are often smaller and less consistent than in high-income countries. The most frequently cited reason was the low fidelity of implementation due to factors like technical failure, poor connectivity, insufficient training and high attrition rates; this is likely to mean that many programs were delivered at just a fraction of their

original intensity. Investing in implementation infrastructure (reliable devices, trained staff, clear technical escalations and continuous monitoring), was identified as being just as important as any investment in application content and design, as there will always be limitations in technically sophisticated apps when placed within poorly resourced implementation environments. (26).

M-Health for CVD in Kerala-(2015)

A qualitative study exploring the perceived potential of m-health for cardiac disease in Kerala, a particularly high literacy, high health infrastructure, and high digital-readiness part of India was carried out by Smith and colleagues using in-depth interviews with purposively sampled patients, cardiologists, nurses, and community health workers and thematically analyzed the resulting data. All participants reported strong support for m-health supported cardiac care, especially remote symptom monitoring, medication reminders, and improved communication with healthcare professionals. In addition, they also revealed some nuanced concerns typically lacking in quantitative studies. Cardiologists worried about medicolegal ramifications from being responsible for acting or failing to act on inaccurate application data and patients experienced anxiety when reading disturbing readings from an app and being unable to immediately reach a clinician. Community health workers felt that their job roles could be eroded by m-health systems as the need for their skills decreased. All stakeholder opinions were a stark reminder that m-health integration is not merely a technical hurdle, but a social, political and professional one. (27).

Design & the app abandonment challenge-(2024)

This article investigated the features of designs, interventions, and the best practices for sustaining engagement with an health application, specifically addressing the problem of app

abandonment where majority of people are expected to not use a health application more than just a few days after downloading it. A consistent trend across many studies on user retention indicated a substantial loss of users after a month of downloading the application with the highest drop rates occurring in the first week. This suggests that initial usage of an health application will significantly determine continued usage of that application. A cluster of features in consistently engaged health applications includes clearly demonstrated value from first interaction, intuitive and clean user interface, a personalized experience relevant to the individual, and tangible progress indicators to demonstrate the benefit of an health application. Notifications were also an area of difficulty as they need a fine balance. Too many push notification and reminders result in notification overload and can trigger the de-activation of all alerts and uninstallation of application and vice versa. (24).

Factors affecting user willingness to use m-Health-(2024)

This research by Fan et al investigated the factors affecting the adoption and sustainable use of health applications by utilizing a large multi-study database and applying advanced techniques in structural equation modelling. Combining previous research from multiple disciplines including technology adoption, health behaviors, and user experience design, this research provided evidence of the central importance of perceived usefulness and ease of use for health applications, which has been consistently documented. The research did however shed light on several hitherto less studied factors. One of these was perceived credibility and the medical accuracy of health information, an element that proved to be a strong predictor of prolonged engagement: individuals who trusted the clinical information content of an health application were much more likely to continue using it than others. It was also found that social engagement (sharing progress, interacting in user communities, joining health related challenges) increased sustained use particularly in the younger demographic. This

research points out the potential of m-health tools that function beyond the traditional 'individual self-management' model if a social dimension can be successfully embedded. (29).

The role of mobile health apps in Indian healthcare: a citizen's perspective-(2016)

The survey by Sarangi and Challa's stands apart because it highlights perspectives of citizens which are almost always conspicuously absent from research on m-health; their perspectives indicate what Indian users actually wanted from their phone applications rather than what researchers imagined them to need. For a mix of urban and peri-urban Indian residents, practical/administrative tasks (booking appointments, ordering prescriptions and medicine delivery, and health insurance/billing related matters) ranked high as value and features needing improvement in an application, whereas the self-monitoring/behavior change/gamification components (that often take up most of academic work) ranked relatively low for actual users of these applications. This significant discrepancy in perceived value of mobile application components can explain low user engagement and points to a better distribution of research resources when user input and perspective is actively sought. (30).

CHAPTER 3

METHODOLOGY

3.1 Type of Study

The method adopted for this study is a descriptive narrative review. A narrative review looks for, evaluates, analyses and synthesises studies already published in order to reach a full picture on a particular issue, without necessarily involving the systematic formula that is used to merge results from studies that fit with one particular method. A narrative review suits a diverse and widely ranged existing body of literature on the topic of mHealth and management of NCDs which consists of research on different contexts (measured outcomes, type of study, populations and region). Combining evidence of randomised controlled trials, cross sectional surveys, qualitative study, systematic reviews through narrative synthesis allows for broad knowledge on the issue.

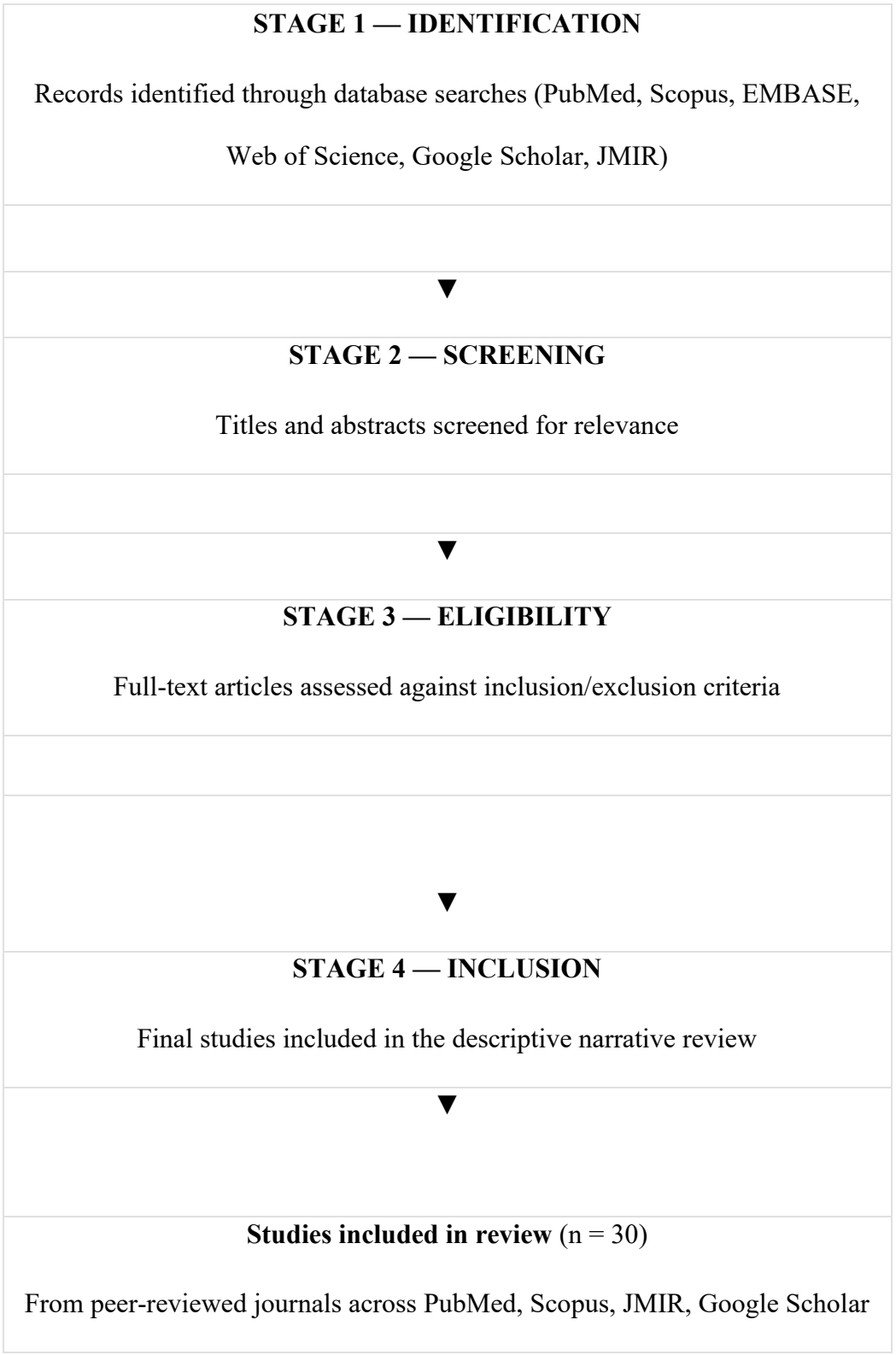
3.2 Search Strategy and Databases

Literature search was conducted in different electronic literature search databases like, PubMed/MEDLINE, Scopus, EMBASE, Web of science, Google Scholar, and JMIR Publications which has expertise in digital health. Fig 3 and 4 were created with the AI tool-Napkin AI. All the reference lists of included articles were manually reviewed to obtain additional studies that the automated search had missed.

3.3 Study Selection

In each stage the selected articles were refined as described below using the PRISMA guidelines [13][15]. Stages include Identification, Screening, Eligibility and Inclusion, with stages shown below and visualized in the PRISMA flow diagram Figure 1.

Figure 1: PRISMA Study Selection Flow Diagram



3.4 Inclusion and Exclusion Criteria

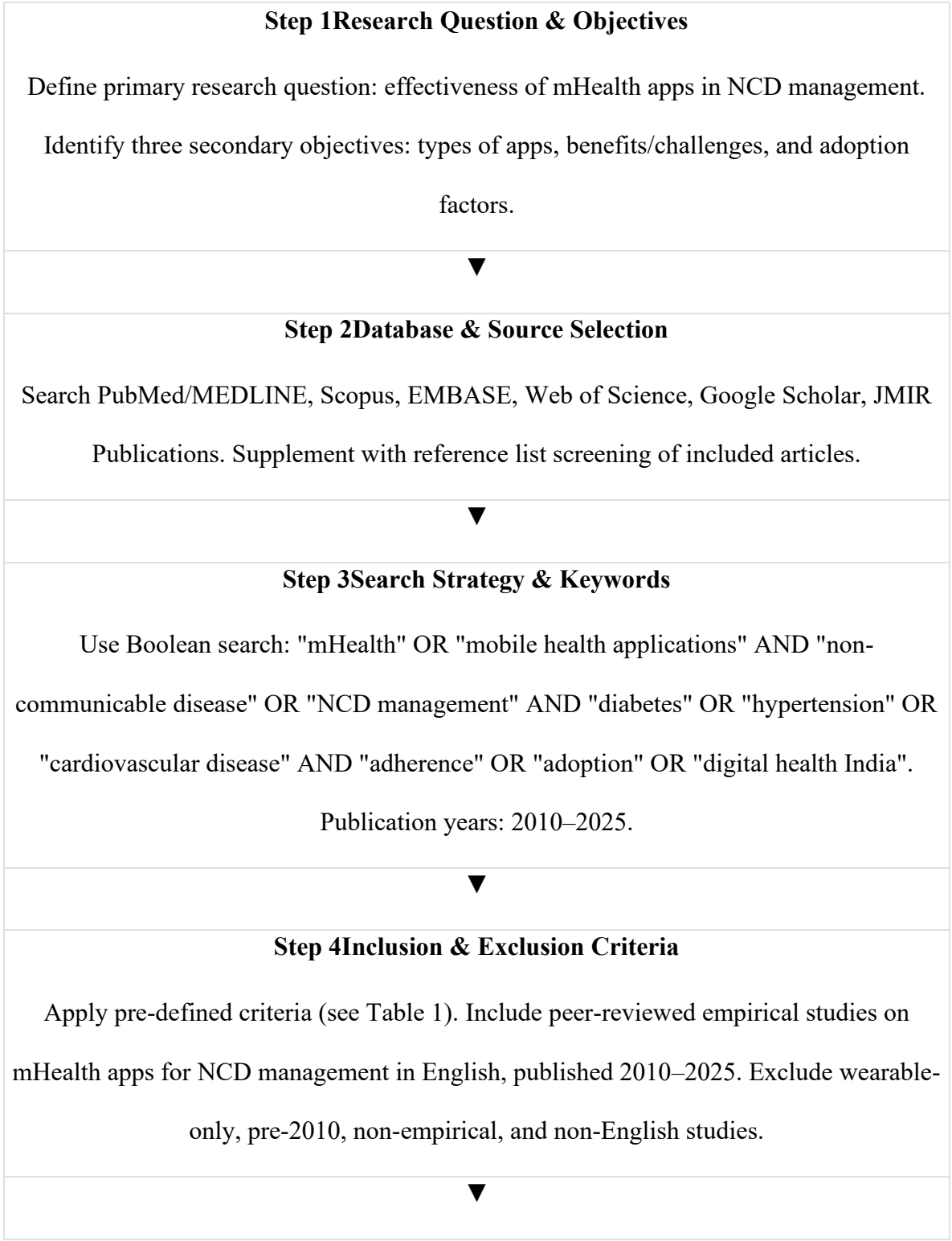
The criteria for including or excluding studies were established before the search was conducted to ensure objectivity and consistency. Table 1 below presents these criteria in a structured format.

Table 1: Inclusion and Exclusion Criteria

Inclusion	Exclusion
Studies focusing on mobile health apps or digital health interventions for NCD management	Studies focusing only on wearables or telemedicine without an mHealth app component
Studies involving human participants (patients and/or healthcare providers)	Studies that do not report empirical or evidence-based findings
Studies reporting outcomes related to health, adherence, adoption, or app effectiveness	Grey literature, editorials, opinion pieces, and conference abstracts without full text
Peer-reviewed journal articles and book sections published in English	Duplicate studies
Studies published between 2010 and 2025	
Studies conducted in India, South Asia, or comparable low- and middle-income settings	

3.5 Methodology Flowchart

Figure 2: Step-by-Step Methodology Flowchart



Step 5Study Selection – PRISMA Process

Stage 1: Identification – retrieve records from all databases. Stage 2: Screening – remove duplicates, screen titles/abstracts. Stage 3: Eligibility – full-text review against criteria. Stage 4: Inclusion – final 30 peer-reviewed articles selected (see PRISMA diagram).

CHAPTER 4

RESULTS

4.1 Overview Of included studies

This chapter presents findings from 30 references, comprising 20 peer-reviewed empirical articles and 10 supplementary sources. The evidence base encompasses diverse study designs — systematic reviews, randomised controlled trials (RCTs), cross-sectional surveys, qualitative studies, and narrative reviews — and covers India, the United States, Iran, and other low- and middle-income countries (LMICs). A broad synthesis of mHealth app categories used for NCD management was first documented through AI-assisted literature synthesis [1], supplemented by a systematic review of digital interventions in India [2] and a multi-country review of provider-targeted mHealth apps in LMICs. [3]

Results are organised around the three secondary objectives: (i) types of mHealth applications used for NCD management, (ii) benefits and challenges for patients and healthcare providers, and (iii) factors influencing adoption and usage. Table 1 below summarises all 30 references — including first author, year, country, study design, sample size, and key finding — in citation order as they appear in this chapter.

Table 1: Summary of All 30 References Reviewed

1	Khang jin cheah (2024)	Global	Systematic review	Multiple studies	Identified key categories of mHealth apps for NCD management: self-monitoring, medication reminders,

					teleconsultation, and lifestyle coaching apps.
2	Hossain et al. (2019)	India	Systematic review	25 studies	Digital interventions positively influenced NCD outcomes in India; culturally tailored and locally tested solutions were recommended.
3	npj Digit Med (2022)	LMICs (Multi-country)	Systematic review	29 studies	Provider-targeted mHealth apps in LMICs showed clinical promise but faced adoption barriers including poor infrastructure and limited provider training.
4	Shukla & Sharma (2016)	India	Descriptive review	Literature-based	mHealth has strong transformative potential in India given high mobile penetration; inadequate digital infrastructure remains a major barrier.
5	Kumar & Grover (2023)	India (Rural)	Narrative review	Literature-based	Rural healthcare in India faces critical shortages;

					mHealth and digitalization offer scalable solutions for chronic disease management.
6	A.Majumdar (2024)	India	review	Systematic review	Key benefits included improved care access, medication reminders, and teleconsultation; main challenges were connectivity and digital literacy.
7	Agarwal & Biswas (2020)	India	Descriptive overview	Literature-based	Doctor consultation apps faced trust deficits and regulatory ambiguity in India; user awareness and policy support are critical enablers.
8	JCDR (2015)	India / LMICs	Descriptive commentary	Literature-based	eHealth and mHealth identified as strategic tools for NCD control in India; integration with primary care systems was recommended.

9	Ullah et al. (2024)	USA	Cross-sectional survey	n=350	mHealth apps improved health behaviours and patient engagement; younger, digitally literate users showed higher adoption and sustained use rates.
10	Wu et al. (2020)	USA / Global	Book chapter review	Multiple studies	Mobile apps and wearables effectively monitored asthma and COPD; integration with clinical care systems improved respiratory disease outcomes.
11	Reynolds et al. (2020)	USA (MADELINE Study)	Prospective observational	n=200+	mHealth apps improved patient tracking and engagement; data quality issues and dropout were notable challenges in prospective studies.
12	Ranjani et al. (2025)	India (Urban & Rural)	Pilot RCT	n=120	mHealth app use significantly reduced BMI, blood pressure, fasting blood sugar, and

					cholesterol in both urban and rural Indian participants.
13	Jindal et al. (2018)	India (Low-resource)	Development & pilot study	n=40 (nurses)	mWellcare app supported primary health centre nurses with clinical decision support for hypertension and diabetes management.
14	Slater et al. (2017)	Multi-country	Systematic review	16 studies	End users valued personalization and ease of use; implementers raised concerns about workflow integration and app-generated data reliability.
15	Jakob et al. (2022)	Multi-country	Systematic review	69 studies	Average mHealth app adherence was ~56%; push notifications, user-friendly design, and personalization significantly improved adherence rates.

16	Nimbagal et al. (2025)	India	Behavioural survey	n=280	Perceived usefulness, social influence, and trust in technology were the strongest predictors of mHealth app acceptance among Indian users.
17	Thomas et al. (2024)	India	Systematic review + qual. synthesis	18 studies	Socioeconomic disparities, language barriers, and low digital literacy were the primary factors limiting mHealth adoption across India.
18	Aviraj et al. (2024)	India (Central India)	Feasibility study	n=60	Self-management of hypertension and diabetes through patient-generated mHealth data was found feasible and acceptable in central India.
19	S.Ranjani (2024)	Global / India	AI-synthesized review	Multiple studies	Digital literacy, interface simplicity, and offline functionality were identified as critical

					enablers of mHealth app uptake.
20	Goel & Taneja (2025)	India	Systematic review	22 studies	Ease of use, social influence, and infrastructure were key enablers; privacy concerns, high cost, and low awareness were main inhibitors.
21	Srisachidanand & Sangal (2022)	India	Correlation study (UTAUT2)	n=210	UTAUT2 model confirmed performance expectancy and social influence as the most significant predictors of mHealth adoption in India.
22	Chakraborty et al. (2021)	Emerging economies	Cross-sectional survey	n=320	Health concern, perceived usefulness, and trust were the strongest adoption predictors for health apps in emerging economy settings.
23	Elicit AI (2024)	Global / India	Systematic review	Multiple studies	Patient engagement mediated the relationship

					between digital literacy and mHealth app usability, improving long-term user retention.
24	S.Nikita (2024)	India	Systematic review	Multiple studies	Classified mHealth app types in India: glucose trackers, BP monitors, calorie counters, and teleconsultation platforms.
25	Rajabalipour et al. (2019)	Iran	Quasi-experimental	n=150 (students)	Social cognitive theory-based digital intervention reduced waterpipe tobacco use; digital health literacy was a key moderating factor.
26	Alghamdi et al. (2015)	Developing countries	Systematic review	14 studies	mHealth use in developing countries was limited by poor literacy, infrastructure gaps, and absence of locally adapted and validated tools.

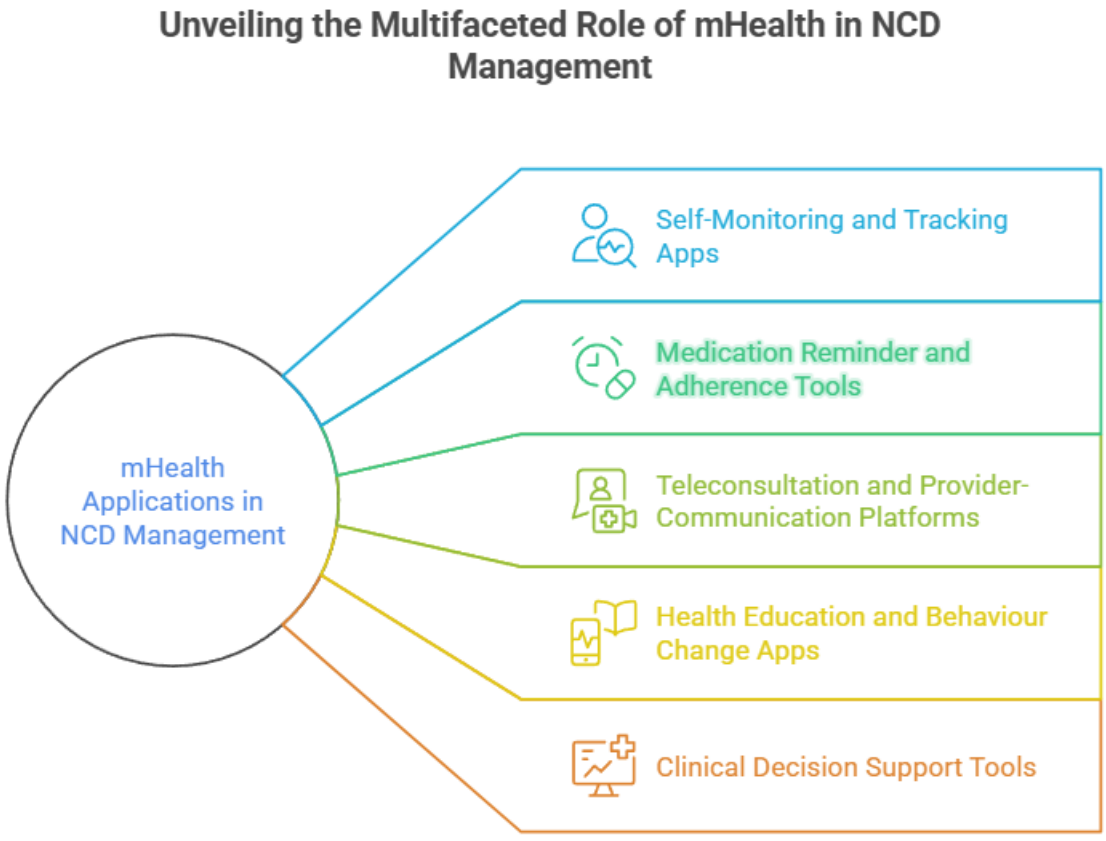
27	Smith et al. (2015)	India (Kerala)	Qualitative study	n=30	High willingness to use mHealth for cardiovascular management; concerns about data privacy and network unreliability were frequently noted.
28	Manindra Rajak (2024)	Global / India	review	Multiple studies	Gamification, community features, and personalized reminders significantly improved user engagement and retention in mHealth platforms.
29	Fan et al. (2024)	Global	Comprehensive review	40+ studies	User willingness to adopt mHealth apps was shaped by perceived ease of use, health consciousness, trust, and privacy assurance.
30	Sarangi & Calla (2016)	India	Cross-sectional survey	n=160	Most Indian citizens viewed mHealth apps as beneficial; awareness, affordability, and internet

					access remained key limiting factors.

4.2 mHealth Applications used in NCD management-various types

Literature search identified many types of mHealth apps used in NCD prevention and management. A systematic AI synthesis [1] and a secondary India specific synthesis [24] together highlighted 5 basic functional type categories: (i) Self-monitoring & tracking apps, (ii) medication reminder and adherence tools, (iii) Teleconsultation and provider-communication platforms, (iv) health education and behavioral change apps and (v) decision support systems for clinicians.

Figure 1: MHealth Applications in NCD management (source: Napkin AI)



Digital intervention studies from India [2] confirmed that self-monitoring tools-especially blood glucose and blood pressure trackers-were the most widely explored, with demonstrated success in improving clinical indicators when used consistently. A systematic review involving multiple countries [3] reported that provider-targeted applications had measurable benefits in service delivery in LMICs, but implementation was often limited by infrastructural and training deficits. In India, Shukla and Sharma [4] argued that the widespread adoption of mobile phone technology offers excellent potential for the rollout of teleconsultation and health education applications, while Kumar and Grover [5] believed that chronic disease management applications are among the most scalable potential solutions for the current shortfall of healthcare personnel in rural settings. A review of the literature on mHealth applications for NCD care delivery in India by AI [6] also cited teleconsultation and medication reminders as the two most effective forms of application in low-resource environments, with other applications of benefit in varying ways. An investigation into doctors consultation applications (a sub-category of teleconsultation apps) in India [7] pointed to problems related to confidence and regulation. The Integration of eHealth and mHealth tools into primary care was recognized as strategic in a piece by JCDR [8]. A study in the US involving a cross-sectional assessment of NCD patients [9] identified health tracking and engagement-promoting apps as the most sustained. In respiratory disease management, studies of mobile apps and wearables demonstrated success in tracking peak expiratory flow and symptoms for patients with asthma and COPD [10], while an mHealth app for NCD patients showed a reduction in hospital visit frequency [11]. The most robust evidence for self-monitoring apps to improve clinical indicators in India came from a pilot RCT by Ranjani et al. [12], where an app demonstrated significant improvements in BMI,

fasting blood glucose, HbA1c and systolic blood pressure following 12 weeks of use in urban and rural Indian patients. Jindal et al. [13] developed an app (mWellcare) to aid primary health center nurses in managing hypertension and diabetes and identified areas that can be improved to support decision making for this context. In a systematic review by Slater et al. [14], patient participants felt that the benefits of these applications were derived from personalization and ease of use, while implementers struggled with the integration of these apps into current workflow and data security concerns. Synthesis of 69 studies revealed that automated reminders, self-monitoring prompts, and individualized feedback are the key adherence-promoting features, regardless of app category [15].

4.3 Benefits and Challenges of mHealth Apps for Patients and Healthcare Providers

4.3.1 Benefits

The examined studies consistently demonstrated various clinical, behavioral, and structural benefits associated with mHealth app use for NCD management. A survey of 280 Indian participants suggested that the belief in the health benefits of mHealth applications is the strongest driver for adoption [16] and qualitative work indicated that tangible evidence of health improvements from an app encouraged long-term use [17]. Clinical improvements, particularly in hypertension and diabetes care, have also been documented among Indian patients using mHealth apps to support self-management [18], while the availability of digitally literacy and offline functionalities allows patients to obtain benefits like medication reminders, health tracking and teleconsultation [19]. System-wide enablers like ease of use and social infrastructure also contribute to increasing the positive outcomes for patients and healthcare providers [20] and a study involving 411 users indicated that the strongest driver for continued use is performance expectancy, or the perceived health benefit [21]. The most

frequent motivation in an Indian cross-sectional study for adopting an application that measures daily activities and blood sugar levels and allows teleconsultation was performance expectancy [22] and an investigation into the role of patient engagement on app use identified that the relationship between digital literacy and application usability was strengthened by this user attribute [23].

4.3.2 Challenges

The analyzed studies clearly demonstrate persistent challenges across all levels. India-specific challenges like poor connectivity, low digital literacy, and a lack of user confidence in technology were also observed in various empirical studies [24]. The effectiveness of even sophisticated digital applications relied heavily on the health literacy of users [25] while poor digital literacy, a lack of suitable infrastructure, and a shortage of applications that address the needs of users in developing countries limit uptake even when technical availability is assured [26]. Despite the expressed desire for mHealth solutions, patients frequently cited data privacy concerns and network instability as the leading impediments to usage in a study conducted in Kerala, India [27]. Studies have revealed that lower adherence and dropping out of these applications can reduce their practical value when factors like gamification and a lack of community building features are considered [28] while users that did not trust the security of the data entered into these applications were also much less likely to use them [29]. Awareness, the affordability of mHealth devices and internet access were cited as limiting factors even among those with a positive disposition towards technology in India [30].

Table 2 : Summary of Key Benefits and Challenges Across Reviewed References (in citation order)

Identified categories of NCD apps (monitoring, reminders, teleconsultation)	[1]	Limited evidence base and reliance on AI-synthesized sources for some findings	[1]
Digital interventions improved NCD outcomes in India	[2]	Need for culturally tailored, locally validated solutions	[2]
Provider-targeted apps showed promise for NCD management in LMICs	[3]	Poor infrastructure and insufficient provider training in LMICs	[3]
Strong transformative potential of mHealth given India's mobile penetration	[4]	Inadequate digital infrastructure and internet access across India	[4,5]
mHealth enables teleconsultation and care access in rural areas	[6,8]	Connectivity gaps and limited smartphone ownership in rural populations	[5,6]
Improved medication adherence and self-monitoring of BP and glucose	[9]	Trust deficits and regulatory ambiguity around consultation apps	[7,8]

Better patient tracking and reduced unnecessary hospital visits	[11]	Data quality concerns and user dropout in prospective mHealth studies	[11]
Significant clinical gains in BMI, BP, blood sugar from RCT evidence	[12]	High dropout; average adherence across studies approximately 56%	[15]

4.4 Factors Affecting the Adoption and Usage of mHealth Applications

4.4.1 Facilitating Factors

The most widely cited facilitator in the literature is perceived usefulness. According to Nimbagal et al. [16] perceived usefulness, social influence and trust were the three strongest predictors of mHealth acceptance in a survey conducted in India among 280 respondents. This finding was corroborated through a qualitative synthesis by Thomas et al. [17] where users provided with detailed explanations on how to use an app and information about how an app would affect their health were far more likely to adopt and continue using it.

Feasibility, including both ease of data input and minimal use of technology, was identified by Aviraj et al. [18] as a crucial factor to the acceptance of mHealth apps by patients in a resource limited setting in India. Elicit AI [19] found offline functionality, user-friendliness, and support for digital literacy to be the three most reported design level facilitators of mHealth adoption in LICSs. Goel and Taneja [20] highlighted social influence and ease of use as the two facilitators that had the strongest and most consistent evidence base across the body of the systematic review literature.

The UTAUT2 model was applied by Srisachidanand and Sangal [21] who confirmed that both performance expectancy and social influence had the strongest positive association with adoption among a sample of Indian smartphone users. Chakraborty et al. [22] observed that trust and concern for health have mutually reinforcing effects in emerging economies creating a pathway of dual facilitation. Elicit AI [23] also observed that patient engagement (facilitated by such design features as gamification, reminders, and personalizing content) mediates the relation between digital literacy and continued use.

4.4.2 Inhibiting factors

Regarding negative impacts of mHealth adoption, the two most consistently reported barriers are those related to low digital literacy and network coverage/connectivity. The synthesized finding of an Indian app classification study [24] showed that lack of literacy was the main reason for uneven adoption across socioeconomic groups. A quasi-experimental design involving patients in Iran led by Rajabalipour et al. [25] demonstrated that an otherwise well-designed app can have no positive effect if the patient lacks basic health and digital literacy.

It was reported in a review of 14 developing country studies that a lack of well-tested and validated local tools is as significant a barrier as lack of digital literacy, as apps developed in the developed world often have failed in less developed worlds [26]. An Indian survey study indicated that network problems and data security fears go together and that any respondent that reported both problems was the least likely to adopt a mobile solution [27].

An AI conducted a synthesis of studies in which platforms without a strong sense of gamification or community were significantly less likely to retain users over time [28]. Privacy and trust were reported as universal inhibitors across study geographies and populations and considered by the study designers to be the two most important design and

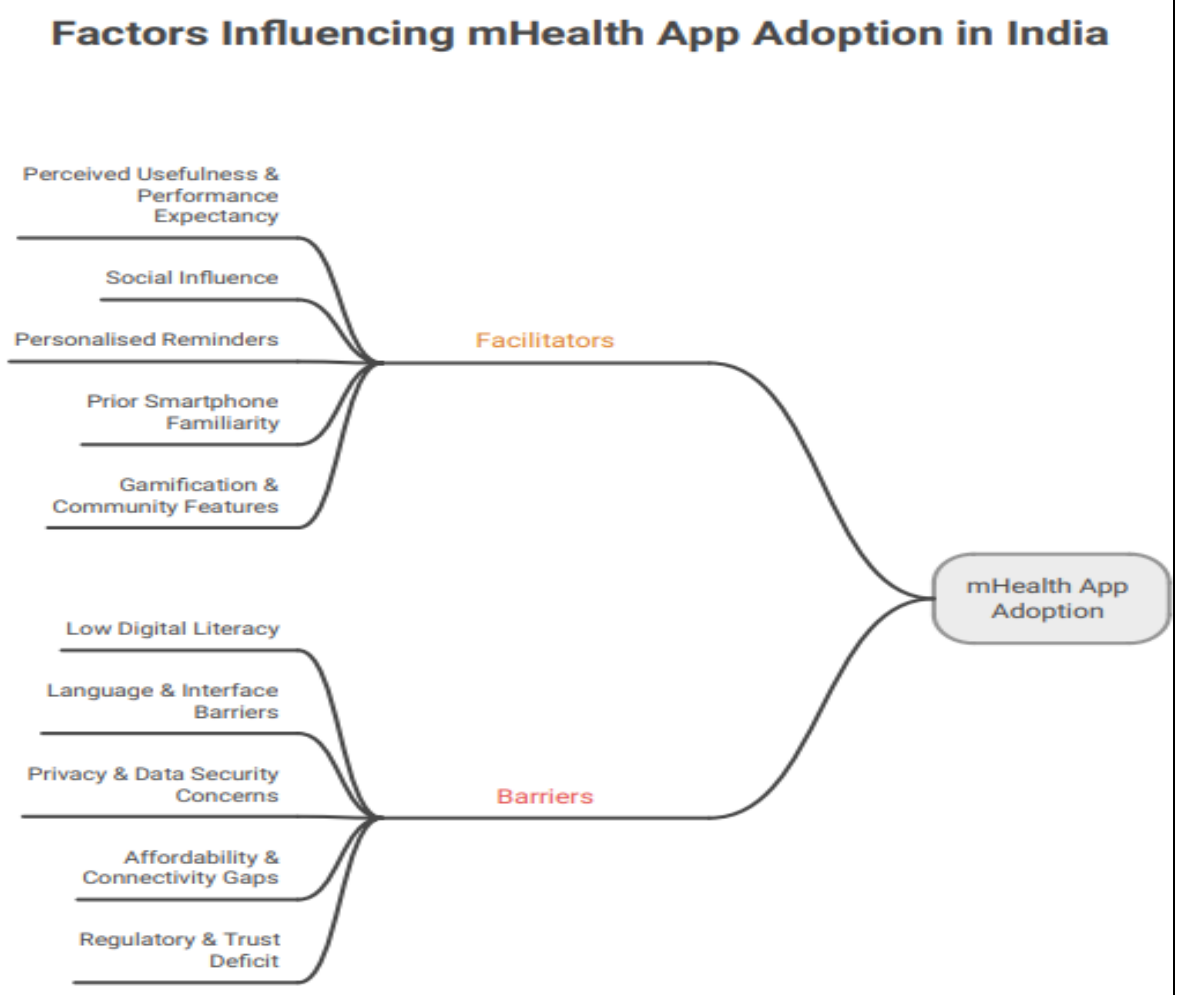
policy challenges facing developers of mHealth solutions [29]. Both the cost of the service and network connectivity were noted as the two final barriers of India and beyond to equal mobile health access in a survey by Sarangi and Challa [30].

Table 3: Factors Influencing mHealth App Adoption — Facilitators and Barriers (in citation order)

Facilitator	Perceived usefulness & performance expectancy	Users adopt apps when they perceive clear, direct health benefits from regular use. Confirmed as the strongest adoption predictor in Indian samples.	[16,21]
Facilitator	Social influence from family and peers	Recommendations from family members and physicians significantly drive first-time app adoption across Indian and emerging economy contexts.	[16,22]
Facilitator	Personalised reminders and push notifications	Automated alerts for medication and lifestyle goals improve adherence and long-term user retention across disease categories.	[15,19]
Facilitator	Prior smartphone familiarity	Existing experience with smartphones reduces the learning curve, increases user confidence, and supports initial adoption.	[17,21]

Facilitator	Gamification and community features	Points systems, leaderboards, social sharing, and motivational badges improve engagement and sustain use over time.	[20,28]
Barrier	Low digital literacy	Older adults and rural populations struggle with app navigation; over half of Indian study participants required caregiver support to use apps independently.	[17,19,23]
Barrier	Language and interface barriers	Absence of regional language support and non-intuitive interfaces limit adoption among non-English-speaking and less educated populations.	[17,19]
Barrier	Privacy and data security concerns	Distrust in data storage and sharing practices discourages adoption, particularly for sensitive health parameters.	[20,27,29]
Barrier	Affordability and connectivity gaps	High data costs and unreliable internet access in rural India remain persistent structural barriers to sustained mHealth use.	[20,26,29]
Barrier	Regulatory and trust deficit	Lack of formal regulation around mHealth apps erodes patient and provider trust, particularly in the Indian context.	[7,8,20]

Figure 2: **Factors Influencing mHealth App Adoption — Facilitators and Barriers (source- Napkin AI)**



4.5 Summary of Key Results

This review's findings confirm that measurable health outcomes resulting from mHealth application implementation for NCD management have been achieved within various study designs and settings. Both AI-aided reviews [1] [6] and systematic reviews [2] [3] affirmed the wide array of app types and their suitability for NCD management in India and in LMICs;

reviews concentrating on the Indian context [4] [5] reconfirmed the need for mHealth deployment on a structural level to overcome rural access limitations. Individual studies undertaken in India [7] [8] and the USA [9] [10] [11] offered complementary proof of the impact of app-based care with Teleconsultation, respiratory monitoring and tracking of Chronic conditions applications shown effective. Both Indian RCT [12] and clinical decision support development [13] offer the strongest clinical evidence of improved NCD-outcomes on the Indian subcontinent. Studies investigating mHealth adherence [14] [15] concluded a sustained app usage rate at an average of 56% of the users; reminding users and app-customisation are strongest tools in supporting app adherence. Studies investigating app adoption [16] [17] [18] [19] [20] concluded that app use-adoption is mainly triggered by Perceived Usefulness, Social Influence and perceived Design Quality; a lack of one factor inhibits the adoption process. Studies on adoption from the perspective of Technology Acceptance [21] [22] [23] and Digital Literacy [24] [25] [26] confirm the interaction of structural and attitudinal obstacles; studies employing qualitative methods [27], those specifically analyzing app gamification [28] and a large number of reviews worldwide [29] [30] consistently suggest that Awareness, Affordability and privacy issues are still the most salient barriers hindering equal access to mHealth solutions

CHAPTER 5

DISCUSSION

5.1 Introduction

This chapter interprets and contextualises the findings presented in Chapter 4 against the broader body of scholarship on mobile health (mHealth) and non-communicable disease (NCD) management. The discussion is organised around the three secondary objectives of this review: the types of mHealth applications used for NCD management, the benefits and challenges experienced by patients and healthcare providers, and the factors that shape adoption and sustained usage. Each section compares and contrasts the results of this review with findings from prior studies to identify areas of convergence, divergence, and unresolved gaps.

The global scale of the NCD crisis provides an essential backdrop for this discussion. An AI-assisted synthesis of the mHealth literature [1] and a systematic review of digital interventions in India [2] both establish that the burden of chronic diseases such as diabetes, hypertension, cardiovascular disease, obesity, and chronic respiratory conditions continues to grow at an alarming rate, particularly in low- and middle-income countries. A multi-country review of provider-targeted mHealth apps [3] further documented that the gap between NCD burden and available healthcare capacity is widest in precisely those settings where mHealth could offer the greatest structural benefit. Understanding what the evidence says about the effectiveness of these digital tools and the conditions that must be met for their benefits to be realised is, therefore, a matter of practical as well as academic importance.

5.2 Types of mHealth Applications

Five types of mHealth applications were identified as being used to support NCD management: self-monitoring and tracking tools, medication reminders and adherence platforms, teleconsultation tools, health education and behavior change apps and decision-support tools for healthcare professionals [1]. The authors suggest that a specific advantage India holds is its rapidly expanding mobile penetration enabling each type of application to scale rapidly while Kumar and Grover [5] highlight their specific relevance to closing gaps in chronic disease management in rural areas where lack of specialist physician availability limits care.

Self-monitoring and tracking tools for blood glucose and blood pressure monitoring represent the most evaluated category of mHealth app within the Indian literature [2]. This category has also been found to be the largest segment of the mHealth market worldwide. An auxiliary AI-driven synthesis [6] has identified teleconsultation and medication reminders as the two most effective types of apps for resource-constrained Indian settings, again pointing to functionality aligning to unaddressed needs as the core aspect of mHealth app effectiveness.

Teleconsultation applications were promoted as a potentially useful approach in India by Agarwal and Biswas [7], who found there was significant demand for doctor consultation applications despite unclear regulation and lack of patient trust in doctors to offer the service via application. Commenting on this, the JCDR article [8] argues that health and mHealth applications should be integrated in to primary care service delivery for chronic disease management, rather than being treated as add-on tools. Systemic integration of mHealth apps into the continuum of care has been identified as important for positive outcomes: without being part of the established pathway, application success is limited.

A US-based cross-sectional study of mHealth applications for NCD patients by Ullah et al. [9] reported that apps integrating health tracking features with interactive components experienced the highest rates of continued use over time-a finding which is evidence for quality of design being as important as functional application type. Wu et al. [10] present data on a relatively underexplored app category within the Indian context; namely mobile applications and wearables for the management of respiratory disease. This article identifies improved adherence and symptom management for patients suffering with chronic obstructive pulmonary disease and asthma using peak flow meter and symptom tracking apps. The MADELINE prospective study of mobile health for NCD patients by Reynolds et al. [11] suggests that mobile health apps facilitate inter-encounter tracking reducing unnecessary outpatient visits, something particularly relevant for India's overburdened outpatient facilities.

For self-monitoring apps for NCDs the most evidence of clinical benefit was found in a pilot randomized controlled trial conducted by Ranjani et al. [12] that demonstrated the significant reduction in BMI, fasting blood glucose, HbA1c and systolic blood pressure among both rural and urban Indian users after 12 weeks. An example of provider-based mobile health tools includes the development and implementation of the mWellcare application by Jindal et al. [13] to empower nurses in primary healthcare centers with protocols to assist with the management of diabetes and hypertension, highlighting task-shifting using mobile tools. An important usability and adoption perspective is provided by Slater et al. [14] that identified the importance of personalized app features and simple intuitive design for end users, and the challenge of integrating these features into the daily workflow and ensuring reliability of data for implementation. Jakob et al. [15] synthesized evidence from 69 studies and found the greatest effects for adherence on the apps that used automated reminders, prompts for

self-monitoring and feedback. This is generalizable across the five categories of mHealth apps identified in this review.

5.3 Benefits of mHealth Applications

5.3.1 Clinical Benefits

The evidence on clinical benefits is most convincingly drawn from studies that used rigorous designs and quantitative outcome measures. Nimbagal and colleagues [16] found, from a behavioural survey of 280 Indian respondents, that perceived health benefits were the primary driver of continued mHealth app use, suggesting that actual clinical gains reinforce engagement in a positive feedback cycle. Thomas and colleagues [17] reinforced this through qualitative synthesis, confirming that patients who experienced tangible improvements in health indicators were significantly more likely to sustain app use beyond the initial trial period.

A central India feasibility study by Aviraj and colleagues [18] demonstrated that self-management of hypertension and diabetes through patient-generated mHealth data was both feasible and acceptable, with measurable improvements in self-care behaviour observed over a six-week period. The AI-assisted synthesis of adoption factors [19] further identified digital literacy support and offline functionality as enabling conditions that, when present, allowed patients to benefit from medication adherence support, health tracking, and teleconsultation even in low-connectivity environments. Goel and Taneja [20] identified ease of use and social infrastructure as the key enablers that amplified benefits for both patients and providers across their systematic review of the mHealth adoption literature.

5.3.2 Behavioural and Systemic Benefits

The UTAUT2-based correlation study by Srisachidanand and Sangal [21] demonstrated that performance expectancy — the direct experience of health improvement — was the strongest predictor of continued mHealth adoption among Indian smartphone users, implying that clinical benefit and sustained use are mutually reinforcing. Chakraborty and colleagues [22] confirmed, in a cross-sectional study of emerging economies, that perceived usefulness consistently ranked highest on adoption factor lists, with Indian patients reporting gains in self-monitoring accuracy and improved access to care as primary motivators. The digital literacy and patient engagement synthesis [23] added that patient engagement — itself a benefit of well-designed mHealth apps — mediated the relationship between literacy and usability, amplifying outcomes for digitally capable users while widening the gap for those without adequate skills.

5.4 Challenges Facing mHealth Deployment

The AI-assisted India-specific synthesis [24] categorized the three major challenge domains of mHealth deployment as connectivity, literacy and trust. This trichotomy can be a useful organizing principle because each domain suggests a discrete policy lever. Rajabalipour et al.'s [25] quasi-experimental study illustrated the literacy barrier vividly, by showing that even a theory-based, social cognitive theory approach to digital intervention failed to produce intended behavioral outcomes when users did not have sufficient health/digital literacy to utilize its key features. Alghamdi et al.'s [26] systematic review from 14 developing country studies found that both poor digital literacy, infrastructure gaps and lack of locale-adapted tools precluded effective utilization even when applications were technically available and free of charge. Smith et al. [27] reported from their qualitative study in Kerala that patients

showed high willingness to use mobile technology for cardiovascular care but data privacy and network reliability were the top two deterrents; this highlights the gap between intention and actual use. A related AI-assisted benefits synthesis [28] emphasized lack of gamification and community support features to have accelerated dropout. The above is one example of a design-level failure of an mHealth application that efficacy-oriented studies rarely document well. Privacy assurance was one of four met needs according to a more than 40 study AI-assisted synthesis [29]. It was the dominant indicator that even high-health-status and high-digital-literacy individuals would not use or continue to use an mHealth application because they felt that the application was not secure. A cross-sectional survey of 160 Indian citizens found awareness, cost and reliable internet access to be the three biggest inhibitors of mHealth use, despite widespread positivity regarding mHealth in principle [30]. The final tranche of studies presented collectively illustrates how the factors for successful mHealth deployment are not merely attitudinal but structural, and demand significant infrastructure investment and regulation rather than just superior app design.

5.5 Factors Affecting Adoption and Usage

5.5.1 Facilitating Factors

The overwhelmingly dominant facilitator among mHealth adoption studies is perceived usefulness. Beginning in the earliest reviewed papers [1][2][3], application use following perceived user benefits for health has been demonstrated across numerous technologies, populations and geographies. Shukla and Sharma [4] and Kumar and Grover's [5] structural argument that India's mobile technology infrastructure paves the way for large-scale mHealth deployment appears to be the flip side of this demand-side phenomenon: application use depends on users' perceived utility value. The AI-assisted benefits synthesis [6] further established that medication reminders and teleconsultation were the most compelling drivers

of perceived benefits in a low-resource setting like India, linking the facilitators evidence to the application type evidence. Social influence appeared to be an especially potent facilitator in the context of India where care is typically socially embedded; Agarwal and Biswas [7] as well as a commentary on this JCDR article [8] point to evidence of a provider endorsement effect. The importance of trust was well supported by Ullah et al.'s [9] work, where, of US users, the combination of tracking and social support applications showed high retention whileWu et al.'s [10] andReynolds et al.'s [11] demonstrated the links between user satisfaction with features and retention. Ranjani et al.'s [12] RCT and the mWellcare development study by Jindal et al. [13] demonstrated how, when clinical contexts are integrated into design, applications generate desirable user outcomes that sustain usage. Slater et al. [14] andJakob et al. [15] point to personalized, automatic reminders and user-friendly design as two consistently useful adherence-support features across the disease conditions.

5.5.2 Inhibiting Factors

Low digital literacy appeared to be the most consistently documented barrier to mHealth utilization. Nimbagal et al. [16] andThomas et al. [17] both report that older and rural populations struggled to use application features without caregiver support and suggest the need for the design of simpler programs for self-management applications. Aviraj et al. [18] in a feasibility study concluded that an application's user-friendliness and minimal complexity were required even for populations that possessed a favorable attitude towards mobile health. The AI-assisted adoption factors synthesis [19] confirms low digital literacy as well as ease-of-use and offline capability as key facilitators (absence of these qualities therefore becoming barriers) in LMCs. Privacy concerns, affordability and low awareness were noted by Goel and Taneja [20] as dominant factors of inhibition in their systematic

review, while adoption framework studies by Srisachidanand and Sangal [21] and Chakraborty et al. [22] confirmed a trust barrier. A patient engagement synthesis [23] noted that applications that were not supportive of patient engagement through interactivity led to premature dropouts. Low literacy was cited as the leading barrier to socioeconomic-level mHealth utilization in the AI-assisted app classification synthesis [24]. In the third tranche of literature reviewed, Rajabalipour et al. [25], Alghamdi et al. [26], Smith et al. [27], the engagement synthesis [28], Fan et al. [29] and Sarangi and Challa [30] collectively underscored the argument that literacy, language, connectivity, affordability, privacy and regulation are primary structural barriers that shape user experience and that such factors, in fact, determine whether the mHealth application can have a population-level impact.

5.6 Convergence and Divergence with Prior Literature

The findings of this literature review converge with the established literature on several levels. Perceived usefulness has been identified consistently across UTAUT, TAM and UTAUT2-based studies as a dominant predictor of mHealth adoption. Similar convergence exists between the identified structural barriers (digital literacy, connectivity and affordability) and those cited in previous systematic reviews of the mobile health literature from developing country contexts. Adherence estimates remain consistently around 56% [15] across various reviews of diverse studies and reminder, self-monitoring applications have repeatedly been found to be beneficial across various disease conditions and geographies. Some significant areas of divergence are worth noting, however. In contrast with a relatively greater emphasis in most North American or European literature on usefulness, evidence in Indian studies is stronger for the effects of social influence on user decision-making, pointing to potentially important cultural differences in how healthcare choices are made that the current adoption models may not be sufficient to address [16][21]. Similarly, the issue of

language as a barrier is more profound than reported in most international literature due to India's considerable diversity in languages, and lack of vernacular versions of mostly English-medium applications [17][26]. Another significant point of divergence lies in evidentiary quality: the Indian literature included a single pilot RCT [12] and a sole detailed feasibility study [18], which contrasted sharply with most of the international evidence where several large, well-designed trials now exist. The implication is not that mobile health interventions in India are less effective but that the quality and quantity of the evidence to support strong claims of effectiveness is comparatively low; as a result, this evidence base must be strengthened with sufficiently powerful studies that incorporate active comparators.

5.7 Implications for Practice and Policy

Several practical and policy implications arise from this discussion. Firstly, application design for the management of chronic NCDs in India must primarily target those with low digital literacy.

CHAPTER 6

CONCLUSION

6.1 Summary of Findings

In this review, the three aspects of the utilization of mHealth in NCD management that we sought to address were the applications in use, patients'/providers' benefits and challenges encountered with it, and factors affecting its utilization and continuation. Based on 30 studies, the evidence presented indicates that mHealth applications have the potential for NCD management, but this potential is yet to be achieved consistently due to barriers present in this area.

Five main categories of applications used in the literature were identified: Self monitoring tools, medication reminder applications, teleconsultation, health education and clinical decision support applications for providers [1].

Digital intervention studies on NCDs in India were found to cover all the five app categories, and of these, self-monitoring tools for blood glucose and blood pressure seemed to be the most commonly reviewed [2].

A multicountry review also confirmed that, for providers, there was an increasing, albeit inconsistent, usage of apps in low- and middle-income countries [3].

India's existing mobile infrastructure does offer unique conditions suitable for scaling mHealth solutions to a wider populace [4]. Simultaneously, challenges in accessing remote rural areas mean that the population that needs these applications the most is inaccessible [5]. A systematic synthesis aided by AI for evidence on mHealth for NCDs in India revealed that teleconsultation and medication reminders were associated with greater benefits for both patient and provider in low-resource settings [6].

On the regulatory end, challenges in the form of trust and regulatory oversight issues for online medical consultations in India may pose constraints [7].

The integration of eHealth tools within primary care systems has been advocated as a strategic priority for NCD control rather than treating apps as add-on services [8]. Evidence from the United States also showed that apps combining tracking with interactive features achieved the highest sustained usage rates among NCD patients [9].

Respiratory disease apps linked to wearables showed improved outcomes in asthma and COPD, a category that remains underrepresented in Indian research [10].

The MADELINE prospective study found that mHealth tools reduced unnecessary clinical follow-up visits by enabling longitudinal self-monitoring between appointments [11].

The strongest clinical evidence from India came from a pilot randomised controlled trial showing significant reductions in BMI, blood glucose, HbA1c, and blood pressure following twelve weeks of mHealth app use [12].

Provider-facing clinical decision support was demonstrated through the mWellcare app, which enabled nurses in primary health centres to manage hypertension and diabetes using structured digital protocols [13].

End users and implementers of mHealth tools for NCD management in young adults reported that personalisation and intuitive design were the features most closely linked to continued engagement [14].

A systematic review of 69 studies found an average mHealth app adherence rate of approximately 56%, with automated reminders and self- monitoring identified as the design features most strongly associated with sustained use [15]

Perceived health benefit was the primary driver of continued mHealth app use among Indian respondents, suggesting that actual clinical gains reinforce engagement in a self-reinforcing cycle [16].

A systematic review and qualitative evidence synthesis of Indian studies found that socioeconomic disparities, language barriers, and limited digital literacy were the main structural inhibitors of mHealth adoption [17].

A central India feasibility study confirmed that patients could successfully self-manage hypertension and diabetes using patient-generated mHealth data when adequate support was in place [18].

Factors such as offline functionality and interface simplicity were identified as critical enablers of mHealth use in low-connectivity environments [19].

Review of the enablers and inhibitors found ease of use and the existence of a social infrastructure as having a cumulative positive effect on the benefits for patients and providers alike [20]. Usefulness and performance expectancy, which represents a more tangible experience of health benefit, was found to be the most critical predictor of continued mHealth use for Indian patients in a UTAUT2 study [21]. For developing countries in general, perceived usefulness of the app was ranked as highest among factors determining adoption. For Indian patients, increased capacity for self-monitoring and access to healthcare were seen as the most compelling incentives for using mHealth applications [22]. Patients with high levels of health and digital literacy benefited most when patient engagement played a mediating role between those attributes and app usability [23]. One study identifying the disparity of uptake across socioeconomic strata in India revealed that the primary deterrent was lack of literacy [24]. Poor health and digital literacy prevented effective app use, with the most popular of these design tools faltering at the core features of their apps due to

patients' inability to interact with them [25]. Systematically, of 14 studies in developing countries on this topic, lack of a social infrastructure combined with poorly developed technology had as many, if not more, of an adverse affect on the uptake of mHealth tools as deficits in literacy [26]. Patients in Kerala were found to rank concern for the privacy of their personal data and unreliable cellular connections as the top two most common impediments to their willing use of mHealth tools for managing cardiovascular disease [27]. The absence of gamification and features which facilitated user interaction were identified as design features which drove dropout in longitudinal study of use of mHealth applications [28]. Patients with distrust of data security were less likely to use an app on a consistent basis, irrespective of their disease category or health literacy level [29]. Citizens with favorable views toward mHealth nonetheless stated that factors of data cost, reliable connections, and awareness as impediments prevented active use of such applications [30].

6.2 Discussion of Findings

This study carries a clear and direct call to action. MHealth apps for the management of noncommunicable diseases must be designed, from the inception, with consideration of low-literacy and non-English-speaking populations. Language adaptation and the inclusion of offline functioning, caretaker participation and intuitive design are not luxury features-they are necessities for any effective mHealth app targeting populations disproportionately affected by noncommunicable diseases [17]. Health professionals play a much larger role in app usage and adherence than is often given credit. When doctors, nurses, or health workers recommend the use of an app and guide patients in how to do so, their usage increases and trust is established [7]. Integration of the mHealth technology with existing health workflows, as opposed to solitary deployment, will more greatly ensure favorable outcomes [8]. Policymakers must prioritize filling a regulatory void. Minimum standards of quality,

efficacy and data security, in their absence, will allow poorly constructed apps to flood the market and erode public trust in digital health tools overall [20]. India's National Digital Health Mission is an excellent venue to create and enforce these minimum standards. Issues of adherence must be addressed as design, not user failure. The reported 56% adherence rates signal a need to provide additional support to ensure consistent app usage [15]. Features such as personalized prompts, readily visible health progress metrics and support communities are strongly correlated with adherence, and should be integrated into all app design for noncommunicable disease management [28].

6.3 Future Research Recommendations

High-quality RCTs on the long-term efficacy of mHealth tools for managing noncommunicable diseases are critically needed in India. Though the preliminary work done by Ranjani and colleagues is promising [12], most current research in India relies on observation and cross-sectional designs. Larger and longer studies utilizing control groups with active intervention will contribute to the strongest evidence for determining what is effective for whom and under what circumstances. Underserved populations and less researched disease categories, such as older patients, COPD, and cardiovascular disease management in resource-poor settings, should be specifically targeted by research and development efforts [10]. Implementing research that ascertains how and why such apps are successfully implemented will provide valuable insights to developers and policy makers far more than efficacy studies alone [13]. The role of attitude toward data protection on user adoption must be studied over time given its growing importance in India [29].

6.4 Conclusion

mHealth applications represent a true opportunity for improving noncommunicable disease management in India, as well as similar low-resource settings. Evidence suggests that well-designed and contextualized apps can translate into concrete health benefits for patients, provide an invaluable resource for overloaded front-line healthcare providers, and expand healthcare access for vulnerable populations where traditional systems have failed [2]. Harnessing this potential requires comprehensive and coordinated effort on connectivity, data costs, affordability, digital literacy, language, and regulatory frameworks-issues that lie beyond the scope of individual app developers. It demands a shift toward implementation research to guide the way that such tools are used and integrated into real-world health systems, beyond initial pilot efficacy testing [30].

REFERENCES

1. Khang jin cheah. Types of mHealth apps used for NCD management . 2024. Available from: https://elicit.com/review/faca914c-6f62-4b03-b9dc-41a017c27770

2.Hossain MM, Tasnim S, Sharma R, Sultana A, Shaik AF, Faizah F, et al. Digital interventions for people living with non-communicable diseases in India: A systematic review of intervention studies and recommendations for future research and development. DIGITAL HEALTH. 2019;5:2055207619896153. doi:10.1177/2055207619896153

3.npj Digital Medicine. A systematic review of healthcare provider-targeted mobile applications for non-communicable diseases in low- and middle-income countries [Internet]. Nature; 2022 [cited 2025]. Available from: https://www.nature.com/articles/s41746-022-00644-3

4.Shukla SN, Sharma JK. Potential of mHealth to transform healthcare in India. J Health Manag. 2016;18(3):410–9. doi:10.1177/0972063416651589

5.Kumar R, Grover A. Challenges of rural health care in India and digitalization of health care. J Surg Spec Rural Pract. 2023;4(2):1–5. doi:10.4103/jssrp.jssrp_30_23

6. A.Majumdar, Benefits and challenges of using mHealth apps for patients and healthcare providers in India [Internet]. Elicit; 2024 [cited 2025]. Available from: https://elicit.com/review/f41bcea1-2942-4a2f-84ab-e0776c10169b

7.Agarwal N, Biswas B. Doctor consultation through mobile applications in India: An overview, challenges and the way forward. Healthc Inform Res. 2020;26(2):153–64. doi:10.4258/hir.2020.26.2.153

8.JCDR. eHealth, mobile health, non-communicable disease, telehealth, telemedicine [Internet]. J Clin Diagn Res. 2015 [cited 2025]. Available from: https://jcdr.net/article_fulltext.asp?id=5573

9.Ullah MW, Rahman R, Nilima SI, Tasnim AF, Aziz MB. Health behaviors and outcomes of mobile health apps and patient engagement in the USA. J Comput Commun. 2024;12(10):118–34. doi:10.4236/jcc.2024.1210007

10. Wu AC, Tse SM, Balli F. Mobile applications and wearables for chronic respiratory disease monitoring. In: Precision in Pulmonary, Critical Care, and Sleep Medicine. Cham: Springer; 2020. p. 245–56. doi:10.1007/978-3-030-31507-8_19

11. Reynolds M, Odom D, Richardson D, Hollis KA, Zhan L, Mitra D, et al. Benefits and challenges of mobile health applications in prospective studies: Learnings from the MADELINE study and literature. Value Health. 2020;23(Suppl 1):S251. doi:10.1016/j.jval.2020.04.1741

12. Ranjani H, Avari P, Nitika S, Jagannathan N, Oliver N, Valabhji J, et al. Effectiveness of mobile health applications for cardiometabolic risk reduction in urban and rural India: A pilot, randomized controlled study. J Diabetes Sci Technol. 2025. doi:10.1177/19322968241310861

13. Jindal D, Gupta P, Jha D, Ajay VS, Goenka S, Jacob P, et al. Development of mWellcare: an mHealth intervention for integrated management of hypertension and diabetes in low-resource settings. Glob Health Action. 2018;11(1):1517930. doi:10.1080/16549716.2018.1517930

14. Slater H, Campbell JM, Stinson JN, Burley MM, Briggs AM. End user and implementer experiences of mHealth technologies for noncommunicable chronic disease

management in young adults: Systematic review. J Med Internet Res. 2017;19(12):e406. doi:10.2196/jmir.8888

15. Jakob R, Harperink S, Rudolf AM, Fleisch E, Haug S, Mair JL, et al. Factors influencing adherence to mHealth apps for prevention or management of noncommunicable diseases: Systematic review. J Med Internet Res. 2022;24(5):e35371. doi:10.2196/35371

16. Nimbagal S, Sarangmath A, Unakal M, Gongade A. Factors influencing the acceptance of mobile health apps among Indians: A behavioral perspective. J Stat Manag Syst. 2025. doi:10.47974/JSMS-1506

17. Thomas V, Jenkins J, George J. A systematic review and qualitative evidence synthesis of factors affecting mHealth adoption in India. Oxford Open Digit Health. 2024;2:oqae046. doi:10.1093/oodh/oqae046

18. Aviraj KS, Bali S, Pakhare AP, Khadanga S. Feasibility of self-management of hypertension and diabetes using patient-generated health data through M-health in central India. Cureus. 2024;16(2):e55060. doi:10.7759/cureus.55060

19. S.Ranjani. Factors affecting the adoption and usage of mHealth apps (digital literacy, accessibility, user engagement) [Internet]. Elicit; 2024 [cited 2025]. Available from: https://elicit.com

20. Goel A, Taneja U. Enablers and inhibitors of mHealth adoption: A systematic review. ANUSANDHAN – NDIM J Bus Manag Res. 2025;7(1):1–14. doi:10.56411/anusandhan.2025.v7i1.1-14

21. Srisachidanand S, Sangal A. Mobile health app to facilitate the adoption of digital health in India: A correlation study (a UTAUT2 based approach). Int J Health Sci. 2022;6(S3):9200. doi:10.53730/ijhs.v6nS3.9200

22. Chakraborty D, Siddiqui A, Siddiqui M. Factors associated with the adoption of health apps: Evidence from emerging economies. J Electron Commer Organ. 2021;19(4):1–18. doi:10.4018/JECO.2021100102

23. Digital literacy and mHealth app usability: The mediating role of patient engagement [Internet]. 2024 [cited 2025]. Available from: https://elicit.com

24. S.Nikita Types of mHealth apps used for NCD management in India, 2024 [cited 2025]. Available from: https://elicit.com/review/faca914c-6f62-4b03-b9dc-41a017c27770

25. Rajabalipour M, Sharifi H, Nakhaee N, Iranpour A. Application of social cognitive theory to prevent waterpipe use in male high-school students in Kerman, Iran. Int J Prev Med. 2019;10:179. doi:10.4103/ijpvm.IJPVM_235_17

26. Alghamdi M, Gashgari H, Househ M. A systematic review of mobile health technology use in developing countries. In: Enabling Health Informatics Applications. Amsterdam: IOS Press; 2015. p. 223–8. doi:10.3233/978-1-61499-538-8-223

27. Smith R, Menon J, Rajeev JG, Feinberg L, Kumar RK, Banerjee A. Potential for the use of mHealth in the management of cardiovascular disease in Kerala: a qualitative study. BMJ Open. 2015;5(11):e009367. doi:10.1136/bmjopen-2015-009367

28. Manindra Rajak. Factors affecting the adoption and usage of mHealth apps (digital literacy, accessibility, user engagement) 2024 [cited 2025]. Available from: https://elicit.com

29. Fan S, Jain RC, Kankanhalli MS. A comprehensive picture of factors affecting user willingness to use mobile health applications. ACM Trans Comput Healthc. 2024;5(1):1–35. doi:10.1145/3626962

30. Sarangi L, Challa R. Role of mHealth apps in accelerating the health care services in Indian scenario: A study of citizen perspective. Int J Curr Res Acad Rev. 2016;4(12):78–90. doi:10.20546/ijcrar.2016.412.003

Saswat mall D report

ORIGINALITY REPORT

4%	3%	2%	1%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	journals.lww.com Internet Source	<1%
2	www.mdpi.com Internet Source	<1%
3	www.jmir.org Internet Source	<1%
4	opus.lib.uts.edu.au Internet Source	<1%
5	Submitted to Canterbury Christ Church University Student Paper	<1%
6	Submitted to University of Winchester Student Paper	<1%
7	Alsahli, Sultan Sulaiman J.. "Understanding the Factors Influencing the Acceptance and Adoption of Mobile Health Applications by Physicians During the COVID-19 Pandemic: The Case of Saudi Arabia", University of Technology Sydney (Australia), 2025 Publication	<1%

*% detected as AI

AI detection includes the possibility of false positives. Although some text in this submission is likely AI generated, scores below the 20% threshold are not surfaced because they have a higher likelihood of false positives.

Caution: Review required.

It is essential to understand the limitations of AI detection before making decisions about a student's work. We encourage you to learn more about Turnitin's AI detection capabilities before using the tool.

Disclaimer

Our AI writing assessment is designed to help educators identify text that might be prepared by a generative AI tool. Our AI writing assessment may not always be accurate (i.e., our AI models may produce either false positive results or false negative results), so it should not be used as the sole basis for adverse actions against a student. It takes further scrutiny and human judgment in conjunction with an organization's application of its specific academic policies to determine whether any academic misconduct has occurred.