

# The Effect of Mobile Health App Technologies Enhancing Chronic Patient Adherence to Medications: A Systematic Review

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## ABSTRACT

**Background:** Medication adherence is essential part of curing the chronic diseases among the patients. As the technology is advancing the healthcare institutions are also taking help from the technologies. Mobile app technologies are considered to be important in enhancing the patients' adherence to the medication. The current systematic review is conducted to explore the effectiveness of mobile health app technologies enhancing chronic patient adherence to medications.

**Method:** A thorough search of databases, including Scopus, PsycINFO, and Web of Science, was conducted in order to categorize relevant research that was published between 2020 and 2024. The inclusion criteria for this research were English-language and from above search engines. The selected studies also have to offer useful information on team dynamics and employ recognized measurement scales. Following an initial screening and quality evaluation, twenty two studies were included in the synthesis.

**Results:** The study database was searched through electronic databases, identifying 3476 records. Twenty-seven unique records were assessed for eligibility based on titles and abstracts. After initial screening, twenty-seven studies were selected for full-text assessment. After independent review, twenty-two studies met criteria and were included in the systematic review. The selected studies were conducted between 2020-2024 and varied in design. The PRISMA flowchart illustrates the selection process. Quality evaluation involves peer-reviewed journals, overall assessment, and quality management.

**Conclusion:** This paper examines the effectiveness of mobile app technology for adherence medication among the patients with chronic diseases. The systematic

Jameel Ahmed Hazzazi, Mariam Yahia Ghowaidi, Faisal Mohammed Ali Guhal, Nadia Gassem Ahmad Otaif, Sherifa Muhammed Hussain Muhzery, Laila Yahya Ghwaidi, Safia Yahya Ghwaidi, Maryam Muhaimid Hammoud Al-Azmi, Almuhammad Yahya Ali Khubrani, Hanan Yahya Mohammed Otaif, Fatimah Gassem Otif review has the 22 articles from the three search engine such as Scopus, Web of Science, and PsycINFO databases. The themes extracted from the SR as The efficiency of mobile app technology solutions, COVID-19's Effect on the Adoption and Use of Health Technology, the Implementation and Sustainability of mHealth Solutions and Patient Engagement, and User Experience of Mobile app technology. The study recommended that Mobile health app technologies can improve medication adherence in chronic patients. Long-term efficacy depends on data security, privacy, and user experience. Policymakers should implement guidelines, research, and collaboration.

**Keywords:** Mobile Health App, Chronic Patient, Adherence to Medication, Systematic Review.

## 1. Introduction

A chronic patient is the one who is experiencing sickness over the three months or more than that which also worsen as the time passes. Chronic illness does not cure but is controllable and manageable. There are different chronic illnesses as cardiovascular, arthritis, diabetic, hypertension, cancer and stroke. Chronic diseases impact negatively on patients' lives as socially and financially.<sup>1,2</sup> People with chronic diseases have limited social interaction which leads them toward isolation. Another stressful factor is financial crisis during the treatment of patients with chronic diseases. Due to financial crisis patients do not take medication as prescribed by doctors which worsen the disease.<sup>3,4,5</sup> However, malnutrition can be caused by environmental factors such as limited access to food or reduced food intake, leading to nutritional imbalances and affecting growth, development, and health. Malnutrition related to diseases, caused by increased metabolism, decreased appetite, or loss of energy, can develop into acute or chronic diseases.<sup>6,7,8</sup>

Adherence to medication is very important for patients with chronic diseases as it control and manage their diseases. Patients who take medicine properly have more positive outcome of treatment as compare to those who quit when the symptoms get better but not cure. There have been different awareness programs which educate the patients about importance of medication during any chronic disease.<sup>9,10,11,12,13</sup> Modern technology is emerging in the healthcare institutions with positive impact on the treatment. There are different types of modern technologies being used in the healthcare centers which decreasing the workload of healthcare providers.<sup>14,15</sup> The treatment of medical conditions has been significantly improved by the use of various medical technologies, including telemedicine, wearable sensors, and AI tools. These advancements have expanded treatment options, streamlined operations, and facilitated clinical research. However, the challenge of unstandardized data presents a challenge for healthcare organizations. The use of cloud, blockchain, and AI tools can enhance patient care, real-time information exchange, and clinical decision support.<sup>16,17,18,19,20</sup>

Mobile health applications are a promising solution to improve treatment adherence in the management of chronic diseases. These applications use digital tools to provide personalized healthcare solutions directly to users, making it easier

for patients to manage their health. They provide reminders for medication doses, educational content about diseases and treatments, track medication usage and health indicators, and facilitate communication with healthcare providers.<sup>21.22.23.24.25</sup> Mobile health applications also empower patients through education and engagement, providing access to articles, videos, and interactive content that educate users about their chronic conditions and the role of medications in managing these diseases. They also create support communities for patients, which enhance interaction and reduce feelings of loneliness. Studies have shown that mobile health interventions, including mobile applications, significantly increase adherence rates compared to control groups<sup>26.27.28.29.30</sup> However, the challenges include the digital divide, which limits the scope of this intervention, and user engagement, which can vary significantly. Concerns about privacy and data security are also important because patients may be hesitant to use mobile health applications due to worries about the use and protection of their personal health data.

## 2. Methods

### Research Objective

The objective of research is to explore the effect of mobile health app technologies enhancing chronic patient adherence to medications.

### Research Question

1. What is the impact on mobile health app on adherence to medications?
2. How mobile health app technologies enhance adherence to medication among the chronic patients?

### Literature Search Strategy

A comprehensive search strategy was developed to identify relevant studies. Databases such as Scopus, PsycINFO and Web of Science were searched using a combination of keywords related to “Chronic Patients”, “Adherence to Medications”, “Mobile App Technology” and “The Effect of Mobile Health App Technologies Enhancing Chronic Patient Adherence to Medications.”

Table 1 Syntax Search

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Syntax 1	“Chronic Patients”, “Adherence to Medications” and “Mobile Health App Technology”
Syntax 2	“The Effect of Mobile Health App Technologies Enhancing Chronic Patient Adherence to Medications.”

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Table 2 Statistics from the Data Base

No	Database	Syntax	Year	No of Researches
1	Scopus	Syntax 1		980
		Syntax 2	2020	350
2	Web of Science	Syntax 1	-	870
		Syntax 2	2024	238
3	PsycINFO	Syntax 1		690
		Syntax 2		348

The study used Scopus, Web of Science, and PsycINFO databases to categorize relevant research publications from 2020-2024. The most significant articles were found in Scopus 1330 and Web of Science 1108 whereas PsycINFO had 1038 had representative thoroughness in the scientific search. The total researches were searched as 3476.

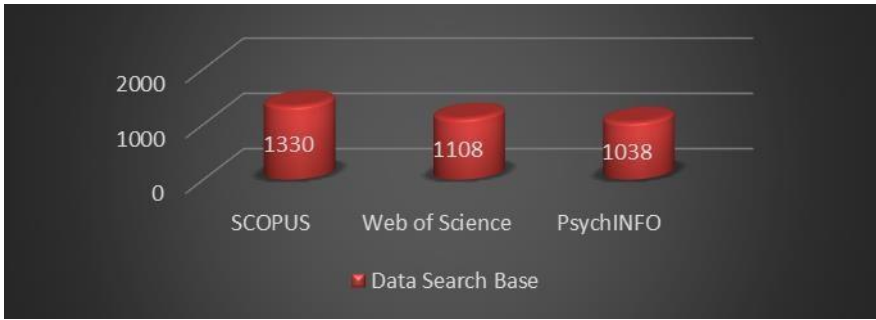


Figure 1 Graphic representation of search database according to different search engines

**Inclusion and Exclusion Criteria**

The use of mobile app technology to enhance chronic patients' medication adherence is examined in this review. It highlights how crucial it is to manage chronic illnesses by adhering to recommended treatment guidelines. The review covers research on the effect of mobile apps on medication adherence that has been published in peer-reviewed journals, conference proceedings, and English-language reports. To ensure a thorough grasp of the technology's efficacy, the evaluation incorporates papers ranging from observational studies to randomized controlled trials. The studies were

eliminated from further consideration after being methodically evaluated for relevance. In order to improve health outcomes in the management of chronic diseases, the review seeks to shed light on how mobile app technology might be a useful tool for patients and healthcare professionals.

**Quality Assessment**

The included studies have been assessed for quality and methodological consistency using appropriate tools, such as the Joanna Briggs Institute Critical Appraisal Checklist for various research designs. The assessment takes into account variables including sample size, data collection techniques, research design, and potential bias. Quality assessment led to the exclusion of several studies, but the results were still interpreted by considering the strengths and weaknesses of each method.

**Table 3 Assessment of the literature quality matrix**

Sr #	Author (First Author, Year)	Are the selections of studies described appropriately?	Is the literature covered all relevant studies?	Does the method section describe?	Were findings clearly described?	Quality rating
1	Alshehri, F. (2021)	Yes	Yes	Yes	Yes	High
2	Alharbi, R. (2021)	Yes	Yes	Yes	Yes	Medium
3	Alzahrani, A. (2022)	Yes	Yes	Yes	Yes	High
4	ALsharif, A. H. (2022)	Yes	Yes	Yes	Yes	Medium
5	Alsaad, H. A. (2022)	Yes	Yes	Yes	Yes	High
6	Alnanih, R. (2024)	Yes	Yes	Yes	Yes	High
7	Altamimi, A. F. (2021)	Yes	Yes	Yes	Yes	Medium
8	Chew, S. (2020)	Yes	Yes	Yes	Yes	High
9	Fleming, G. A. (2020)	Yes	Yes	Yes	Yes	High
10	Guo, Y. (2020)	Yes	Yes	Yes	Yes	High
11	Khan, N. (2020)	Yes	Yes	Yes	Yes	Medium
12	Knitza, J. (2020)	Yes	Yes	Yes	Yes	High
13	Liu, K. (2020)	Yes	Yes	Yes	Yes	High
14	Matricardi, P. M. (2020)	Yes	Yes	Yes	Yes	High
15	Mason, M. (2022)	Yes	Yes	Yes	Yes	Medium
16	McBride, C. M. (2020)	Yes	Yes	Yes	Yes	High
17	Park, L. G. (2020)	Yes	Yes	Yes	Yes	Medium
18	Pires, I. M. (2020)	Yes	Yes	Yes	Yes	High
19	Peng, Y. (2020)	Yes	Yes	Yes	Yes	High
20	Subramanian, M. (2020)	Yes	Yes	Yes	Yes	Medium
21	Tangari, G. (2021)	Yes	Yes	Yes	Yes	Medium
22	Yang, C. (2022)	Yes	Yes	Yes	Yes	High

The systematic review of studies provided clear descriptions, methods, selection processes, literature coverage, and clear conclusions, resulting in a "High or Good" rating for their quality.

**Study Selection**

Two independent reviewers screened retrieved studies for eligibility, then reviewed full-text articles against inclusion and exclusion criteria, with disagreements resolved through discussion or consultation with a third reviewer

Table 4 Selected Studies for SR (Systematic Review)

No	Author	Research	Year
1	Alshehri & Alshaikh <sup>1</sup>	Exploring the constituent elements of a successful mobile health intervention for prediabetic patients in King Saud University Medical City Hospitals in Saudi Arabia: cross-sectional study.	2021
2	Alharbi, R. et al. <sup>2</sup>	Utilization of health applications among patients diagnosed with chronic diseases in Jazan, Saudi Arabia during the COVID-19 pandemic.	2021
3	Alzahrani Gay & Alturki <sup>3</sup>	Exploring Saudi individuals' perspectives and needs to design a hypertension management mobile technology solution: Qualitative study.	2022
4	Alsharif <sup>4</sup>	Attitudes of patients with chronic diseases toward management eHealth applications systems in post-COVID-19 times.	2022
5	Alsaad, H. A. et al. <sup>5</sup>	Assessment of self-medication practice and the potential to use a mobile app to ensure safe and effective self-medication among the public in Saudi Arabia.	2022
6	Alnanih, R., Balabid, A., & Bahmdean, L. <sup>6</sup>	Senior-centered design for mobile medication adherence applications based on cognitive and technology attributes.	2024
7	Altamimi, A. F. et al. <sup>7</sup>	The attitude and prevalence of patient noncompliance toward chronic disease medications in Saudi Arabia.	2021
8	Chew, S. et al. <sup>8</sup>	Usability and utility of a mobile app to improve medication adherence among ambulatory care patients in Malaysia: qualitative study.	2020
9	Fleming, G. A. et al. <sup>9</sup>	Diabetes digital app technology: benefits, challenges, and recommendations. A consensus report by the EASD and ADA Diabetes Technology Working Group.	2020
10	Guo, Y. et al. <sup>10</sup>	Mobile health technology to improve care for patients with atrial fibrillation.	2020
11	Khan, N. <sup>11</sup>	Mobile Health Technology to Enhance Healthcare Service Delivery in Developing Nations (Saudi Arabia).	2020
12	Knitz, J. et al. <sup>12</sup>	Mobile health usage, preferences, barriers, and eHealth literacy in rheumatology: patient survey study.	2020
13	Liu, K. et al. <sup>13</sup>	Effectiveness of mobile app-assisted self-care interventions for improving patient outcomes in type 2 diabetes and/or hypertension: systematic review and meta-analysis of randomized controlled trials.	2020
14	Matricardi, P. M. et al. <sup>14</sup>	The role of mobile health technologies in allergy care: An EAACI position paper.	2020
15	Mason, M. et al. <sup>15</sup>	Technologies for medication adherence monitoring and technology assessment criteria: narrative review.	2022
16	McBride, C. M. et al. <sup>16</sup>	Patients' experiences of using smartphone apps to support self-management and improve medication adherence in hypertension: qualitative study.	2020
17	Park, L. G. et al. <sup>17</sup>	Perceptions and experiences of using mobile technology for medication adherence among older adults with coronary heart disease: A qualitative study	2020
18	Pires, I. M. et al. <sup>18</sup>	Research on the classification and applicability of the mobile health applications.	2020
19	Peng, Y. et al. <sup>19</sup>	Effectiveness of mobile applications on medication adherence in adults with chronic diseases: a systematic review and meta-analysis.	2020
20	Subramanian, M. et al. <sup>20</sup>	Precision medicine in the era of artificial intelligence: implications in chronic disease management.	2020
21	Tangari, G. et al. <sup>21</sup>	Mobile health and privacy: cross-sectional study.	2021
22	Yang, C. et al. <sup>22</sup>	Interventions for improving medication adherence in community-dwelling older people with multimorbidity: A systematic review and meta-analysis.	2022

### 3. Result

#### Study Database

A systematic search of electronic databases identified 3478 records. After removing

duplicates, 22 unique records were assessed for eligibility based on titles and abstracts.

### Title and Abstract Screening

The reviewer evaluated the titles and abstracts of the identified records in the first screening. Twenty two studies were chosen for full-text review using this procedure. The reviewers' disagreements were settled by consensus and discussion.

### Full-Text Assessment

The full texts of the twenty-two selected studies were found and independently reviewed against the inclusion and exclusion criteria by two reviewers. Following the full-text assessment, twenty two studies met the criteria and were involved in the systematic review.

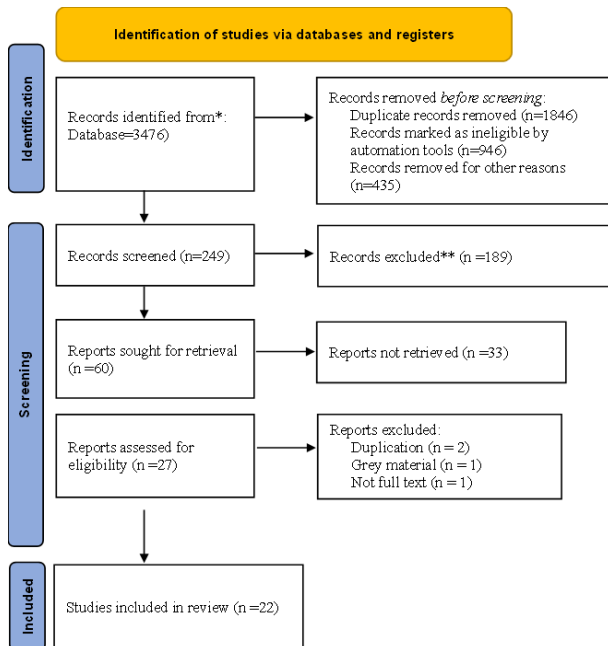
### PRISMA Flowchart

The study selection process is illustrated in the PRISMA flowchart (Table 4). It provides a visual representation of the number of records at each stage of the selection process, from initial database search to final inclusion in the systematic review.

### Identification of studies via databases and registers

Quality evaluation is a systematic process that includes assessing study quality using data from peer-reviewed journals, largely assessment, and quality management, providing valuable information on research techniques and pressure application.

Table 5 Identification of Studies via Database



## Data Extraction

For assessment, a uniform data extraction form was created. Key findings, participant characteristics, research characteristics (authors, publication year), and any other pertinent information were retrieved by two reviewers separately from the selected papers. Consensus was used to settle disagreements.

Table 6 Research Matrix

No	Author, Year	Aim of Study	Methodology	Sample	Setting	Result
1	Alshehri, F., & Alshakhs, F. (2021)	Explore successful mobile health interventions for prediabetic patients	Cross-sectional study	250 participants	King Saud University Medical City Hospitals	Key elements for effective interventions identified, including user engagement and health education.
2	Alharbi, R., et al. (2021)	Utilization of health applications among chronic disease patients during COVID-19	Cross-sectional survey	400 patients	Jazan, Saudi Arabia	Increased use of health apps; identified barriers to usage such as lack of awareness.
3	Alzahrani, A., et al. (2022)	Explore perspectives on hypertension management mobile tech	Qualitative study	30 participants	Saudi Arabia	Identified needs for personalized features and ease of use in hypertension management apps.
4	Al-Sharif, A. H. (2022)	Assess attitudes towards eHealth applications post-COVID-19	Qualitative study	50 patients	Saudi Arabia	Positive attitudes towards eHealth; emphasized the need for improved digital literacy.
5	Alsaad, H. A., et al. (2022)	Assess self-medication practices and potential app use	Cross-sectional study	200 participants	Saudi Arabia	High prevalence of self-medication; interest in mobile app support for safe practices.
6	Alnaanih, R., et al. (2024)	Design senior-centered medication adherence apps	Qualitative study	40 older adults	Saudi Arabia	Focused on cognitive and technology needs; emphasized simplicity and accessibility in app design.
7	Altamimi, A. F., et al. (2021)	Attitudes towards medication noncompliance in chronic disease	Cross-sectional study	300 patients	Saudi Arabia	High rates of noncompliance; need for better patient education and follow-up strategies.
8	Chew, S., et al. (2020)	Usability of a mobile app for medication adherence	Qualitative study	20 patients	Malaysia	Positive feedback on usability; recommended enhancements for user engagement features.
9	Fleming, G. A., et al. (2020)	Evaluate benefits and challenges of diabetes apps	Consensus report	N/A	Europe/USA	Highlighted advantages of mobile apps in diabetes management; noted challenges like data privacy.
10	Gao, Y., et al. (2020)	Improve care for atrial fibrillation patients using mobile health	Review	N/A	Various	Concluded that mobile health technology can significantly enhance patient care and outcomes.
11	Khan, N. (2020)	Enhance healthcare delivery with mobile health in developing nations	Literature review	N/A	Saudi Arabia	Mobile health shows promise in improving healthcare access and quality in developing contexts.
12	Knitzka, J., et al. (2020)	Assess mobile health usage in rheumatology	Patient survey study	500 patients	Germany	Identified user preferences and barriers to mobile health technology adoption.
13	Liu, K., et al. (2020)	Effectiveness of mobile app-assisted interventions	Systematic review	40 studies	Various	Found positive outcomes for diabetes and hypertension management with mobile app interventions.
14	Maticcardi, P. M., et al. (2020)	Role of mobile health in allergy care	Position paper	N/A	Europe	Stressed the importance of mobile health in allergy management and patient education.
15	Mason, M., et al. (2022)	Review medication adherence monitoring technologies	Narrative review	N/A	Various	Discussed a range of technologies for monitoring medication adherence effectively.
16	McBride, C. M., et al. (2020)	Patients' experiences with self-management apps	Qualitative study	25 patients	Ireland	Reported positive experiences with self-management apps; suggested improvements for integration.
17	Park, L. G., et al. (2020)	Experiences using mobile tech for medication adherence	Qualitative study	30 older adults	USA	Positive perceptions; highlighted the need for better user interfaces and features.
18	Pires, I. M., et al. (2020)	Classification and applicability of mobile health apps	Research study	N/A	Various	Developed a classification framework for evaluating mobile health applications.
19	Peng, Y., et al. (2020)	Effectiveness of mobile apps on medication adherence	Systematic review	35 studies	Various	Significant improvements in medication adherence rates found with app usage.
20	Subramanian, M., et al. (2020)	Implications of AI in chronic disease management	Review	N/A	Various	Discussed the potential of AI to enhance chronic disease management through tailored interventions.
21	Tangari, G., et al. (2021)	Investigate privacy issues in mobile health	Cross-sectional study	300 participants	N/A	Identified significant privacy concerns among users regarding mobile health applications.
22	Yang, C., et al. (2022)	Improve medication adherence in older adults with multimorbidity	Systematic review	40 studies	Various	Found effective interventions to enhance medication adherence among older adults with multiple health issues.

## Data Synthesis

The synthesized findings were presented through a narrative synthesis approach; to explore different types of mobile app technology among patients with chronic diseases and medication adherence by mobile app. Quantitative synthesis approach; examine the effectiveness of mobile app technology.

Table 7 The following sub-themes have been observed among the studies, including in the systematic review.

No	Themes
1	The efficiency of mobile app technology solutions
2	COVID-19's Effect on the Adoption and Use of Health Technology,
3	the Implementation and Sustainability of mHealth Solutions
4	Patient Engagement, and User Experience of Mobile app technology

#### 4. Discussion

As the themes extracted from the systematic reviews of 22 research papers are discussing about different aspect of mobile app and adherence to medication among the patient with the chronic diseases. The first theme as it discussed about the efficiency of mobile app technology solutions in which the Lie et al. (2020) had examined the effectiveness of M.A technology on adherence of medication. It was resulted that M.A technology educates and give the awareness to the patients about medication which has positive impact on their adherence to the medication. Similarly, another study conducted by Pent et al. (2020) supported the above research as mobile app technology is effective while dealing the patient with diabetes. It was found the mobile app is a useful intervention for diabetic patients. It integrates with the feedback which help the patients to understand about their chronic diseases and its severity if not treated well.<sup>39</sup> Moreover, Khan. (2020) discussed that it increases the healthy behavior engagement and manage the disease at the early phase.

The second theme is discussing about the use of mobile app technology during the COVID-19. As during the pandemic it was not feasible for everyone to meet the doctor in-person because of the virus so people started to adopt the mobile app technology which help them manage their health and it enhance the medication adherence. The research stated that during pandemic, the mobile app technologies were accepted by the patients and the family.<sup>32</sup> Therefore the pandemic was the era where the mobile app technology positively introduced to the patients. Chew and Khan emphasize the importance of ongoing education and training for the efficient use of mHealth technologies, as the rapid proliferation of these technologies can burden support services. They emphasize the need to remove access hurdles and ensure fair access to mHealth solutions.<sup>31</sup>

Third theme discusses about the implementation and sustainability of mobile health app solutions. For development and implementation process of mobile app or mobile health technology, it is important to include the healthcare providers, health ministers, policies makers, stakeholders and the patients. Because of their engagement at the stage of development, make it successful. At the stage of

development of Mobile app patients suggests and give their opinion about it.<sup>50,45</sup> Moreover, for the sustainability of the mobile is depended on the feedback given by patients and healthcare providers. Research stated that feedback is crucial aspect in sustaining equipment or technologies in the healthcare centers.<sup>44</sup> Patients' feedback about the certain feature to be added or removed from the mobile app health also help redesigning and making it more effective for the patients.<sup>32</sup>

Fourth theme was about patient engagement, and user experience of mobile app technology. It discussed about the patients use of mobile app for chronic diseases. It also discussed that self-medication is so common, mobile apps must enable safe behaviors. Simplicity and accessibility are prioritized, with an emphasis on cognitive and technological requirements. Better patient education and follow-up tactics are necessary, nonetheless, due to high noncompliance rates. Create apps that focus on medication adherence for seniors<sup>35,36,37</sup>

## 5. Limitations & Recommendations

Chronic patients' medication adherence can be enhanced by mobile health app technologies that prioritize user-centered design, offer thorough education and training, and integrate with current healthcare systems. For developers to assess the long-term efficacy of these technologies they must emphasize data security and privacy, set up continuing feedback systems, and carries out ongoing study. Users' experiences with these applications can differ greatly, though, depending on a variety of characteristics, including motivation, technological skill, and health literacy. Furthermore, the evaluation of long-term sustainability may be complicated by short-term results, technological obstacles, and outside variables such as modifications to healthcare regulations and the availability of resources.

Policymakers should implement evidence-based guidelines, increase research funding, educate healthcare providers, promote work-life balance, and encourage multidisciplinary collaboration to improve medication adherence and optimize mobile health technology use. Patient feedback and patient-centered care strategies can enhance care outcomes.

## 6. Conclusion

This paper examines the effectiveness of mobile app technology for adherence medication among the patients with chronic diseases. The systematic review has the 22 articles from the three search engine such as Scopus, Web of Science, and PsycINFO databases. The themes extracted from the SR as The efficiency of mobile app technology solutions, COVID-19's Effect on the Adoption and Use of Health Technology, the Implementation and Sustainability of mHealth Solutions and Patient Engagement, and User Experience of Mobile app technology. The study recommended that Mobile health app technologies can improve medication adherence in chronic patients. Long-term efficacy depends on data security, privacy, and user experience. Policymakers should implement guidelines, research, and collaboration.

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