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Using Mobile Health Applications in Postoperative Care: Patients' and Healthcare Providers' Experiences

Metropolia University of Applied Sciences

Bachelor of Healthcare in Nursing

Degree Programme in Nursing

Bachelor's Thesis

20 May 2024

Abstract

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Title: Using Mobile Health Applications in Postoperative Care: Patients' and Healthcare Providers' Experiences
Number of Pages: 31 pages + 2 appendices
Date: 20 May 2024

Degree: Bachelor of Healthcare
Degree Programme: Nursing and Healthcare
Instructor(s): Anna-Kaisa Partanen, Senior Lecturer

Mobile health applications have revolutionized healthcare, enhancing patient engagement, providing health information, and improving clinical outcomes. However, inclusivity and monitoring of technology's impact on workflow are crucial for full realization. The purpose of this study is to describe the experiences of both patients and healthcare providers in utilizing mobile health applications in postoperative care and the aim is to produce knowledge that could be used to improve the practices of both patients and healthcare providers when using mobile health applications in postoperative care. This study employs a qualitative, descriptive review method to explore patients' and healthcare providers' experiences with mobile health applications in postoperative care, focusing on experiences and inductive and dynamic research techniques. Through inductive content analysis, two main categories were identified: patients' experiences and providers' experiences. The content was further subdivided into five generic categories. The study used a Boolean Technique to tailor a search strategy for databases CINAHL Complete and PubMed, utilizing AND, OR, and NOT commands for specific results. This study gathered 13 articles from 2015-2023, published in various countries, including the USA, Canada, Sweden, Australia, the Netherlands, Switzerland, and the UK/Ireland. The population included patients who underwent postoperative surgeries, including breast reconstruction, abdominal surgery, orthopedic surgery, etc, and healthcare providers who performed these surgeries. The literature review examines the use of mobile health applications in postoperative care, focusing on obtaining acceptance, healthcare communications, postoperative care, accessibility, and future preferences. It highlights the benefits of these apps in enhancing patient engagement, promoting accessibility, and empowering patients. Mobile health applications are gaining popularity in postoperative care for improved recovery management. However, challenges include privacy, security, usability, and information overload. Recommendations include prioritizing patient data privacy, providing training, involving patients and healthcare providers in app design, and implementing continuous evaluation.

Keywords: mobile health applications, postoperative care, patients' experiences, and healthcare providers' experiences

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1 Introduction

Many facets of modern life, including health care, have been altered by the arrival of digital technology. Mobile health applications are examples of digital health technology. (Robinson, Oksuz, Slight, Slight and Husband 2020: 2.) Mobile health applications (mHealth apps) have become increasingly popular in healthcare, with the promise of improving patient care and outcomes. In the context of postoperative care in acute surgical settings, mHealth apps have the potential to enhance patient engagement, provide valuable health information, and improve clinical outcomes. (Croke 2020: 11.)

Mobile health applications (mHealth apps) have the potential to increase communication among healthcare practitioners, to improve interaction with physicians and peers, to monitor health remotely as well as to empower patients to take active participation in their care (Croke 2020: 11). The mobile health applications emphasize the importance of patient-centric implementation of mobile apps in routine care, ensuring inclusivity for patients and clinicians of varying digital literacy levels, and monitoring the technology's impact on workflow to fully realize its potential (Lau et al. 2017: 12).

The use of mHealth improves access to information and has the potential to profoundly alter patient-provider interactions (Donevant, Messias and Estrada 2018: 6). Mobile health applications (mHealth apps) offer the potential to improve post-discharge care. Rapid advances in communication and computer technologies during the last few decades have allowed for the development of healthcare tools based on mobile computers and communication devices, which have the potential to influence many facets of healthcare. (Scott, Alore, Naik, Berger and Suliburk 2017: 4.)

The purpose of this study is to describe the experiences of both patients and healthcare providers in utilizing mobile health applications in postoperative care. The study aim is to produce knowledge that could be used to improve the practices of both patients and healthcare providers when using mobile health applications in postoperative care.

2 Background and key terms

2.1 Background

2.1.1 Overview of mobile health applications

Mobile health applications have been rapidly evolving and are increasingly being utilized in various healthcare settings, including postoperative care. These applications have the potential to cater to diverse patient needs and improve health outcomes (Fiordelli et al. 2013: 15). Specifically in the context of postoperative care, mobile applications have been studied for their role in monitoring patients after surgery, detecting complications, and optimizing follow-up care (Armstrong et al. 2014: 4).

Studies have shown that mobile health applications can effectively detect postoperative complications and reduce the need for in-person visits, potentially leading to cost-effective care models (Armstrong et al. 2014: 6). Furthermore, the use of mobile apps in postoperative care has been highlighted as a means to enhance patient recovery, improve monitoring of pain, provide educational opportunities, and facilitate better communication between patients and healthcare providers (Nguyen et al. 2020: 335).

The benefits of utilizing mobile applications in postoperative care extend to both patients and the healthcare system. Patients can benefit from improved monitoring, timely intervention in case of complications, and enhanced engagement in the recovery process (Armstrong 2015: 3). On the other hand, healthcare systems can potentially streamline postoperative care processes, reduce the burden of in-person visits, and enhance the overall quality of care provided to patients (Armstrong et al. 2014: 2).

2.1.2 Importance of postoperative care

Postoperative care is a critical component in the management of patients undergoing surgical procedures. It involves a range of interventions aimed at optimizing recovery, reducing complications, and improving outcomes. Enhanced Recovery After Surgery (ERAS) protocols have been shown to reduce postoperative complications and length of hospital stay (Stowers et al. 2016: 480). These standardized perioperative care pathways aim to enhance patient recovery and minimize morbidity. Studies have emphasized the importance of tailored postoperative care plans for specific patient popu-

lations, such as those undergoing orthopaedic procedures (Sundar et al. 2021: 5). Postoperative complications, including respiratory impairment, delirium, and postoperative ileus, can significantly impact patient outcomes and prolong hospital stays (Gifford et al. 2019: 7). Therefore, customized postoperative care plans addressing these complications are essential for improving recovery and reducing healthcare costs. Healthcare providers, particularly nurses, play a crucial role in delivering postoperative care, as nursing care has been shown to reduce postoperative complications and enhance patient outcomes. Additionally, the use of technology, such as mobile apps for home monitoring, can facilitate postoperative follow-up and improve the continuity of care (Armstrong et al. 2015: 6).

2.1.3 Significance of patients' and healthcare providers' experiences

The importance of patient and healthcare provider experiences in postoperative care and the use of mobile health applications is crucial in optimizing healthcare delivery and improving patient outcomes. Patient-reported experience measures are vital in assessing the quality of care, especially in managing postoperative pain in major orthopaedic surgery (Özdemir et al. 2021:535). Understanding the patient's perspective on postoperative recovery is essential for addressing unmet information needs and enhancing preparedness for surgery (Tunsi et al. 2023: 6). Digital mobile technology has been proven to enhance physician-patient communication, streamline patient care, and improve confidentiality in perioperative messaging, highlighting the significance of technology in postoperative care experiences (Granath et al., 2022: 2). According to Murtha et al 2022, educating patients about their upcoming surgery, potential risks, and postoperative expectations is fundamental in ensuring a successful outcome and enhancing patient satisfaction. Factors such as treating patients with respect, providing shared decision-making, and supporting self-care significantly impact patients' quality of postoperative recovery and satisfaction with care (Natafji et al. 2022: 1520). Furthermore, healthcare providers' perceptions and experiences are critical in understanding patient healthcare utilization, avoidable healthcare visits, and the impact on patients' health and well-being postoperatively (Elagi et al. 2019: 3282). The experiences of healthcare workers with eHealth applications in supporting self-care for patients undergoing major surgery underscore the importance of person-centred care and equal access to quality care (Hadelar et al. 2021: 1598). By considering patient and healthcare provider experiences, healthcare systems can customize care delivery to

meet the unique needs of patients undergoing surgery, ultimately leading to improved health outcomes and increased patient satisfaction.

2.2 Key terms

To conduct the research effectively, the following terms were identified: Mobile health applications, postoperative care, patients' experiences, and healthcare providers' experiences. These are clearly and precisely defined:

Mobile health applications, commonly known as mHealth apps, are software programs designed to run on mobile devices such as smartphones or tablets to support healthcare services and provide health-related information to users. (Wood et al. 2019: 469.)

Postoperative care involves the healthcare provided to patients after they have undergone surgery, focusing on monitoring recovery, managing complications, and facilitating a return to health. It includes monitoring vital signs, pain management, wound care, and identifying any signs of infection or complications. (Lapp et al. 2022: 1.)

Patients' experiences refer to the interactions, perceptions, and outcomes encountered by patients when utilizing mobile health applications for their healthcare needs (Lu et al. 2018: 6).

Healthcare providers' experiences encompass the interactions, perceptions, and challenges faced by healthcare professionals when using mobile health applications in care delivery (Jabour et al. 2021:1270).

3 Purpose, aim, and research questions

The purpose is to describe the experiences of both patients and healthcare providers in utilizing mobile health applications in postoperative care.

The aim is to produce knowledge that could be used to improve the practices of both patients and healthcare providers when using mobile health applications in postoperative care.

The research questions of this study are:

1. What are patients' experiences of using mobile health applications in postoperative care?
2. What are healthcare providers' experiences of using mobile health applications in postoperative care?

4 Methodology and methods

4.1 Data collection method

Methodological approach of this study is qualitative, and method used is descriptive review to understand the human experience in its own setting (Doyle, McCabe, Keogh, Brady and McCann 2019: 445) and to answer the research questions: (1) What are patients' experiences of using mobile health applications in postoperative care? and (2) What are healthcare providers' experiences of using mobile health applications in postoperative care?

Qualitative research is often used to provide straightforward descriptions of experiences and perceptions, especially in areas where little is known about the topic. A descriptive design is most appropriate, as it acknowledges the subjective nature of the problem and the different experiences participants have. This translates into researchers being concerned with understanding the particular human experience in its own setting in qualitative descriptive research. This style of investigation requires inductive and dynamic research techniques that do not alter the data beyond the identification of the phenomena being examined. (Doyle et al. 2019: 444.) According to Danford (2022), this approach originated from the philosophical perspective of naturalistic inquiry and includes acknowledgment of shared experiences and human interactions. It has been described as eclectic in nature, with the goal of describing an individual's experience in their own words, distinctly and clearly, but at less depth than descriptive phenomenology. (Danford 2023: 41.)

4.2 Data search and selection

To guarantee a good quality of source, articles are systematically selected based on the title, abstract, and set of inclusion and exclusion criteria that align with the purpose, aim, and research questions of the study. Articles selected are primary articles, nursing scientific studies published in a peer-reviewed journal, articles published in English, qualitative descriptive literature, 10 years and below, primary studies focusing on mobile health applications, patient and healthcare provider experiences, and postoperative care and Meta-analysis (PRISMA 2020) criteria will be used to ensure transparent and complete reporting of systematic reviews and allowing researchers to assess the trustworthiness and applicability of the findings. (Page 2021: 1.) A preliminary selection of the sources that may be used in the study was carried out by the researchers in accordance with the research questions. In order to get the search record from the database, please refer to **Appendix 1**.

4.2.1 PICo framework

The PICo technique focuses on a qualitative article's Population, Interest, Context. It is widely used in evidence-based research to identify clinical evidence components for systematic reviews and is supported by the Cochrane Collaboration. Below is the PICo analysis for the research study. (Methley, Campbell, Chew-Graham, McNally and Cheraghi-Sohi 2014: 2.)

Table 1. PICo Analysis

PICo Analysis	
Population	Surgical patients/healthcare providers
Interest	Experiences on the use of mobile health applications
Context	Postoperative care

4.2.2 Inclusion and exclusion criteria

The inclusion and exclusion of the qualitative descriptive study “Using Mobile Health Applications in Postoperative Care: Patients’ and Healthcare Providers’ Experiences”.

Table 2. Inclusion and Exclusion

INCLUSION	EXCLUSION
Studies that focus on Mobile health applications, postoperative care, and patient/healthcare providers' experiences.	Studies that focus on Telehealth, preoperative/perioperative care, and do not focus on the experiences of patients/healthcare providers.
Studies published in the English language.	Studies published in other languages.
Studies published between 2013-2023.	Studies published older than 10 years.
Peer-reviewed and primary studies.	Non-peer-reviewed, secondary studies, editorials, expert articles, and articles with no access to full texts.

4.2.3 Search term

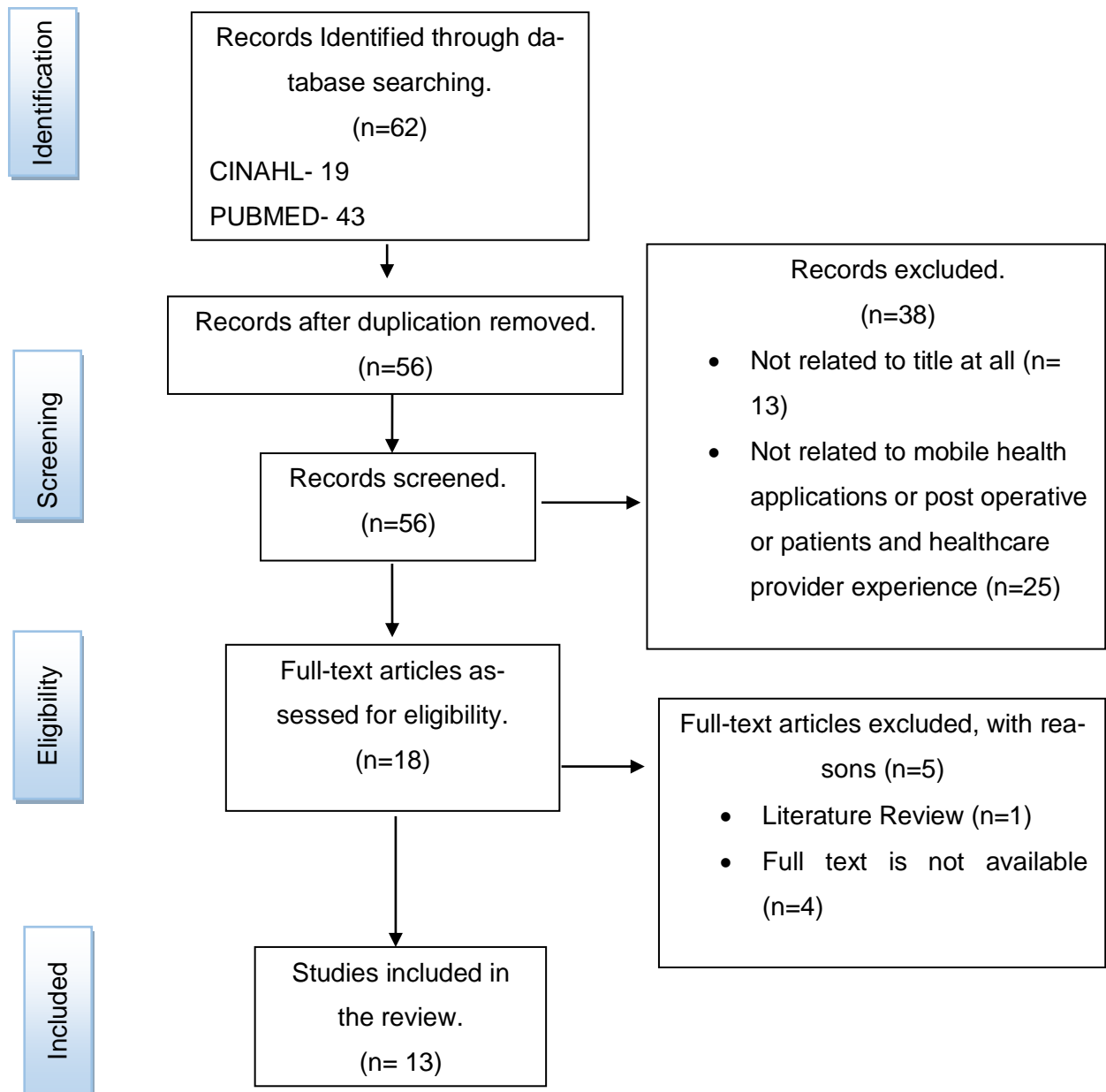
The study established a precise search strategy and was tailored both databases CINAHL Complete (Ebsco) and PubMed. A Boolean Technique is used to form research sentences for each. The **AND** command narrows the search, the **OR** command broadens the search, and the **NOT** command limits the search result. Parentheses, truncation, and phrases are examples of other directives. Refer to **Table 3** for the search terms used from the PICO analysis.

Table 3. Search term for PICO analysis

PiCo Tool	CINAHL Complete (Ebsco)	PubMed
P	experiences or perceptions or attitudes or views of patient and healthcare provider	(experience or perceptions or attitudes or views of surgical patients/healthcare providers)
	experience* or attitude* or perception* or view* of patient and healthcare provider	
AND		
I	mobile health applications or mhealth or mobile apps	(mobile health applications or mHealth or mobile apps)
	use* of mobile health app*	
AND		
Co	postoperative or post operative or post-surgery or post-surgical	(post operative or post-operative or postoperative or post surgery recovery)
	postoperativ* or post surgery or after surgery	
NOT		
	Telehealth or digihealth or ehealth	(telehealth or telemedicine or telemonitoring or telepractice or telenursing or telecare)

4.2.4 PRISMA flow chart

Figure 1: Prisma Flowchart on the data selection process



4.3 Data analysis method

The study utilized and analyzed data related to the experiences of patients and healthcare providers using mobile health applications for postoperative care. The researchers employed qualitative inductive content analysis to explore the thirteen (13)

chosen articles in order to address the two research questions: “What are the patient experiences on using mobile health applications in postoperative care? And What are the healthcare provider experiences on using mobile health applications in postoperative care?”. The table summary (refer to **Appendix 2**) demonstrated that the articles included in this literature review employed mixed methods study designs. In this methodological approach, the authors formed a hypothesis by integrating new information with previous information in order to derive conclusions from all of the information gathered. (Bengtsson 2016: 10.)

The data analyzed using a systematic approach that entails gathering and arranging textual material through manual methods. Retrieval of the meaning units used comprehensive approach utilize in analyzing texts or transcripts, which entails reading and familiarizing with the data before picking and classifying sections of text. The data is systematically arranged based on a broad perspective, and sections of the texts are identified and labelled based on its significance. (Vears and Gillam 2022: 117-119.) As illustrated in **Table 4**, the meaning units have single and multiple meanings. Further examination of the meaning units was accomplished through a separate evaluation of the articles by two researchers. In addition, a research adviser conducted a thorough review of the works to enhance the credibility and verify the precision and dependability of the analysis. The data is systematically arranged based on a broad perspective, and sections of the texts are identified and labelled based on its significance (Vears and Gillam 2022: 120).

Table 4. Examples of the meaning units and coding

Meaning units	Coding
Surgeons reported the easy-to-navigate design, portability, and time efficiency of the mobile device. (Semple et.al 2015: 1.)	The mobile gadget was praised by surgeons for its design that easy to use.
	Makes it possible for users to have continuous access to their devices regardless of where they are.
	The mobile gadget was praised by surgeons for its overall efficiency in terms of time management.
Most patients could have avoided follow-up at 2 and 6 weeks due to its efficacy. Patient and Surgeons reported satisfaction with the device, and 94% would respond to questions using a similar application in the future. (Higgins et.al 2017: 1.)	Patients have a high satisfaction rate.
	Participants like to use the same application in the future.
	Physician have a high satisfaction rate.
	Avoid the immediate and frequently follow- up visits.

After the initial coding, the authors meticulously analyze each portion within that category, carefully examining the text line by line, separating the data into subcategories, and meticulously coding with thorough detail. (Vears and Gillam 2022: 121.) The categories and sub-headings were identified through the process of labeling, as presented in **Table 5**.

Table 5. Examples of the sub-categories and five (5) generic categories

Sub-categories	Generic categories
Acknowledge of benefits in healthcare settings.	Obtaining acceptance
High satisfaction rate.	
App notifications to record discomfort was beneficial.	Healthcare Communications
Contains comprehensive details.	
Enhance compliance to post operative care instructions.	Postoperative Care
Enhance the quality of the treatment.	
Facilitated access to healthcare.	Accessibility
Generate support system.	
Suggestions for optimizing the utilization and enhancing the applications.	Future Preferences
To utilize the same application in the future.	

Thereafter, the researchers assessed whether the fine-grained subcategories were refined by either consolidating them into a single category or keeping them as separate subcategories (Vears and Gillam 2022: 121-122). Initially, a single category was established, but the quantity was subsequently decreased following the collection of data. Meaning units have been rearranged within categories to offer significant category results. The main categories were subsequently created to concisely summarize the underlying evaluation of the texts, as indicated in **Table 6**.

Table 6. The generic categories and main categories

Generic Categories	Main Categories
Obtaining acceptance	<p>Main Category 1: Patients' experiences on using mobile health applications in postoperative care.</p> <p>Main Category 2: Healthcare providers' experiences on using mobile health applications in postoperative care.</p>
Healthcare Communications	
Postoperative Care	
Accessibility	
Future Preferences	

The processing for inductive content analysis utilized in the study are depicted in Figure 2. Following the completion of these procedures, the pertinent extracted units underwent a thorough examination and were deemed suitable for presentation. The data analysis procedure utilized the main categories, general categories, and sub-categories that were provided (**Table 7**). In total, the authors extracted – Thirty-one original expressions (n= 31), twenty-six subcategories (n=26), five generic categories (n=5) and two main categories (n=2).

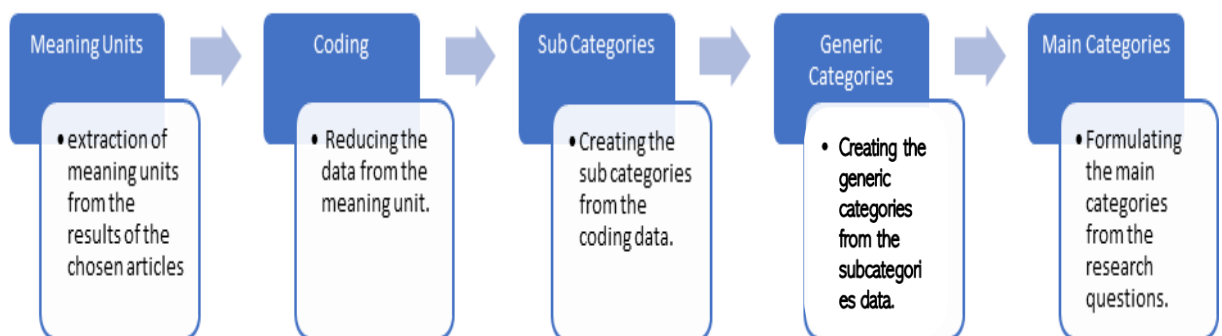
Figure 2: Process of Inductive Content Analysis

Table 7. Units of analysis based on the lists of selected articles

Main Category 1 (Themes): Patients' experiences on using mobile health applications in postoperative care			Main Category 2 (Themes): Healthcare providers' experiences on using mobile health applications in postoperative care	
Units of Analysis (Selected Articles)	Sub-categories	Generic Categories ↓	Units of Analysis (Selected Articles)	Sub-categories
1, 2, 4, 6, 7, 8, 10, 11	Acknowledge of benefits in healthcare settings.	←Obtaining acceptance→	2, 6, 9, 10	Acknowledgement the benefits in healthcare settings.
	High satisfaction rate.			High satisfaction rate.
	The application is highly motivating.			Desire to use the mobile applications
	The application is undoubtedly recommendable.			
8, 10	App notifications to record discomfort was beneficial.	←Healthcare Communications→	10, 12	Contains comprehensive details.
	Contains comprehensive details.			Beneficial to healthcare team.
	Information is comprehensible.			Information is comprehensible. Enhancing communication between patient and healthcare provider.
3, 5, 13	Enhance compliance to post operative care instructions.	←Postoperative Care→	2,12	Optimizing time for follow-up visits.
	Enhance the quality of the treatment			
	Enhance healing process.			Monitor wound remotely.
	Minimize complications.			
5, 8, 10, 11, 13	Facilitated access to healthcare.	←Accessibility→	1, 10	Accessible regardless of the location.
	Generate support system.			Time management efficiency.
	The utilization of self-recording using the app proved to be beneficial.			User Friendly application.
	User Friendly Applications.			
2, 6, 13	Suggestions for optimizing the utilization and enhancing the applications.	←Future Preferences→	2	To utilize the same application in the future.
	To utilize the same application in the future.			
	To utilize both email and text message.			

5 Results

5.1 Summary of selected articles and study results

Thirteen (13) articles between 2015-2023 were obtained for this study after conducting a thorough search and selection of databases. The studies span a range of countries including the USA (n=5), Canada (n=2), Sweden (n=2), Australia (n=1), Netherlands (n=1), Switzerland (n=1), UK, and Ireland (n=1), conducted between 2015 and 2023. The research primarily targets patients undergoing various surgical procedures such as breast reconstruction, orthopedic surgery, colorectal surgery, bariatric surgery, lung robotic surgery, and stress urinary incontinence, among others. Mixed-method approaches combining surveys, questionnaires, and interviews are prevalent, as seen in studies by Semple et al. (2015), Higgins et al. (2017), and Thiel et al. (2020), providing a comprehensive view of patient experiences and outcomes. Quantitative methods like randomized controlled trials and prospective observational studies are also employed, particularly in studies by Jaensson et al. (2017) and Comfort et al. (2021), emphasizing data-driven insights. Qualitative methods focus on detailed interviews, as used by Dahlberg et al. (2018) and Sreedharan et al. (2023), offering deep, personal insights into patient recovery. The selected articles were presented in a comprehensive manner in the table provided below (refer to **Table 8**).

The study aims to produce knowledge that could be used to improve the practices of both patients and healthcare providers when using mobile health applications for post-operative care. The researchers employed inductive content analysis to identify categories and generic categories. Two (2) categories were identified: (1) Patients' experiences on using mobile health applications in postoperative care and (2) Healthcare providers' experiences on using mobile health applications in postoperative care with the same five (5) generic categories: (1) Obtaining acceptance, (2) Healthcare communications, (3) Postoperative care, (4) Accessibility, and (5) Future preferences. The Results of the study were presented in a comprehensive manner in the table provided below (refer to **Table 9**).

Table 8. Lists of selected articles

Country	Year	Author (s)	Methods and Methodology	Participants
Canada	2015	Semple et al.	Mixed-Method - Questionnaire, Survey, and Interviews.	Total Patient (n=65) Breast reconstruction Surgery (n=33) Orthopedic Surgery (n=32)
Canada	2017	Higgins et al.	Mixed-Methods - Survey and Interview.	Total Respondents (n=34) Breast reconstruction and anterior cruciate ligament patient (n=32) Surgeons (n=2)
Sweden	2017	Jaensson et al.	Quantitative Method - Randomized controlled Trial	Patients post operative recovery (n=997)
USA	2017	Scott et al.	Mixed-Method - Survey and interviews.	Total Respondents after colorectal surgery ages 29 to 64 (n=20) Male Patient (n=12) Women Patient (n=8)
Sweden	2018	Dahlberg et al.	Qualitative Descriptive study - Semi-structured interviews.	Total Respondents (n=18) participants aged >17 years who had undergone day surgery
Australia	2019	Elvin-Walsh et al.	Qualitative Method - Cross-sectional online survey.	Total Respondents (n= 92) Dietitians (n=54) Patients undergone post bariatric surgery (n=38)
USA	2020	Kneuert et al.	Qualitative Descriptive study - Surveys	Total Respondents after lung robotic surgery (n=50) Male Patient (n=21) Women Patient (n=25) Male or Female (n=4)
Netherlands	2020	Thiel et al.	Mixed-Method - Questionnaire and Semi-structured interviews.	Total Patient (n=50- Spinal surgery (n=16), Laparoscopic Gastric Bypass (n=16), Hip Arthroplasty (n=5), Knee Arthroplasty, Mamma Reduction, Tibia and Laparoscopic Hernia Repair Osteosynthesis, Laparoscopic Hernia Repair (n=2) each and Parotidectomy, Tonsillectomy, Abdominoplasty, Septoplasty, Expansion Sphincter Pharyngoplasty (n=1) Male Patient (n=18) Women Patient (n=32)
Switzerland	2021	Comfort et al.	Quantitative Method - Prospective, monocentric observational study (utilize questionnaire and rating scale).	Total number of respondents (n=13) they experience in either health care or software development; Ages ranged 24 to 68
USA	2022	Chughtai et al.	Quantitative Method - Collection of patient-reported outcomes using validated questionnaires.	Total respondents (n=20) Patient undergone Stress Urinary Incontinence (SUI) over 18 years of aged (n= 15) Surgeons (n=5)
USA	2023	Low et al.	Mixed-Methods - Survey and Semi-structured interviews.	Total patients (n=15) undergone abdominal cancer surgery
USA	2023	Sreedharan et al.	Qualitative Descriptive study - Semi-structured interviews.	Total number of respondents after colorectal surgery (n=10) Patients (n=5) Surgeons (n=5)
UK and Ireland	2023	Wang et al.	Qualitative Descriptive study - Semi-structured interviews via telephone.	Total Patient (n=25) ; women (n=17) and men (n=8) Patient undergone total hip arthroplasty (n=15) Patient undergone total knee arthroplasty (n=10)

Table 9. Results of the study

RESULTS OF THE STUDY				
MAIN CATEGORY 1: Patients' experiences on using mobile health applications in postoperative care			MAIN CATEGORY 2: Healthcare providers' experiences on using mobile health applications in postoperative care	
Author and Year	Results	Generic Categories	Results	Author and Year
Semple et al. 2015, Higgins et al. 2017, Scott et al. 2017, Elvin-Walsh et al. 2019, Kneuert et al. 2020, Thiel et al. 2020, Chughtai et al. 2022, and Low et al. 2023	Provide high levels of patient satisfaction and willingness	Obtaining Acceptance	Paving the way for leveraging technology to improve patient care	Higgins et al. 2017, Elvin-Walsh et al. 2019, Comfort et al. 2021, and Chughtai et al. 2022
	Importance of designing interventions with patient beliefs and attitudes		Widespread adoption requires further engagement from healthcare providers.	
Thiel et al. 2020, and Chughtai et al. 2022	Enabling timely interventions based on patient-reported data	Healthcare Communications	Facilitate communication and promote patient engagement, allowing patients to report symptoms remotely	Chughtai et al. 2022, and Sreedharan et al. 2023
	Allows patients to self-record their pain levels, promoting continuous monitoring and communication with healthcare providers		Tailored communication strategies are needed to bridge the gap between providers' expectations and patients' preferences, ensuring the successful implementation of remote wound monitoring initiatives	
	Have the potential to enhance healthcare communication and improve care delivery.			
Jaensson et al. 2017, Dahlberg et al. 2018, and Wang et al. 2023	Improve patient recovery and overall care quality	Postoperative Care	Provides surgeons with data on recovery milestones, pain levels, anxiety levels, and functional limitations, enabling individualized planning and early identification of complications.	Higgins et al. 2017, and Sreedharan et al. 2023
	Reduces symptoms, increases engagement, and encourages active participation in recovery		Feasibility of a surgical wound monitoring mHealth/telehealth application, emphasizing the need for technology to improve postoperative care practices.	
Dahlberg et al. 2018, Thiel et al. 2020, Chughtai et al. 2022, Low et al. 2023, and Wang et al. 2023	Barriers to access, such as age, education, and health literacy.	Accessibility	Monitor their recovery remotely, reducing the need for physical visits.	Semple et al. 2015, and Chughtai et al. 2022
	Offers a cost-effective alternative to in-person visits and provides timely support, enhancing healthcare efficiency and social connectedness		Mobile health application is user-friendly interface and reminder features make it accessible and cost-effective, making healthcare more accessible and efficient	
Higgins et al. 2017, Elvin-Walsh et al. 2019, and Wang et al. 2023	Will improve care quality, and ongoing engagement and refinement are essential for evolving patient needs.	Future Preferences	Satisfaction and desire for future use however understanding patients' preferences can guide healthcare technology development for improved patient-centered care.	Higgins et al. 2017

5.2 Patients' and healthcare providers' experiences on using mobile health applications in postoperative care

Mobile health technology, particularly mobile applications (apps), has become increasingly recognized as a viable means for monitoring postoperative patients. Healthcare providers' experiences with mobile health applications in postoperative care are critical for optimizing patient outcomes, developing patient-provider relationships, and enhancing overall satisfaction with healthcare delivery. The studies reviewed provide a comprehensive summary of postoperative patients' and healthcare providers' opinions and experiences with mobile health applications in postoperative care, categorized into acceptance, healthcare communications, postoperative care, accessibility, and future preferences.

5.2.1 Obtaining acceptance

The acceptance of mobile health technology among patients and healthcare professionals is on the rise, although challenges remain in ensuring widespread adoption and long-term adherence. Patient satisfaction with mobile health applications is highlighted in multiple studies. For instance, Semple et al. (2015) and Higgins et al. (2017) report high levels of patient satisfaction and a willingness to use mobile health monitoring applications for postoperative care. However, Scott et al. (2017) notes that while many patients found the apps easy to use, a significant number did not actually use them, indicating a need to address usability issues and patient engagement strategies. Thiel et al. (2020) also found that patients with severe postoperative pain and nausea struggled with app usage, underscoring the importance of usability in these tools. The acceptance among healthcare professionals is crucial, as shown by Elvin-Walsh et al. (2019), who found a positive reception among dietitians and post-bariatric patients. Studies by Chughtai et al. (2022) and Low et al. (2023) in the USA further support the growing acceptance of mobile apps for patient engagement and monitoring, particularly in the perioperative period.

The integration of mobile devices and applications in healthcare settings is gaining traction, as shown by studies emphasizing the acceptance and potential benefits of technology in patient care. Elvin-Walsh et al. (2019) report high rates of smartphone and tablet ownership among post-bariatric patients and dietitians, indicating a readiness to embrace technology. Higgins et al. (2017) and Comfort et al. (2021) also high-

light the positive reception of mobile applications among patients and simulated users, respectively. Chughtai et al. (2022) further emphasizes the global acceptance of mobile apps for monitoring patient-reported outcomes.

5.2.2 Healthcare communications

Mobile health applications enhance communication between patients and healthcare providers, leading to improved care delivery. Thiel et al. (2020) and Chughtai et al. (2022) emphasize the role of mobile apps in facilitating timely interventions based on patient-reported data. Thiel et al. (2020) discuss the Logicapps system in the Netherlands, which allows patients to self-record their pain levels and communicate directly with healthcare providers, prompting timely responses and interventions. Similarly, Chughtai et al. (2022), highlight the app's reminder features, which promote patient compliance with scheduled follow-ups, ensuring continuous monitoring and efficient communication between patients and providers.

Effective communication between patients and healthcare providers is essential for high-quality care. Chughtai et al. (2022) and Wang et al. (2023) highlight the role of mobile apps in facilitating communication and ensuring timely interventions. These apps streamline communication processes, promote patient engagement, and address disparities in wound monitoring needs, contributing to improved healthcare delivery.

5.2.3 Postoperative care

Integrating mobile applications into postoperative care significantly enhances patient recovery and overall care quality. Jaensson et al. (2017) found that patients using the RAPP mobile health app reported fewer symptoms and a better quality of recovery. Dahlberg et al. (2018) emphasize the importance of active patient involvement in their recovery process, highlighting the need for effective support and information. Wang et al. (2023) demonstrate that mobile app-based rehabilitation programs improve patient engagement, motivation, and confidence, indicating the positive impact of digital solutions on postoperative care.

Mobile health applications enhance postoperative care by providing valuable data and enabling personalized follow-up planning. Higgins et al. (2017) emphasize the importance of such systems in monitoring recovery milestones and identifying complications early. Sreedharan et al. (2023) explore the feasibility and usefulness of surgical wound monitoring apps, highlighting the potential of technology to improve postoperative care practices.

5.2.4 Accessibility

The accessibility of digital health technology, particularly smartphones, in postoperative care is critical. Dahlberg et al. (2018) discuss how patient access to smartphones and familiarity with digital technology positively influenced their attitudes toward using e-assessed follow-up apps. However, barriers such as severe postoperative pain, age, and low health literacy still exist, as noted by Thiel et al. (2020) and Chughtai et al. (2022). Addressing these barriers is essential for equitable access to digital health solutions. Low et al. (2023) suggest that future research should focus on optimizing accessibility and usability across diverse patient populations.

Enhancing accessibility to postoperative care through mobile health technology is crucial. Semple et al. (2015) and Chughtai et al. (2022) discuss how mobile apps reduce the need for physical visits to healthcare facilities, providing a cost-effective and efficient alternative for patients. These apps eliminate geographical constraints and ensure accessible healthcare services for all patients.

5.2.5 Future preferences

Understanding and integrating patients' and healthcare providers' preferences into the development of mobile health applications is crucial for future postoperative care. Higgins et al. (2017) and Elvin-Walsh et al. (2019) report high satisfaction levels among patients and dietitians using mobile apps, indicating a willingness to continue using these technologies. Wang et al. (2023) highlight the importance of incorporating patient feedback into the ongoing development of mobile health interventions to better meet evolving needs and preferences.

6 Discussion

This is a descriptive literature review wanted to address two (2) certain research questions: (1) What are patients' experiences of using mobile health applications in postoperative care? And (2) What are healthcare providers' experiences of using mobile health applications in postoperative care? The patients' and healthcare providers' acceptance of mobile health applications in postoperative care is growing as mobile health applications highlighting the potential to improve health outcomes. Previous studies and current studies highlight the benefits of mobile health applications in patients' and healthcare providers' perspective, such as acceptance of using the mobile health applications (Fiordelli et al. 2013: 15, Comfort et al. 2021, Semple et al. 2015, Higgins et al. 2017, Scott et al. 2017, Elvin-Walsh et al. 2019, Kneuertz et al. 2020, Thiel et al. 2020, Chughtai et al. 2022, and Low et al. 2023) , enhanced communication (Nguyen et al. 2020: 335,Thiel et al. 2020, Sreedharan et al. 2023, and Chughtai et al. 2022), improved postoperative care (Jaensson et al. 2017, Dahlberg et al. 2018, Wang et al. 2023, Higgins et al. 2017, and Sreedharan et al. 2023), accessibility (Dahlberg et al. 2018, Thiel et al. 2020, Chughtai et al. 2022, Low et al. 2023, Semple et al. 2015, and Wang et al. 2023). However, the current study highlights challenges in adoption and usability, such as usability issues, patient engagement strategies, and the struggle of patients with severe postoperative pain and nausea (Elvin-Walsh et al. 2019).

The study on using mobile health applications in postoperative care will bring significant benefits to clinical practice, education, management, and society. The findings described the experiences of both patients and healthcare providers in utilizing mobile health applications in postoperative care to produced knowledge that could be used to improve the practices of both patients and healthcare providers when using mobile health applications in postoperative care. Healthcare providers can streamline communication, monitor recovery progress, and educate patients effectively through these applications. Educators can use the study results to inform training programs for future healthcare professionals on using digital health technologies in patient care. Healthcare organizations can make informed decisions on investing in mobile health technologies based on the study findings. Society as a whole will benefit from improved patient outcomes, better communication, and enhanced self-management of postoperative care. The study has comprehensive effects for various users and it is crucial for them to utilize the findings to implement and optimize the use of mobile health applications in postoperative care settings to improve quality of care and patient outcomes.

Mobile health applications have improved postoperative care by enhancing communication between patients and healthcare providers, monitoring patients' progress, and contributing to better health outcomes. However, there is limited research on patient and provider experiences with these tools, creating a need for future studies to gather feedback and identify strengths and weaknesses. In-depth interviews with patients who have used mobile health applications can provide valuable insights into usability and effectiveness, helping developers tailor these tools to meet postoperative patients' and healthcare providers' needs. Additionally, exploring patients' and healthcare providers' perspectives can identify barriers to adoption and opportunities for improvement in integrating these applications into care practices.

Future studies should also examine the benefits of integrating patient-generated data from mobile health applications into clinical decision-making processes. Analyzing the accuracy and reliability of this data will be crucial in maximizing the benefits of these applications in postoperative care. By gathering feedback from both patients and providers, researchers can enhance our understanding of their experiences and perspectives, ultimately improving the quality of care for postoperative patients.

7 Ethics and validity

In ensuring the ethics and validity of the study, researchers guarantee that the research adheres to ethical standards and maintains validity in its findings.

Ethically, researchers conduct a systematic literature review that involves respecting the intellectual property rights of the original authors by appropriately citing and referencing their work. Researchers also ensure that the review process is conducted transparently and without bias, giving credit to the sources to uphold academic integrity. Additionally, ethical considerations include ensuring that the review process respects the confidentiality and privacy of any sensitive information obtained from the literature (Mertz et al., 2020: 3).

To guarantee the validity of the study researchers ensure that the findings accurately represent the existing body of knowledge on the topic. Researchers employed rigorous search strategies to identify relevant literature, critically appraise the quality of the included studies, and synthesize the data in a systematic and unbiased manner (Mertz et al. 2016: 5). The academic articles utilized in this study were acquired from reputable

scientific databases that were acknowledged by the library of Metropolia University of Applied Sciences. The search method was thoroughly and systematically discussed. The utilization of research papers was appropriately acknowledged through the provision of relevant citations and recognition for the researcher's efforts and results. Therefore, all the modified quotations in this study were correctly credited in the reference list. To prevent biases and manipulations, the researchers also upheld integrity and objectivity to guarantee the accuracy of the findings and an accurate evaluation of all references.

Moreover, maintaining the reliability of the review process is crucial for ensuring the trustworthiness of the results. Researchers clearly outline their search methods, inclusion criteria, and data extraction processes to allow for the replication of the review by others (Bachani et al. 2016: 126). By following established guidelines for conducting systematic literature reviews and employing systematic methods, researchers can enhance the reliability and validity of their research findings (Hawkins et al. 2019: 3).

8 Strengths and limitations

The study's objectives and purpose were defined through the gathering of pertinent details. The selection of articles was determined by particular requirements, which included articles published from 2013-2023 also articles focused on Mobile health applications, postoperative care, and patient or healthcare providers experiences. The selected articles provided significant results during the analysis of information, effectively addressing the research questions. The results have been gathered to provide an understanding of patient and healthcare provider experiences with using mobile health applications in postoperative care. Refer to **Table 8** and **Appendix 2** for further details.

The thirteen (13) selected articles related to patient and healthcare providers experiences on using mobile health applications in postoperative care were studied and examined, providing insights into the possible benefits of mobile health applications in postoperative care. Although the selected articles have made essential contributions, it is additionally restricted by several limitations, which necessitates a careful examination of its findings and implications. The study's coverage is enhanced by the inclusion of participants from different areas, but the small number of participants and limited access to patient information restricts the applicability and comprehensiveness of the findings. Furthermore, the dependency on borrowed devices and the inconsistent

quantity of respondent participation add to the dependability of the obtained data. The study's inability to assess and validate the baseline information and conduct testing impacts its capacity to accurately determine the effectiveness of mobile health applications. This raises concerns about the reliability of its findings. Moreover, the dependence on self-reported online surveys intensifies issues regarding the comprehensiveness of the data and the possibility of bias.

Moreover, the study's insufficient inclusion of detailed social background information hinders its capacity to adequately place findings in context. Nevertheless, despite these constraints, the results of the study emphasize the urgent need for enhanced data gathering and analytical methods to improve the quality of patient care in postoperative settings. For researchers to enhance the understanding and implementation of mobile health applications in postoperative care, it is essential to address these methodological problems. This will ultimately lead to improved patient outcomes and healthcare delivery.

9 Conclusions and recommendations

The use of mobile health applications (mHealth apps) in postoperative care is becoming increasingly popular as technology continues to advance in the healthcare industry. These mobile health applications have the potential to improve the way patients and healthcare providers manage and monitor recovery after surgery. Understanding the experiences of both patients and healthcare providers in using these apps is crucial to optimize their effectiveness and integration into clinical practice.

In the studies revealed both patients and healthcare providers have positive experiences with using mobile health apps in postoperative care. Patients reported feeling more engaged and empowered in their recovery process, as the apps provided them with personalized information, reminders, and monitoring tools to track their progress. Healthcare providers, on the other hand, found these apps to be valuable in improving communication with patients, monitoring their condition remotely, and providing timely interventions when needed. However, despite the overall positive experiences, the research also identified several challenges and limitations in using mobile health apps in postoperative care. Patients reported concerns about the privacy and security of their health data, the usability and reliability of the apps, and the potential for information overload. Healthcare providers, on the other hand, faced challenges in integrating the

use of these apps into their workflow, ensuring the accuracy and timeliness of patient data, and addressing technical issues.

Based on the study findings, four (4) recommendations can be made to address the challenges and improve the use of mobile health apps in postoperative care. (1) Prioritize the privacy and security of patient data by ensuring that the apps comply with healthcare regulations and industry standards for data protection. (2) Healthcare providers should also be provided with training and support to effectively integrate the use of these apps into their clinical practice, and to address any technical issues that may arise. (3) Additionally, efforts should be made to improve the usability and reliability of mobile health apps by involving patients and healthcare providers in the design and development process. This includes incorporating user-friendly interfaces, personalized content, and real-time monitoring features to enhance the overall user experience. (4) Continuous evaluation and feedback mechanisms should be implemented to monitor the effectiveness and impact of these apps on patient outcomes and healthcare delivery.

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Search record from the database

DATABASE/DATE / LIMITS	SEARCH PHRASE	TOTAL NUMBER OF HITS/ CITATIONS	PAPERS/ RECORDS INCLUDED BASE ON TITLE	PAPERS/ RECORDS INCLUDED BASE ON ABSTRACT	PAPERS/ RECORDS INCLUDED BASE ON FULL TEXT
CINAHL/ DATE: 26 November 2023/ LIMIT: Language-English	(experiences or perceptions or attitudes or views of patient and healthcare provider) AND (mobile health applications or mhealth or mobile apps) AND (postoperative or post operative or post-surgery or post-surgical) NOT (postoperative or post operative or post-surgery or post-surgical)	18	6	6	3
CINAHL / 26 November 2023	use* of mobile health app* AND experince* or attitude* or perception* or view* of patient and healthcare provider AND postoperativ* or post surgery or after surgery NOT telehealth or ehealth or digital health	1	1	1	1
PUBMED / DATE: 26 November 2023 LIMIT: YEAR: 2013-2023	((experience or perceptions or attitudes or views of surgical patients/healthcare providers) AND (mobile health applications or mHealth or mobile apps)) AND (post operative or post-operative or post-operative or post surgery recovery)) NOT (telehealth or telemedicine or telemonitoring or telepractice or telenursing or telecare)	43	13	11	9
RECORDS IN TOTAL		62	20	18	13
DUPLICATE RECORDS					6
RECORDS AFTER DUPLICATE REMOVE					56
TOTAL NUMBER OF INCLUDED STUDIES					13

Table of the studied selected in the review

ARTICLE NO.	AUTHOR/YEAR PUBLISHED/COUNTRY	TOPIC/ TITLE	METHODOLOGY AND METHODS	PARTICIPANTS	MAIN OUTCOME	LIMITATIONS
1	Semple et al.	Using a Mobile App for Monitoring Post-Operative Quality of Recovery of Patients at Home: A Feasibility Study	Mixed-Method - Questionnaire, Survey, and Interviews.	Total Patient (n=65)	The use of mobile apps for monitoring the quality of recovery in post-operative patients at home was feasible and acceptable to patients and surgeons in the current study. Future large-scale studies in varying patient populations are required.	Small sample participants
	Breast reconstruction Surgery (n=33)					
	2015			Orthopedic Surgery (n=32)		Incomplete information of patient information
	Canada					
2	Higgins et al.	Mobile Web-Based Follow-up for Postoperative ACL Reconstruction	Mixed-Methods - Survey and Interview.	Total Respondents (n=34)	The system accurately assesses patient recovery, potentially changing postoperative orthopaedic patient care.	Restricted Universal accessed
	2017			Breast reconstruction and anterior cruciate ligament patient (n=32)		Small size participants
	Canada			Surgeons (n=2)		Loaned devices
3	Jaensson et al.	Evaluation of postoperative recovery in day surgery patients using a mobile phone application: a multicentre randomized trial	Quantitative Method - Randomized controlled Trial	Patients postoperative recovery (n=997)	A smartphone-based application for measuring patient-reported outcomes reduced postoperative discomfort,	Lack of baseline SwQoR measurement
	2017					Inconsistent Respondent

	Sweden				suggesting systematic e-assessment can enhance recovery quality and pinpoint areas for improvement in perioperative care.	
4	Scott et al.	Mixed-Methods Analysis of Factors Impacting Use of a Postoperative mHealth App	Mixed-Method - Survey and interviews.	Total Respondents after colorectal surgery ages 29 to 64 (n=20)	The study reveals that app adoption by patients is dependent on app-based interventions, which must be highly engaging and address patient perceptions to improve care coordination and communication in the post-operative period.	Small size participants
	2017			Male Patient (n=12)		Inconsistent respondents
	USA			Women Patient (n=8)		
5	Dahlberg et al.	Holding It Together—Patients' Perspectives on Postoperative Recovery When Using an e-Assessed Follow-Up: Qualitative Study	Qualitative Descriptive study - Semi-structured interviews.	Participants aged >17 years who had undergone day surgery (n=18)	Postoperative recovery requires patients to feel safe, reassured, and acknowledged. Support from healthcare organizations and their next of kin can improve care. A mobile app can enhance care and create a sense of support, starting in the prerecovery phase.	Small sample size
	2018					
	Sweden					
6	Elvin-Walsh et al.	Nutritional monitoring of patients post-bariatric surgery: implications for smartphone applications.	Qualitative Method - Cross-sectional online survey.	Total Respondents (n= 92)	The study found that mobile healthcare apps can provide support to patients and dietitians, improving their care quality. Although dietitians	Self-Reported Data
	2019			Dietitians (n=54)		Small sample size, selection bias, and geographical location

	Australia			Patients undergone post bariatric surgery (n=38)	still prefer traditional methods, diversifying to lower-cost, time-effective technology solutions could enhance dietetic practice.	Online survey was self-reported, resulting in incomplete data.
7	Kneuert et al. 2020 USA	Improving patient engagement, adherence, and satisfaction in lung cancer surgery with implementation of a mobile device platform for patient reported outcomes	Qualitative Descriptive study - Surveys	Total Respondents after lung robotic surgery (n=50) Male Patient (n=21) Women Patient (n=25) Male or Female (n=4)	A mobile device platform may serve as an effective mechanism to record perioperative PROs and satisfaction while facilitating patient-provider engagement in perioperative care.	Small sample size (Lung Cancer Surgery patient)
8	Thiel et al.	Patient reported postoperative pain with a smartphone application: A proof of concept	Mixed-Method - Questionnaire and Semi-structured interviews.	Total Patient (n=50- Spinal surgery (n=16), Laparoscopic Gastric Bypass (n=16), Hip Arthroplasty (n=5), Knee Arthroplasty, Mamma Reduction, Tibia and Laparoscopic Hernia Repair Osteosynthesis, Laparoscopic Hernia Repair (n=2) each and Parotidectomy, Tonsillectomy, Abdominoplasty, Sep-	The study indicates that a smartphone app for self-recording postoperative pain among hospitalized patients is user-friendly, high-satisfaction, and could potentially provide a comparable outcome to nurses' pain assessments.	Small size participants (aged 21 to 72)

				toplasty, Expansion Sphincter Pharyngoplasty (n=1)		
	2020			Male Patient (n=18)		
	Netherlands			Women Patient (n=32)		
9	Comfort et al. 2021 Switzerland	Determining the impact of postoperative complications in neurosurgery based on simulated longitudinal smartphone appbased assessment	Quantitative Method - Prospective, monocentric observational study (utilize questionnaire and rating scale).	Total number of respondents they experience in either health care or software development; Ages ranged 24 to 68 (n=13)	The study suggests using a smartphone app to collect postoperative data on subjective well-being, classifying complications based on their impact on patients' well-being.	Small sample size and geographical location.
10	Chughtai et al. 2022 USA	Development and Usability Testing of a Mobile Application to Monitor Patient-Reported Outcomes after Stress Urinary Incontinence Surgery	Quantitative Method - Collection of patient-reported outcomes using validated questionnaires.	Total respondents (n=20) Patient undergone Stress Urinary Incontinence (SUI) over 18 years of aged (n= 15) Surgeons (n=5)	The mobile app for SUI captured important patient-reported outcomes with a high satisfaction reporting from patients and surgeons.	Small sample size Limited social background information Lacked validation testing for improving patient care quality.
11	Low et al.	A Real-Time Mobile Intervention to Reduce Sedentary Behavior Before	Mixed-Methods - Survey and Semi-	Total patients undergone abdominal	Perioperative cancer patients used smartwatch and	Small sample size, a focus on metastatic

	2023	and After Cancer Surgery: Usability and Feasibility Study	structured inter-views.	cancer surgery (n=15)	smartphone-based real-time intervention to reduce post-operative pain, but compliance declined post-surgery. The intervention's effects on recovery and quality of life are ongoing.	peritoneal cancer sur-gery.
	USA					
12	Sreedharan et al.	Patient and Provider Preferences for Monitoring Surgical Wounds Using an mHealth App: A Formative Qualita-tive Analysis	Qualitative Descrip-tive study - Semi-structured inter-views.	Total respondents after colorectal surgery (n=10) Patients (n= 5) Surgeons (n=5)	A prospective approach to the development of a remote wound monitoring applica-tion enables a user-centric development process. Our analysis shows a readiness from both patients and pro-viders to implement remote wound monitoring for identi-fying potential SSIs and coor-dinating surgical wound care within the community.	Small sample size and geographical location.
	2023					
	USA					
13	Wang et al.	Pa-tients' experiences of using a mobile application-based rehabilitation programme after total hip or knee arthroplasty: a quali-tative descriptive study.	Qualitative Descrip-tive study - Semi-structured inter-views via tele-phone.	Total Patient (n=25) Women (n=17) Men (n=8) Patient undergone total hip arthroplas-ty (n=15) Patient undergone	The mobile application-based rehabilitation program has shown potential in support-ing patients' post-arthroplasty rehabilitation, suggesting nurses can utilize mobile technologies to en-hance care quality.	Unfamiliarity with digital Technology Participants are in other regions Potential of bias result
	2023					
	UK and Ireland					

			total knee arthroplasty (n=10)	due to self reported data and the length of the program
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