PATIENT SATISFACTION WITH MOBILE TELEDERMATOLOGY IN THE PRE - AND POST-COVID-19 PANDEMIC: A SYSTEMATIC REVIEW

BY

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Abstract

The necessity for telemedicine services heightened with the onset of the COVID-19 pandemic, resulting in their implementation in areas where they were previously unavailable, aided by mobile devices and their applications. This review compares patient satisfaction with mobile teledermatology before and after the pandemic to identify factors affecting satisfaction and improve the patient experience. Primary studies measuring patient satisfaction with mobile teledermatology for consultation, triage, and follow-up between March 17, 2017, and March 17, 2023, were searched in PubMed, CINAHL, Cochrane databases, and Google Scholar. Ten studies were included and divided into pre- and post-pandemic groups. Demographic data, general satisfaction scores, and qualitative responses were extracted for analysis.

All the reviewed studies indicated that patients exhibited high satisfaction levels. Factors influencing satisfaction positively before the onset of the pandemic included swift response times, rapid data transfer, and reliable connectivity. After the onset of the pandemic, satisfaction was positively associated with convenience, concerns about contact with the COVID-19 virus, and the type of diagnosis. Conversely, after the pandemic began, factors such as poor connectivity, application complexity, age, low IT literacy, fragmented care, increased costs, and gaps in the health value chain contributed to negative satisfaction. Common factors observed in both periods included patient follow-up, time management, self-photography, prior heavy mobile phone usage, intricate mobile applications, and the integration of artificial intelligence. It is possible to develop mobile messaging applications with a teledermatology feature to facilitate communication with other components of the health value chain.

(Total 143 pages)

Keywords: telemedicine, mobile teledermatology, patient satisfaction, COVID-19 pandemic

Student's Signature ..... Thesis Advisor's Signature.....

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Chapter 1

Introduction

1.1. Background and Significance of the Problem

Telemedicine is the delivery of healthcare at a distance using information communication technology for medical information exchange, for the diagnosis, treatment, and prevention of diseases and injuries (Pan American Health Organization (PAHO), 2016). The formal announcement of the SARS-CoV-2 virus (COVID-19) as a pandemic on March 11, 2020, by the World Health Organization led to measures such as lockdowns to enforce social distancing and curb its spread. These measures increased the distance to healthcare. Telemedicine services were mostly used during this period, especially for dermatology (Elsner, 2020; Ibrahim, Magdy, Khalaf, Mostafa, Arafa, 2021) as they were perceived as a safe and convenient method to access care.

It is classified using technology, considering the timing of encounters and the type of technology used for the encounter, whether dedicated teleconferencing equipment, mobile devices, or computers. The classifications are live interactive (LI) or synchronous, which utilizes videoconferencing equipment with participants in real-time contact concurrently at a distance, and the store and forward (SAF) or asynchronous, which involves a timed delay for the assessment of clinical information and images. The hybrid involves concurrent utilization of both the synchronous and asynchronous (Bashshur, Shannon, Krupinski, Grigsby, 2011; Kazi et al., 2021).

The LI has the advantage of immediate communication between the physician and patient, more detailed history collection, immediate monitoring, and as an educational tool. Its disadvantages are the high cost of the equipment, the difficulty of having all participants present simultaneously, the need for training and expertise, and the possibility of technical failure. The SAF has the advantage of flexibility, costs less,

and can accommodate a larger patient volume with less need for technical expertise. Its disadvantages are a lack of immediate response and a loss of rapport between the patient and the physician (Tensen, van der Heijden, Jaspers, & Witkamp, 2016).

Dermatology is a field with a high patient burden and a comparably lower number of specialists as evident even in developed countries with a disparity in the distribution of these specialists between urban and rural areas (Feng, Berk-Krauss, Feng, & Stein, 2018). It occupies a unique niche in telemedicine as the most visual field of medicine, making it suitable for telemedicine techniques. Telemedicine for dermatology is called teledermatology (Perednia, 1995).

Teledermatology is stratified into interaction levels depending on the involved actors. The primary level involves the general practitioner and the patient; the secondary level involves the general practitioner and the specialist dermatologist; the tertiary level involves two dermatologists consulting each other, such as a general dermatologist to a subspecialty dermatologist, and the level of the patient directly to the dermatologist (Tensen et al., 2016).

Teledermatology improves access to dermatology care in underserved/rural areas (Perednia, 1995) and low-resource centers (Tensen et al., 2016). Its usefulness and impact have been studied in areas where the disparity in care is more pronounced (Gold-Olufadi, Jesuyajolu, Cole-Adeife, Emokpare, & Enigbokan, 2023). It is also a valuable educational tool (Barbieri, Nelson, Bream, & Kovarik, 2015; Lee, Finnane, & Soyer, 2018).

Teledermatology using mobile devices is termed mobile teledermatology (Massone, Wurm, Hofmann-Wellenhof, Soyer, 2008). It is unique due to its ability to bridge the gap in access to communication in general and in the context of this study, specifically dermatology care, due to widespread availability, portability, reduced cost, ability to take clearer pictures with immediate image upload, and increased mobile network penetration in rural areas (Tran et al., 2011). Diagnostic concordance with face-to-face consultations has been studied extensively and good concordance rates have

been established (Ebner, 2008; Amin, Kuruvilla, & Ali., 2013; (Lamel, Haldeman, Ely, Kovarik, Pak, & Armstrong, 2012; Tran et al., 2011). The classifications from telemedicine to the levels of teledermatology are outlined in Figure 1.1 below.

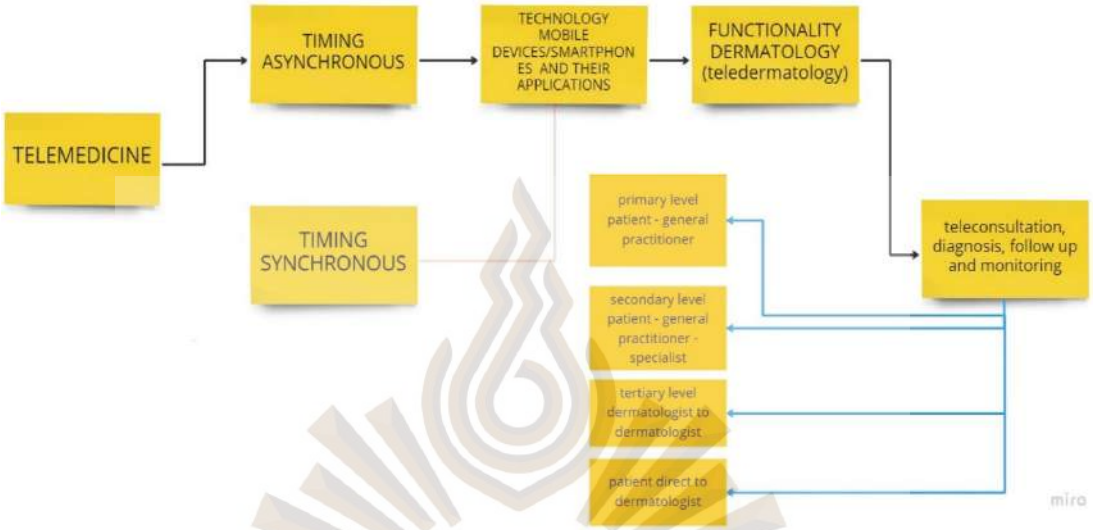

Figure 1.1 Classification of telemedicine depicting timing, technology, and functionality

Source: Bashur et al., 2011

The importance of constant evaluation of telemedicine systems especially as they relate to stakeholders in the telemedicine value chain becomes more necessary with the constant evolution of new technologies used for telemedicine delivery and access (Garcia & Adelakun, 2019). An example of a model for evaluating telemedicine systems is the Model for the Assessment of Telemedicine Applications (MAST) which has a patient perspective domain with satisfaction/acceptance as one of its outlined topics for evaluating telemedicine. This highlights the importance of satisfaction for the success of telemedicine applications (Kidholm et al., 2012).

There is no consistent definition of satisfaction (Hadeler, Gitlow, & Nouri, 2021). For patients, it is considered a post-purchase phenomenon that reflects how much they liked or disliked a service after experiencing it. It has been used to measure effectiveness of innovations, and as a key care outcome (Ofili, 2014). It is important to stakeholders in the medical value network and is researched as a means of improving service delivery, retaining old customers, attracting new ones, and saving costs (Lin &

Kelly, 1995). It is highly user-dependent on different domains based on the field it is studied (Alrubaiee & Alkaa'ida, 2011). In the field of telemedicine, domains identified over the years include accessibility, technical quality, interpersonal interactions, efficacy and outcomes, virtual environment, interface, finance (cost/reimbursement), continuity of care, and timesaving or consuming (Hadeler, Gitlow, & Nouri, 2021).

It is confirmed that there was a surge in telemedicine use during the pandemic and mobile devices were part of the technological means used to access telemedicine services during this period (Mu, Liu, Li, & Zhang, 2021). Satisfaction with mobile teledermatology has been studied for patients before (Kaliyadan, Amin, Kuruvilla, & Ali, 2013; Mounessa et al., 2018; Wang et al., 2018) and during the COVID-19 pandemic (Mu et al., 2021; Ouellette & Rao, 2022; Sendagorta et al., 2021). However, we consider that the use of mobile teledermatology during the pandemic was a matter of necessity due to the enforcement of lockdowns and not a choice, with the possibility of minimal stakeholder engagement. Moreso, individuals who are not ICT savvy or aged individuals might find it difficult to use the technology (Handa et al., 2021) with the possibility of experiencing technology anxiety (Tsai, Cheng, Tsai, Hung, & Chen, 2019) due to the added technological limitations from the variability of devices (Wang et al., 2018). Based on the factors mentioned above, there is a possibility of differences in satisfaction with the use of such devices for teledermatology before and after the onset of the pandemic for which no reviews are available, and which we seek to find out.

1.2 Research Objectives

1.2.1 Comparison of patient Satisfaction with the use of mobile teledermatology before and after the onset of the COVID-19 Pandemic.

1.2.2 Identify factors responsible for increased or decreased satisfaction with the use of mobile teledermatology before and after the onset of the COVID-19 pandemic.

1.3 Research Questions/Assumptions

Was teledermatology using mobile devices a satisfactory means of accessing dermatology care before and during the COVID-19 pandemic?

Patient satisfaction with mobile teledermatology before and after the onset of the Covid-19 pandemic?

The research question was formulated based on the SPIDER framework (Cooke, Smith, & Booth, 2012).

For this study, the framework will be: -

Sample – participants, patients.

Phenomenon of interest – mobile teledermatology

Design – interview, questionnaire.

Evaluation – Satisfaction or non-satisfaction

Research type – qualitative, quantitative, and mixed methods reviews.

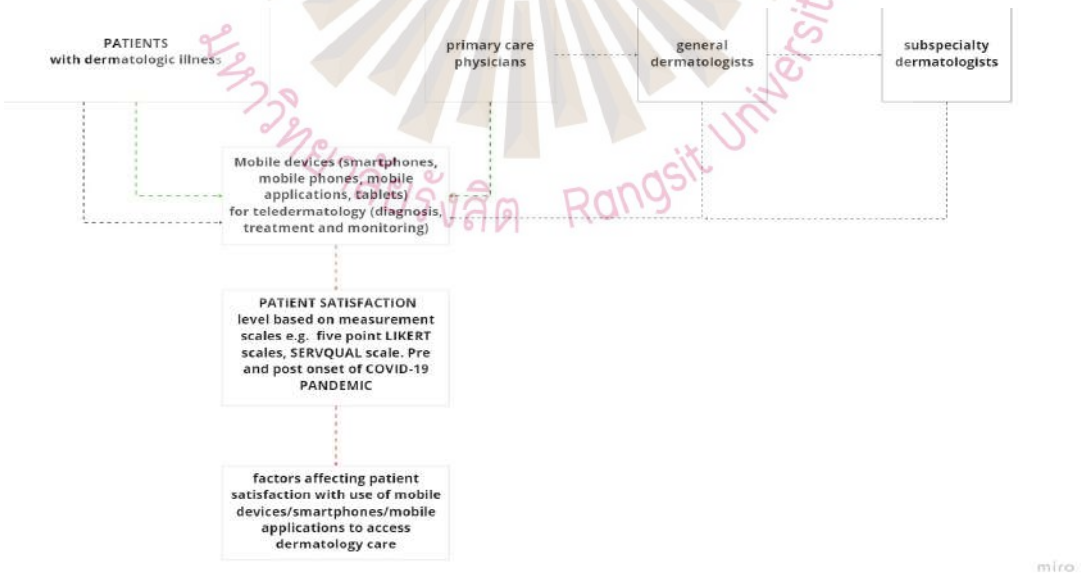

Figure 1.2 Conceptual Framework

Source: Researchers Computation, 2024

1.4 Research Framework

1.4.1 Theory – mobile teledermatology was a satisfactory means of accessing dermatology care before and during the COVID-19 pandemic.

1.4.2 Hypothesis – Patient Satisfaction with mobile teledermatology was the same before and after the COVID pandemic.

1.5 Definition of Terms

Term 1 **Teledermatology** - The application of telemedicine whereby the participants are located at a distance from each other and use mobile equipment rather than stationary equipment (Perednia 2005).

Term 2 **Mobile Teledermatology** – Dermatology at a distance with the participants using mobile devices like cellular phones or personal digital assistants (Massone et al., 2008).

Term 3 **Satisfaction** - The result of the gap between expected and perceived characteristics of a service (Ofili 2014).

Term 4 **Mobile Device** – a piece of portable electronic equipment that can connect to the internet, especially a smartphone or tablet computer (Franklin, et al., 2020).

Term 5 **Smartphone** - a mobile phone that performs many of the functions of a computer, typically having a touchscreen interface, internet access, and an operating system capable of running downloaded applications (Franklin et al., 2020).

Chapter 2

Literature review

2.1 History of Telemedicine

Telemedicine has existed since the 1950s, initiated by the United States of America with the 1959 telepsychiatry project closely followed by Canada with a teleradiology project. The space age saw more projects, notably, the NASA STARPAHC aimed at caring for astronauts in space. There was a lull in telemedicine by 1986 and a resurgence in the 1990s with an increment of projects from four to 200 by 1998 coinciding with the availability of cheaper and more readily accessible technology (Whitten & Sypher, 2006).

In Australia, rural-based projects on teleophthalmology and telepsychiatry were initiated and by the 1990s an interactive telemedicine link between the Royal Adelaide Hospital and the Whyalla Hospital was established. Formal launching of the telemedicine industry was done in that country in 1998 and by the year 2000, 41 telemedicine projects existed in one state alone (Lim, Egerton, & Shumack, 2000).

Telemedicine is used in various fields of medicine but mainly for home-based patient care, emergency, and information services. It has applications in radiology for transmitting images (teleradiology), treating cardiac disorders (telecardiology), telepsychiatry, and teledermatology. Its scope has been extended into the field of surgery (telesurgery) with its use for either remote monitoring of surgical procedures or the actual performance of surgical procedures via robotics (Tuckson, Edmunds, & Hodgkins, 2017).

Historically, Telemedicine has witnessed a cyclical pattern of interest and disinterest almost every decade due to advancements in technology with increased

funding and regression with discontinuation of funding. Its resurgence occurred in the 1990s due to improved technology, reduced cost, and the demand for equitable access to healthcare (Mowatt, Bower, Brebner, Cairns, Grant, & McKee, 1997).

2.2 Teledermatology

The term teledermatology, which is simply the application of telemedicine in dermatology, was first propounded after adjudging its value in an underserved rural area (Perednia, 1995). It has such a value due to the visual nature of dermatologic diseases which can be captured and transferred using imaging technologies (Frühauf et al., 2012). As a discipline, it is majorly classified based on timing and technology into synchronous, asynchronous, and hybrid (Kazi et al., 2021). The advantages and disadvantages of these are outlined in Table 2.1 below .

Table 2.1 Advantages and disadvantages of LI and SAF

LI (Synchronous)	**SAF (Asynchronous)**
Advantages	Advantages
i) Immediate communication between patient and physician. ii) Detailed history. iii) Immediate monitoring of treatments. iv) Educational value for general physicians.	i) Flexible. ii) Cheap. iii) Accommodates larger patient volume. iv) Less need for technical expertise. v) Reduced patient waiting times and times away from work. vi) Does not affect normal workflow.
Disadvantages	Disadvantages
i) Expensive equipment. ii) Possibility of equipment failure and downtimes during sessions.	i) Lack of immediate response. ii) Loss of rapport between physician and patient. iii)

Table 2.1 advantages and disadvantages of LI and SAF (Cont.)

LI (Synchronous)		SAF (Asynchronous)	
iii)	Need for training and expertise.	iv)	Lack of synergy with patients' medical records.
iv)	Affects normal workflow.		
v)	Not suitable for young/camera-shy patients.		
vi)	Difficulty in getting all participants together at the same time.		

Source: Eedy & Wootton, 2001; Tracy 2004; Lee et al., 2018

Teledermatology has different levels of interactions based on the actors involved. The primary level involves direct communication between the patient and his or her primary care provider or dermatologist for initial diagnosis or referral (patient to primary care provider). The secondary level involves the communication between the patient and the general practitioner who then communicates and passes the patient's medical information to the dermatologist (primary care physician to a dermatologist). Tertiary tele dermatology entails communication and cooperation between dermatologists (dermatologist to dermatologist). There is an additional level of patients directly to the dermatologist (Tensen et al., 2016). Teledermatology also has subspecialties which include teledermoscopy, tele-wound care, and tele-dermatopathology (Braun et al., 2005).

2.3 Mobile Teledermatology

Mobile teledermatology refers to the use of mobile devices for dermatology (Massone et al., 2008). The earliest published study on mobile teledermatology in 2005 focused on telewound care (Braun et al., 2005). An earlier study on the use of mobile devices (phones) for teledermatology using a Nokia 7650 mobile phone was carried out in 2003 but published in 2005 gave encouraging diagnostic concordance (Massone et al., 2005).

Mobile teledermatology became more popular between the years 2008 to 2012, occasioned by improvements in cameras, improved portability, improved wireless networks for immediate image upload (Zuo, Guo, & Rao, 2013), increased mobile phone penetration in hard-to-reach and underserved areas with stigmatized populations (Azfar et al., 2011), and the proliferation of health-related mobile applications on such devices (Flaten, St Claire, Schlager, Dunnick, & Dellavalle, 2018).

A significant initial concern with using mobile devices for teledermatology was diagnostic concordance compared to in-person visits and other technologies. This has been extensively studied and concordance has been proven in different studies for different conditions (Ebner et al., 2008; Massone et al., 2007; Tran et al., 2011) including screening for life-threatening skin cancers e.g., melanoma (Lamel et al., 2012). This is attributable to the ability of mobile devices to take clearer, well-defined images (Lee et al., 2018) and has led to the belief in the superiority of diagnosis via mobile teledermatology compared with that of non-dermatologists even when images are obtained by non-medical personnel (Shin, Kim, Ryu, Yoon, & Jo, 2014). Other concerns are lack of regulation (Azfar et al., 2011), Misinformation from unvetted information (Flaten et al., 2018), medico-legal concerns, and data safety (Shin et al., 2014).

There is a significant skin disease burden worldwide that needs to be mitigated by specialist dermatologists who are not readily available. This is more pronounced in sub-Saharan Africa which is one of the poorest regions of the world with the largest skin disease burden (Tran et al., 2011), even in countries with the availability of dermatologists they are mostly clustered in urban areas (Feng et al., 2018). Mobile teledermatology is seen as a technological tool to bridge the gap of disparity in access to dermatological care because of the widespread availability of mobile devices, low cost of procurement, and decreased cost to patients who don't need to travel over long distances which requires finance and absence from work (Ouellette & Rao, 2022). Increased penetration of mobile networks in rural areas has also led to their increased utilization (Azfar et al., 2011). Its impact is especially seen in underserved areas (Frühauf et al., 2012) and low-income groups (Lee et al., 2018).

Mobile devices have been used to deliver dermatology care for chronic conditions such as psoriasis (Frühauf et al., 2012), eczema, viral warts, and fungal infections (Shin et al., 2014). Acne, atopic dermatitis, and seborrheic dermatitis (Handa et al., 2021). It is applicable for screening pigmented skin lesions for melanoma (Massone et al., 2007) with a more recent study showing a 100% detection rate for skin cancers in a low-prevalence population (Markun, Scherz, Rosemann, Tandjung, & Braun, 2017). It has successfully been used in age-related dermatology practice e.g., in pediatric patients (Fiks et al., 2018) and geriatric patients (Bosanac, Nguyen, Bui, Eisen, & Sivamani, 2018; Trinh et al., 2022), hair and nail conditions, nevi, seborrheic keratoses, and scars (Lee et al., 2018).

The formal announcement of the sars-cov-2 virus (COVID-19) as a pandemic by the World Health Organization on the 11th of March 2020 led to worldwide panic with the emergency institution of containment measures such as lockdowns and social distancing. It brought to the limelight the need for services that do not require in-person or direct contact. For skin ailments, Teledermatology was seen to be impactful with increased uptake especially in developed countries by as high as 80% (Mu et al., 2021) with newer innovations coming up (Elsner, 2020). The utilization of mobile devices for teledermatology was also positively impacted during the COVID-19 pandemic (Handa et al., 2021).

For Mobile teledermatology, one of the major limitations at its initial stages was the poor camera quality of devices in use which has drastically changed over the years. lack of adequate or inability to enforce regulations is another visible drawback of mobile teledermatology (Azfar et al., 2011). Non-recognition by third-party payers has led to reimbursement issues for physicians and decreased patient-physician relationships, misinformation due to unvetted information readily accessible to patients (Flaten et al., 2018). Other issues border on data safety, medico-legal concerns, and a high possibility of fragmented care due to non-merging with electronic health records (Chuchvara, Patel, Srivastava, Reilly, & Rao., 2020).

2.4 Satisfaction

Satisfaction is a crucial aspect of quality of care aptly described as a key outcome of care. However, definitions of satisfaction have not been consistent (Hadeler et al., 2021). Patient satisfaction was defined as "the result of the gap between expected and perceived characteristics of a service" (Ofili, 2014). "It is an expected outcome of any innovation or intervention to ensure successful implementation and avoid losses" (Liddy, Afkham, Drosinis, Joschko, & Keely, 2015). Satisfaction, feasibility, and patient outcomes have been used to measure the effectiveness of an innovation (Raposo, Alves, & Duarte, 2009). Satisfaction is also a topic considered under the patient's perspective domain as part of the model for the assessment of telemedicine applications (Kidholm et al., 2012). It is a multidimensional construct with different domains contributing to its perception and instruments measuring it should consider its multidimensional nature. The various aspects of a service should be highlighted for respondents to express their satisfaction with each aspect, avoiding measuring general satisfaction alone (Ofili, 2014) because responses to such general satisfaction questions cannot explain the aspects of care the patient is satisfied with.

There are different instruments used to measure satisfaction, but there is no single standardized instrument. Most instruments are questionnaires and nine of them are specific to telehealth. They usually measure different constructs, have different numbers of questions, and populations they apply to. (Langbecker, Caffery, Gillespie, & Smith, 2017). Most studies modify these questionnaires to suit cultural differences (Yadav et al., 2022). There are also non-questionnaire-based instruments e.g., visual analog scales (Heidemeyer, et al., 2023).

For telemedicine in general, such dimensions/domains can be subdivided into, system quality (ease of use, reliability, environment), net benefits (cost, ease of scheduling appointments, duration, usefulness), healthcare (interaction with a provider, relationship with provider, treatment, and outcomes of medical quality and care quality), information quality (information completeness and privacy), and others such as reuse, and end-user support (Garcia, Olayele, & Han, 2017). For Teledermatology the

environment (physical and virtual), interpersonal relations, technical quality, efficacy, accessibility, availability, and continuity, cost, were domains identified with patient satisfaction (Hadeler et al., 2021) alongside the impact on daily life, and usability (Wang et al., 2018).

Further defining the dimensions/domains for teledermatology with relation to telemedicine in general, the environment concerns the contextual, and physical attributes of where the teleconsult ensues, Interpersonal relations have to do with the bond or relationship with the health care provider, and how the patient perceives the provider as considering his or her perspectives, technical quality concerns how reliable, dependable, and accurate the system is, while ease of use/usability concerns how user friendly with reduced need for excessive physical or psychological effort to utilize a system. Continuity/reuse concerns the patient's willingness to use teleconsultation in the future and recommend it to others. Accessibility/ease of scheduling concerns how easy the patient can schedule, and the duration of waiting to get an appointment with a healthcare provider, efficacy relates to the treatment received via teleconsultation and the healthcare outcomes from such treatments (Garcia et al., 2017; Hadeler et al., 2021). Cost can be direct or indirect with direct cost associated with the patient's perception of the monetary cost of teleconsultation, while indirect cost can be seen with an increase or decrease in productivity, non-quantifiable cost, and fixed costs (Garcia et al., 2017, PAHO, 2016). Impact on daily life encompasses timesaving, duration, and usefulness of the teleconsult to the patient, with some elements of cost-saving (Garcia et al., 2017; Hadeler et al., 2021; Wang et al., 2018).

The impact of various dimensions on satisfaction depends on the types of respondents involved. they form a complex interplay that can affect satisfaction; however, they are not universal to all satisfaction studies (Garcia & Adelakun, 2019).

Recent reviews on patient satisfaction with telemedicine reported satisfaction with its utilization by patients (Pogorzelska & Chlabicz, 2022), especially in the areas of efficacy, accessibility, and interpersonal interactions (Nanda & Sharma, 2021)

There have been satisfaction studies for teledermatology with one of the earliest studies, showing a rating of 63% satisfaction among providers of care stating they were more satisfied than the patients (Weinstock, Nguyen, & Risica, 2002). Some have found no difference in satisfaction levels between patients and providers citing a yearning for personalized care and a reduction in waiting times as important factors for patients (Collins, Walters, S., & Bowns, 2004). More recent studies also found high general satisfaction with teledermatology (Hadeler et al., 2021). An early comparison of SAF teledermatology and face-to-face consultations did not show a significant difference in satisfaction between the two (Collins et al., 2004), this was also noted when comparing the live interactive method. However, some patients found it better than the face-to-face consultation based on the focused attention they received from the physician (Hicks et al., 2003). Another comparison of the SAF and LI methods on satisfaction showed no significant difference in the levels of satisfaction between the two methods (Mounessa et al., 2018). Utilization of mobile devices for teledermatology can be hampered by the technological limitations between devices e.g., some applications can only work on the Android operating system and not the Apple iOS (Wang et al., 2018). Demographics of age may also affect ICT savviness with younger and more educated patients more likely to adopt the technology (Handa et al., 2021; Wang et al., 2018).

2.5 Rationale: patient satisfaction with mobile teledermatology

It is confirmed that there was an upsurge in telemedicine use during the COVID-19 pandemic (Mu et al., 2021; Sendagorta et al., 2021) to maintain healthcare services and reduce the risk of transmission.

Prior to the pandemic studies were conducted to measure satisfaction with mobile teledermatology utilizing smartphones and mobile applications (Wang et al., 2018) even in subspecialties such as pediatric dermatology (Fiks et al., 2018) and teledermatology in general. Likewise, studies during the pandemic also confirmed satisfaction with its use (Sendagorta et al., 2021; Handa et al., 2021; Yadav et al., 2022) prompting further refinement of the process. However, there is a lack of reviews specifically comparing user satisfaction with mobile devices for dermatology care

before and after the pandemic to determine if there were any significant changes in satisfaction between the two periods

This is important as it can be safely assumed that the surge of telemedicine during the pandemic constituted an indispensable necessity to ensure access to care despite restriction of movement due to lockdowns and other social distancing measures, compelling patients to resort to unconventional methods of accessing care. Therefore, it was not a matter of choice or preference as seen with the failure of forced acceptance of telehealth for physicians (Thomas et al., 2022).

This can be further buttressed by the fact that although patients were satisfied with teledermatology and indeed mobile teledermatology, preference was still for face-to-face consultations across studies (Hadeler et al., 2021; Handa et al., 2021). The pandemic has provided an opportunity to examine how transitioning from a period of choice to one with limited options impacts satisfaction with an innovation, particularly considering its increased utilization, which was almost nonexistent in some areas (Handa et al., 2021).

In addition, mobile/smartphones have different manufacturers with different specifications, interfaces, screen sizes, and resolutions, operating systems, camera qualities (magnification and picture quality), speeds of operation, storage capacity, and user-friendliness (Franklin et al., 2020) which can also constitute a technological limitation (Wang et al., 2018). These highlight the multidimensional nature of most IT innovations (Gagnon et al., 2012) which can potentially affect satisfaction. Also, it has been shown that younger patients are more likely to utilize this method (Mu et al., 2021; Wang et al., 2018) due to the possibility of various difficulties that can be encountered by patients who are aged, not literate, not ICT savvy, and did not have a choice but to use this technology to access care during the COVID-19 pandemic which could lead to widening of the gap (Handa et al., 2021).

This comparison will shed light on whether there was a noticeable increase or decrease in patient satisfaction between these two periods, or if there was no discernible

change. Such an assessment is crucial for evaluating the effectiveness of the innovation of mobile teledermatology, as satisfaction can serve as a measure of effectiveness and is considered a key outcome of care (Ofili, 2014). It will inform future decisions regarding whether to continue investing in enhancing the process or to discontinue it altogether if deemed unsatisfactory.

Chapter 3

Research Methodology

This study, Patient Satisfaction with Mobile Teledermatology in the Pre - and post-COVID-19 Pandemic; A Systematic Review, aims to primarily determine patients' satisfaction levels with mobile teledermatology delivery for a period before and after the onset of the COVID-19 pandemic.

Mobile devices considered in this study are those devices that can connect to the internet via mobile network providers and Wi-Fi networks, i.e., mobile phones, smartphones, and tablets with the following operating systems, Android OS, Apple iOS, and Microsoft OS. These devices run on mobile applications and can make calls over mobile networks or the Internet (Franklin et al., 2020). Mobile applications were considered because they are used via these devices and some studies only mention the software application and not the hardware technology (Wang et al., 2018).

For this systematic review, the SPIDER (Sample, Phenomenon of Interest, Design, Evaluation, Research type) was used to formulate the research question and to determine the inclusion and exclusion criteria, keywords, and search terms that were used for the search (Cooke et al., 2012). The PRISMA 2020 reporting guidelines were used for the reporting of this review (Page et al., 2021).

Review team

i. Dr. Oraya Kwangsukstid.
ii. Dr. Kishimi Ismaila.

3.1 Population and samples

The final population of studies for this review was obtained at the end of our systematic database search process and identification of studies relevant to our research

question using our inclusion and exclusion criteria. This entire process is outlined in section 3.3.

3.2 Research Instruments

The following research instruments were used in this study.

a) The PRISMA 2020 R-package and shiny application – an online application that is specifically designed to help produce PRISMA-compliant flow diagrams (Haddaway, Page, Pritchard, & McGuinness, 2022).

b) PRISMA 2020 checklist - This is a checklist form of the PRISMA 2020 guidelines for reporting systematic reviews. Each item of the checklist is explained by the PRISMA 2020 statement paper (Page et al., 2021).

c) ROBS -2 – The Cochrane collaboration tool for assessing the risk of bias (Bourtron, 2022).

d) CASP: Critical Appraisal Skills Programme Checklist

e) JBI checklist (Joanna Briggs Institute).

f) Zotero software – This software was used as a reference manager for this research.

3.3 Data Collection

Before commencing data collection, we outlined inclusion and exclusion criteria for articles we retrieved from our database search.

3.3.1 Inclusion criteria

a) All articles that had the following characteristics were included in our review.

b) Studies within a Six (6) year time frame between 1st March 2017 and 1st March 2023. (we will include studies based on the actual dates they are carried out and not the date of publishing so as not to include studies not carried out within the period or after the period).

c) Qualitative and Quantitative or mixed studies evaluating satisfaction among patients accessing dermatology care via mobile teledermatology.

d) Studies detailing the use of mobile devices for consultation, diagnosis, monitoring, and follow-up of skin diseases.

e) Studies in the English language

3.3.2 exclusion criteria

All articles that had the following characteristics were excluded from our review.

a) Studies before the 1st of March 2017 and after the 1st of March 2023

b) Studies that did not evaluate patient satisfaction either as a primary or secondary outcome.

c) Studies that evaluated the use of other devices which are not mobile, for access to care.

d) Studies in which mobile devices were used for any other purpose apart from consultation, diagnosis monitoring, or follow-up.

e) Studies not in the English language.

A more detailed table titled "exclusion and inclusion criteria table" explaining the inclusion and exclusion criteria, and the rationale for each criterion using the SPIDER framework is attached in Appendix A.

3.3.3 Database Search/Identification Stage

The search strategy for this systematic review followed the terms of the SPIDER framework for a systematic review. The search terms and synonyms are outlined in Table 3.1 below.

Table 3.1 Keywords and synonyms for search

Sample	**Phenomenon of interest**	**Design**	**Evaluation**	**Research type**
Patient	teledermatology	questionnaire	Satisfaction	qualitative
	telemedicine	Interview	Non-satisfaction	quantitative
	Smartphone	Survey	dissatisfaction	

Table 3.1 Keywords and synonyms for search (Cont.)

Sample	Phenomenon of interest	Design	Evaluation	Research type
	Cellphone			
	Mobile application			
	Store and forward			
	Mobile health			

Source: Cooke et al., 2012

Based on these, a Boolean search linking the keywords was carried out in the following databases.

a) Cochrane Library
b) PubMed
c) CINAHL
d) Google Scholar (supplementary database)
e) Individual journals related to telemedicine.

The major keywords were (teledermatology) AND (satisfaction) AND (patient). These keywords were expanded based on the synonyms considering different studies use different terms. The focus was on periods before and after the COVID-19 pandemic. Therefore, a search to identify studies directly linked to the pandemic was carried out as written below.

The potential for qualitative data in the articles was further accommodated by adding the research designs and research types to ensure specificity and reduce unnecessary hits while searching the databases (Cooke et al., 2012).

This was done in all databases for a time frame between 1st March 2017 and 1st March 2023.

A summary of the search procedure for individual databases is presented from 3.3.3.1 to 3.3.3.4 below. Results from each search using the different keywords and search terms were grouped according to the databases they were obtained from in the

Zotero application which was used to remove duplicate studies. They were added together to give an initial number designated as n1 in table 4.1 of chapter 4. Figure 4.1 of Chapter 4 shows the flow of the search process. The full search terms and keyword combinations used for the various databases can be found in the attached pictures, and titled “Identification stage” in Appendix A.

3.3.3.1 PubMed database

We carried out an initial basic search with the initial keywords followed by an advanced search with keywords synonyms. Filters of the date range between 1/3/2017 to 1/3/2023 were used and we excluded systematic reviews. We expanded the search further to include the keywords COVID-19 or Sars COv-2 which gave results already contained in the initial search. Adding the keywords quantitative and qualitative yielded zero results.

3.3.3.2 Cochrane database

The search manager function was used to search the Cochrane library for trials using mesh terms, and titles, abstracts, or keywords before combining the different search strings with either AND/OR. The date range limits were between 1st March 2017 and 1st March 2023. An initial and expanded search with more keyword synonyms was carried out.

3.3.3.3 CINAHL database

The advanced search function was used to conduct a Boolean /phrase search of the CINAHL database. An initial basic search was conducted followed by an advanced search with the expansion of keywords. The search was edited to find all search terms and apply equivalent subjects and, all publication types within the time frame of 1/3/2017 to 1/3/2023.

3.3.3.4 Google Scholar

As we stated in the published protocol, the Google Scholar search engine was used for the supplementary search (Harris et al., 2018). We used it as a database in the initial keyword search. The initial search with Google Scholar returned many systematic reviews making it less specific for primary studies. For this reason, systematic reviews were excluded from the search terms as seen below.

Teledermatology OR telemed AND mobile application OR smartphone OR Mobile health OR store and forward AND patient satisfaction AND dermatology OR skin -systematic review.

Furthermore, Individual journals relevant to telemedicine were searched to ensure completeness (Booth, 2016). This was necessary to ensure studies were not excluded based on indexing shortcomings of some keywords in various databases.

The primary reviewer conducted the database search, and it was vetted by the secondary reviewer.

3.3.4 Screening strategy

The screening strategy we used is as outlined in 3.3.4.1 to 3.3.4.6 below.

3.3.4.1 Screening stage 1 (screening of titles and abstracts)

This stage involved manual screening of titles and abstracts from the Boolean search for relevance to the research question. It was carried out by both researchers to reach an agreement as to why articles should be included or expunged based on their titles and abstracts. Duplicate articles were also sought again at this stage.

Articles we did not deem fit for exclusion based on their title or abstract were tabulated and added for the second level of screening as studies with unclear abstracts.

Articles that were excluded after the initial screening of titles and abstracts were tabulated in an Excel sheet titled “excluded studies from the title and abstract screening”, with reasons for their exclusion given. This is attached in Appendix B.

We added the studies with unclear titles and abstracts and those with clear abstracts. They were counted, and their total number was designated as n2 in table 4.2 of Chapter 4.

3.3.4.2 Screening stage 2 (retrieval of articles)

In this stage, we made attempts to retrieve the full texts of both clear and unclear articles (n2) from screening stage one. The articles whose full texts we retrieved were tabulated, counted, and designated a number n3 in Table 4.3 of Chapter 4.

Articles whose full texts could not be retrieved after an exhaustive process were noted and attempts were made to contact the respective authors of these articles via phone or e-mail.

A time frame of one month was given after which articles that we could not retrieve their full texts, and there was no response from the authors were completely excluded. This is presented in an Excel sheet titled, Unretrieved Clear Studies, attached in Appendix B.

3.3.4.3 Screening stage 3 (full-text critical review for inclusion/exclusion criteria, and citation search)

This stage involved full-text reviews for inclusion and exclusion criteria. The articles whose full texts we obtained were analyzed to make sure they met the inclusion criteria set out. Those that did not meet the inclusion criteria were excluded with reasons and designated as n4 in table 4.4 of chapter 4 while those that met the inclusion criteria were included for the next screening process and designated as n5 in table 4.4 of chapter 4 on the PRISMA flow diagram. The appraisal was done independently by members of the review team.

These studies that met the inclusion criteria constituted the articles for which we conducted a forward and backward citation search using the Google Scholar search engine. After obtaining studies via the citation search, we removed duplicate studies and carried out a title and abstract screening. This was followed by attempts to obtain the full texts, and full-text reviews utilizing the inclusion and exclusion criteria in preparation for the last stage of screening. This process is presented in Table 4.5 of Chapter 4.

The two reviewers met to further agree or disagree on the inclusion of studies. There was no disagreement and therefore no engagement of a third reviewer.

3.3.4.4 Screening stage 4 (full-text critical review for study quality)

The final screening process involved those articles (n6) from the keyword and database search and the citation search that passed all the screening stages i.e., are not duplicates, are in the English language, full texts have been retrieved, and meet the inclusion criteria set out. The quality of individual studies was ascertained at this stage using appropriate tools according to study type, i.e., CASP, ROBS-2 for RCTS, and JBI for cross-sectional studies.

These are the studies from which we extracted data for our final analysis and comparisons. These are presented in table 4.6 of chapter 4. No articles were excluded based on our risk of bias assessments.

The protocol was published on PROSPERO. It was accepted on the 7th of June 2023 with registration number CRD42023431109.

3.3.4.5 Risk of Bias

Bias is an important factor to consider for any review. We used the following to reduce the Risk of Bias for the general study and to assess the Risk of Bias in individual studies.

a) Our search protocol included citation searching and the use of Google Scholar as a supplementary search tool for unpublished studies to reduce publication and location bias due to indexing issues with database searches, especially for qualitative data.

b) We removed duplicate studies to eliminate duplication bias.

c) We outlined all declarations of any conflicts of interest.

d) There were no disagreements after discussions, especially on changes to the protocol as the review progressed. All changes suggested were agreed upon and effected without the need for a third party.

e) We used the CASP, JBI, and ROBS-2 checklists to assess study validity in the last screening stage eliminating bias in the results of included studies.

f) We graded the risk of bias for each study accordingly.

We graded the risk of bias for individual studies based on different domains for risk of bias which we had assessed using the checklists stated in 3.3.4.4. The grades are,

a) good methodological quality/low risk of bias, based on at least four out of five domains.

b) fair methodological quality/moderate risk of bias based on three out of the five domains.

c) and poor methodological quality/high risk of bias if less than three domains are checked within the study.

The focus was on questions within domains that are related to cross-sectional studies. These domains are as follows (Viswanathan et al., 2008).

a) Selection bias - if the study applied inclusion and exclusion criteria uniformly.

b) Performance bias – if researchers rule out the impact from concurrent intervention or an unintended exposure?

c) Attrition bias- if the study ruled out the impact of concurrent intervention or unintended exposures.

d) Detection bias – if interventions or exposures are assessed using reliable measures or, if outcomes are assessed and defined using valid and reliable measures or, confounding factors measured using valid and reliable measures.

e) Reporting bias – were potential outcomes pre-specified and reported

The risk of bias assessments is presented in Table 4.7 of Chapter 4, with symbols of + (positive) or – (negative) to depict if the study is at risk of bias or not for a specific domain. The individual findings supporting the risk of bias assessments, the checklists used, and additional information on conflict of interest are further presented in Table 4.8 of Chapter 4. The filled risk of bias assessment forms can be found in Appendix C. Studies with a high risk of bias will be stated when making the comparisons.

3.3.4.6 Pooling and Classification of Data

After obtaining all relevant literature within the set time frame and according to the inclusion and exclusion criteria set out, data from the studies included (n6) were pooled and a study characteristic table was formed (Mckenzie & Brennan, 2022) using Microsoft Excel. The table was formed according to the contexts of study design/methods and the context of respondents divided into the pre- and post-COVID-19 periods and structured according to the study dates.

a) Research type whether Quantitative, qualitative, or Mixed.

b) Design/methodology of study – (questionnaire, interview), characteristics of participants.

c) Type of scale used to measure satisfaction (SERVQUAL, LIKERT, visual analog scale) or qualitative measurement. Domains of satisfaction considered; levels of satisfaction obtained, and satisfaction as a primary or secondary outcome of the study.

d) Type of data synthesis used and results.

e) Type of mobile technology/application used – smartphone, mobile phone, tablet, mobile application (android, apple, Microsoft operating systems) with factors affecting satisfaction stated.

f) Type of intervention i.e., triage, diagnosis, the institution of treatment, or monitoring of treatment/follow-up.

g) Geographical distribution of studies (regions of the world), urban or rural.

h) Bibliographic data and domain of satisfaction studied.

i) Participant groups involved. E.g., if a specific age group accessing care via mobile devices.

Data pooled from these subheadings were divided into two sets based on a time frame before and after the onset of the COVID-19 pandemic. This was used for the final comparison.

j) Studies before the onset of the COVID-19 pandemic i.e., March 1st, 2017, to March 1st, 2020, i.e. 3 years before the onset of the covid 19 pandemic.

k) Studies post onset of the COVID-19 pandemic i.e., March 2nd, 2020, to March 1st, 2023, i.e. 3 years post onset of the COVID-19 pandemic.

The characteristics of the studies table are presented in Table 4.9, the context of participants, and Table 4.10, the context of studies in Chapter 4. The complete table is attached in a Microsoft Excel sheet in Appendix B.

We extracted the general satisfaction scores in percentages from the general satisfaction questions within the questionnaires of studies that had such questions. We also extracted the satisfaction scores in percentages based on the domains of satisfaction from individual questions within questionnaires. We did this by choosing questions that fit best into a specific domain and obtaining the scores. The data extracted are contained in Microsoft Excel sheets titled “satisfaction scores” and “domains” respectively which can be found in Appendix B. These will form the basis of our data comparison between the two periods.

We also identified studies that measured satisfaction qualitatively via interviews or as part of their questionnaires. We extracted the qualitative data from the studies, classified and tabulated them according to domains, and outlined the factors facilitating or barring satisfaction, see Table 4.11 of Chapter 4.

We also identified the factors that affected the satisfaction of respondents pre- and post-onset of the pandemic from the results and discussion sections, see Table 4.13. of Chapter 4.

We also extracted the conclusions on general satisfaction from all the studies, see Table 4.14 of Chapter 4.

3.4 Data Analysis

For data analysis, we first compared the study characteristics between the two periods narratively. This comparison can be found in section 4.2.1 of chapter 4.

We then extracted the general satisfaction scores in percentages from the various questionnaires that had specific general satisfaction questions. We divided the scores into periods pre- and post-onset of the COVID-19 pandemic as per our set criteria for the dates. We used the pooling decision tree (Morton et al., 2018) to arrive at the decision not to pool data for a meta-analysis (Deeks, Higgins & Altmann , 2022). A copy of the pooling decision tree can be found in Appendix B. We used a structured reporting format (Mckenzie et. al., 2022) to compare the general satisfaction scores between the two periods based on the scores obtained. We also calculated the means of the percentages of the studies between the two periods for further comparison.

The qualitative data we obtained from the studies can be described as thin, being that the studies were not fully qualitative alone, and the fact that we were looking for sociocultural aspects that could have hindered satisfaction with the use of mobile devices for teledermatology delivery, alongside the technological aspects. (Noyes et. al., 2022; Flemming, Booth, Garside, Tuncalp & Noyes, 2019).Only a few studies had such qualitative measures, of which only one study had a robust qualitative interview. Therefore, carrying out a full thematic synthesis with coding was not feasible. We however developed descriptive themes of the responses and divided them into either barriers or facilitators of satisfaction. This is presented in Table 4.11 of Chapter 4.

We also compared the satisfaction scores between the two periods based on identified domains of satisfaction because satisfaction is a multidimensional construct with different dimensions affecting its perception (Ofili, 2014). These domain scores are presented in Table 4.12 of Chapter 4. The complete data which includes the questions from individual study questionnaires that are representative of domains are attached in an Excel sheet titled “Questionnaire comparison domains” in Appendix B.

We grouped the factors identified to have affected satisfaction into barriers and facilitators and converged them into various identifiable domains of satisfaction specific to teledermatology. We further discussed these factors concerning their negative or positive impact on satisfaction between the two periods. This was done in section 4.2.3 of chapter 4.

The findings from the synthesis of the data are fully explained in section 4.2 of chapter 4. Recommendations were proposed in the conclusion section.

Chapter 4

Research Results

Introduction

The results presented in this chapter are from data extracted from the studies that met all the inclusion criteria as stated in Chapter 3. A structured reporting of the findings according to the PRISMA 2020 checklist was used. Here we present the search strategy as carried out in the various databases. The results from the search, screening stages, selection process, risk of bias assessments, and a summary of results.

4.1 Results of database Search and identification of studies

The search and identification process for this systematic review was carried out for a total of four databases, and Google Scholar. A forward and backward citation search was also carried out using Google Scholar. At the end of the entire screening process, we had a total of ten studies that met our set inclusion criteria. The individual database search results are presented in Table 4.1 below, and the entire screening process to arrive at the ten studies is depicted in Figure 4.1 below using the PRISMA 2020 flow diagram (Haddaway et al., 2022).

Table 4.1 Results from individual databases and removal of duplicates.

Database	**Initial n for database search**	**2nd search with expanded keyword**	**Combination of initial searches**	**Number of studies left after removal of duplicates with Zotero**
PubMed	48	8	56	48
CINAHL	22	17	39	21
COCHRANE	24	4	28	22
GOOGLE SCHOLAR			105	90
	94	134	228	181 3 duplicate studies were manually removed. 181-3= 178
Total				n1=178

Source: Researchers Computation, 2024

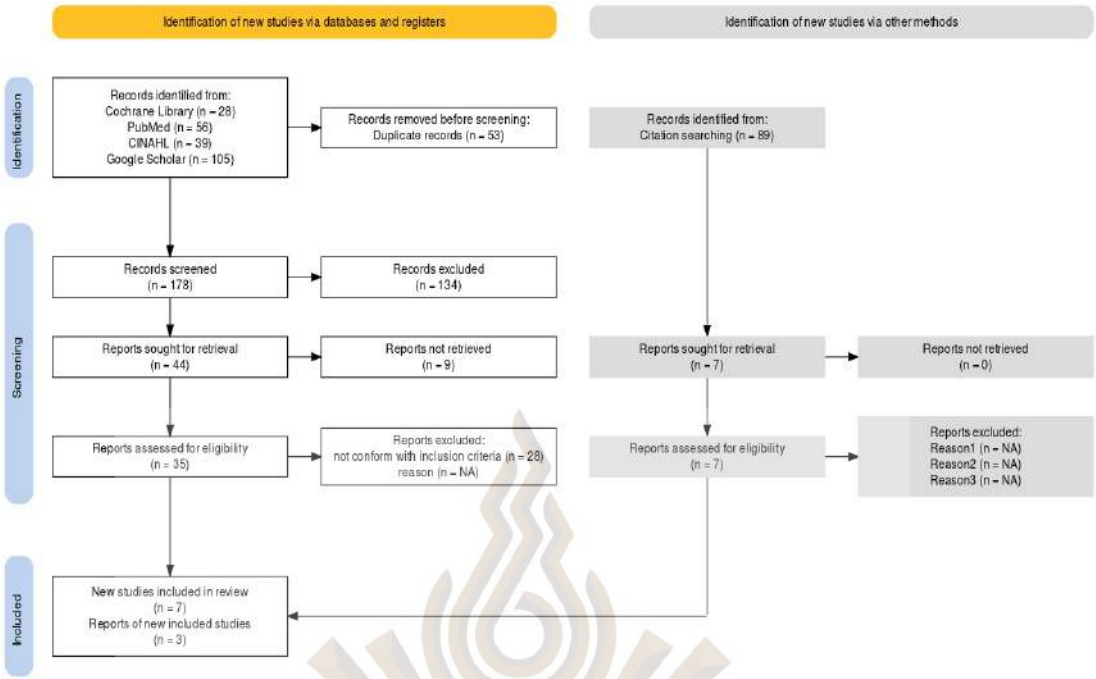

Figure 4.1 PRISMA flow diagram of search

Source: Researchers Computation, 2024

4.1.1 Screening stage one

After the search and selection phase, we had a total of 178 studies which we designated as n1. These studies were included for the first stage of screening i.e., screening stage one. This stage involved the removal of duplicates and the screening of titles and abstracts for relevance to the research question. The results for this stage are presented in Table 4.2 below.

Table 4.2 Screening stage one. The number of studies left after screening titles and abstracts (n2).

Total studies after removal of duplicates (n1).	**Excluded studies after the title and abstract screening.**	**Cleared for second-stage screening.**	**Unclear abstracts.**	**Total No of studies for screening stage 2 (clear 20 + unclear 24 = n2)**
178	134	20	24	**n2 = 44**

Source: Researchers Computation, 2024

4.1.2 Screening Stage 2

After the screening stage one, we had a total of forty-four studies which we designated as n2 for the second screening stage. We were able to retrieve a total of thirty-five studies while nine could not be retrieved. Mails were sent out to the Authors of the individual studies, and we got some responses. After one month, studies for which no author response was obtained were excluded. The results are presented in Table 4.3 below.

Table 4.3 Screening stage two. Number of studies retrieved, and email responses.

	No. of studies, screening stage 1	**Screening stage 2** retrieved	**Screening stage 2** Not retrieved	**Email responses**	**No responses**
Sure	20	16	4	2	2
Unsure	24	19	5	0	5
	44	**n3= 35**	**9**		

Source: Researchers Computation, 2024

For the studies with clear titles and abstracts, we sent a total of five emails. One for a retrieved study (Heidemeyer et. al., 2023) for clarity. Another for (Yee, Mmbaga, Mcharo, Juma, & Wanat, 2023) which necessitated its exclusion. In one study (Stadler et al., 2021) the email did not deliver after two attempts. For the remaining two studies that we could not retrieve the full study articles, there were no responses via email. We made continuous efforts to retrieve them before the completion of this review. Consequently, both studies (Kaur, Guag & Kaur, 2021; Ringwald, Arnold, Haase, Jünger, & Lutze, 2022) fall into the post-onset COVID-19 period. They were separated and outlined in a Microsoft Excel sheet titled ‘un-retrieved clear studies in Appendix B.

For studies with unclear titles and abstracts, we sent a total of eleven Emails. Six for articles that had been retrieved but we needed more clarity before inclusion/exclusion, and five requesting the full articles of the studies. One article

(Hamad, Fox, Kammire, Hollis & Khairat, 2022) did not have an email address, or any other contact address so the authors could not be reached.

We got responses from six authors of articles that had unclear titles and abstracts (Marchell et al., 2017; Cheng et al., 2022; Kohn et al., 2022; Livesey, Plant, Simmonds, & Mitchell, 2022; Low et al., 2023; Millán-Cayetano et al., 2017), they were excluded based on these email responses. They are depicted in green in a Microsoft Excel sheet titled "exclusions from unclear studies" in Appendix B with reasons for their exclusion.

There were no responses from five authors after the stipulated one month for the studies with unclear titles, and abstracts, (Gong, Hou, Guo, & Feng, 2022; Martora et al., 2022; Moore et al., 2022; Nwankwo et al., 2022; Ruggiero, Megna, Fabbrocini, & Martora, 2022). Therefore, we had to exclude them after one month as stated in Chapter 3.4 iii. However, we carried out another review of the titles and abstracts again before finally excluding them. They are depicted in red in a Microsoft Excel sheet titled "Exclusions from unclear studies" in Appendix B.

After article retrieval, we had a total of 35 studies (n3) which we moved to the next screening stage.

4.1.3 Screening Stage 3

In this stage, we conducted a full-text review of the inclusion and exclusion criteria we had set earlier. The process is represented in Table 4.4 below.

Table 4.4 Screening stage 3. Results of full-text review of retrieved articles for inclusion and exclusion criteria.

Screening stage 3	**Screening stage 3**	**Total**	
Excluded	included		
9	7	16	Clear studies
19	0	19	Unclear studies
n4=28	**(n5) = 7**	35	

Source: Researchers Computation, 2024

From the thirty-five articles we screened in the third stage based on our inclusion and exclusion criteria, we excluded a total of twenty-eight articles and included seven (n5).

All the seven included were from the initial studies with clear abstracts, and titles. The nine excluded from the studies with clear titles and abstracts are presented in a Microsoft Excel sheet titled "exclusion from clear studies" with reasons for their exclusion in the appendix.

All the twenty-four unsure studies (retrieved/un-retrieved) were excluded at the end of this stage, they are presented in a Microsoft Excel sheet titled "exclusion from unclear studies" with reasons for their exclusion in the appendix.

4.1.4 Citation Search

From our citation search, 3 studies met the inclusion criteria, two from the forward citation search, and one from the backward citation search. The process is presented in Table 4.5 below.

Table 4.5 Citation search results from Google Scholar

	Forward citation search	**Number of Studies excluded after title and abstract screening.**	**Studies for inclusion criteria screening.**	**Studies included from citation searches.**
Total	76	72	4	**2**
	Backward citation search			
Total	13	12	1	**1**

Source: Researchers Computation, 2024

4.1.5 Included studies

The seven studies from the database search and the three studies from the citation search were combined making a total of ten studies (n6) we moved to the screening stage four which entailed a critical review of study quality. The studies are presented in Table 4.6 below with full bibliographies and dates of commencement. They are divided

into pre- and post-onset COVID-19, from keyword and database search or citation search.

Table 4.6 Included studies, search source, and date of commencement/ending.

Study title	Keyword/database or citation search source.	Date of study commencement
Pre-COVID onset studies		
Gilling et al., 2020	Keyword and database search	January 2019 to February 2019
Wang et al., 2018	Keyword and database search	February to April 2017
Horsham et al., 2020	Keyword and database search	March 6, 2017- and completed in August 2018. Analysis December 2018
Po (Harvey) Chin et al., 2020	forward citation search on Google Scholar	April to May 2019
Post-covid onset studies		
Handa et al., 2021	Keyword and database search	May 20, 2020, to October 31, 2020
Trinh et al., 2022	Keyword and database search	16th November 2020 to 9th July 2021
Yadav et al., 2022	Keyword and database search	December 2020 to April 2021
Heidemeyer et al., 2023	Keyword and database search	October 2020 to November 2021
Weeraphorn & Sirithanabadeekul, 2023.	forward citation search using Google Scholar	July to December 2021
Damsin et al., 2023	forward citation search using Google Scholar	September 2020 to August 2022

Source: Researchers Computation, 2024

4.1.5 Screening Stage 4

We present the results of the checklist review of studies for methodological quality. All completed checklist assessments are attached in Appendix C. Table 4.7 below presents summaries of the risk of bias according to domains of bias (Viswanathan et al., 2008), while Table 4.8 presents the checklist findings for the various studies.

Table 4.7 Risk of bias according to domains of bias.

Study title	Selection bias	Performance bias	Attrition bias	Detection bias	Reporting bias
(Wang et al., 2018)	-	+	-	-	-
(Po (Harvey) Chin et al., 2020)	+	+			-
(Gilling et al., 2020)	-	+	-	+	-
(Horsham et al., 2020)	-	+	-	-	-
(Handa et al., 2021)	+	+	-	-	-
(Trinh et al., 2022)	+	+	-	+	-
(Yadav et al., 2022)	-	+	-	-	-
(Heidemeyer et al., 2023)	-	+	-	-	-
(Weeraphon & Sirithanabadeekul, 2023)	-	+	+	+	-
(Damsin et al., 2023)	+	+	-	-	-

Source: Researchers Computation, 2024

Table 4.8 Risk of Bias Assessments

Study Pre-onset	Checklist	Study quality	Positives	Negatives	Conflicts of interest	Rating
(Wang et al., 2018)	[1]JBI checklist	Good methodological quality for a cross-sectional study	Confounders identified. Pearson's correlation, one-way ANOVA, and t-tests were used for analysis. Inclusion criteria stated. Standard telemedicine questionnaires were used.		None declared	4 out of 5. Risk of performance bias.

Table 4.8 Risk of Bias Assessments (Cont.)

Study Pre-onset	Checklist	Study quality	Positives	Negatives	Conflicts of interest	Rating
(Po (Harvey) Chin et al., 2020)	JBI Checklist	fair methodological quality for a cross-sectional study	Confounders identified. stratification carried out. A well-designed questionnaire was used. Outcomes were measured reliably and non-parametric tests, Wilcoxon rank sum test, and Kruskal Wallis test were used.	No well-defined selection criteria	Dr. Po (Harvey) Chin and Prof. Yu Chuan Li are founders of Derm AI Co. Ltd.	3 out of 5. Risk of performance, and selection bias.
(Gilling et al., 2020)	JBI checklist	Fair quality for a cross-sectional study	Large sample size. Confounders identified. Inclusion criteria described. Settings described. Questionnaire translated from English to Danish, but the authors did not feel it was validated. No back translation. Stratification was done for identified	Liable to a lot of confounders as identified by the authors. No statistical analysis to deal with confounders. A high risk of recall bias because of the 2-to-	No conflicts of interest to declare.	3 out of 5. Risk of performance and of recall bias

Table 4.8 Risk of Bias Assessments (Cont.)

Study Pre-onset	Checklist	Study quality	Positives	Negatives	Conflicts of interest	Rating
			confounders. X^2 test used	12-month timeline for response		
(Horsham et al., 2020)	JBI checklist	Good quality	The internal consistency of the questionnaire was assessed. Respondents from a randomized group. No significant difference in characteristics between those who completed and those who withdrew. Confounder identified and stratification/regression.	voluntary nature of participants, who may hold positive viewpoints, thus results not generalizable, more women than men	Study funded by a research grant from the National Health and Medical Research Council,	4 out of 5 Risk of performance bias
Post onset						
(Handa et al., 2021)	JBI	Fair quality for a cross-sectional study	Participants with missing information were excluded to deal with missing data. Complete case analysis.	No methods to deal with confounders in the stage of	None to declare.	3 out of 5. Risk of Selection, and performance bias.

Table 4.8 Risk of Bias Assessments (Cont.)

Study Pre-onset	Checklist	Study quality	Positives	Negatives	Conflicts of interest	Rating
			Confounders identified. Kendall's tau was used for statistical analysis of correlation which is appropriate as a non-parametric test for ordinal data.	patient selection.		
(Trinh et al., 2022)	JBI	Poor quality for a cross-sectional study	descriptive statistics of Means, standard deviations, and frequency for survey responses used. Graphical representation of the frequency of values outlined	No proper inclusion criteria. No analysis to adjust confounders. statistical analysis was done; settings were described in detail, but subjects were not described. Small	None to declare.	2 out of 5 Risk of selection, performance, and detection bias

Table 4.8 Risk of Bias Assessments (Cont.)

Study Pre-onset	Checklist	Study quality	Positives	Negatives	Conflicts of interest	Rating
				sample size.		
(Yadav et al., 2022)	JBI	good quality for a cross-sectional study	Inclusion criteria identified. Contacting timeline stated. Confounders identified Response bias mitigated. Univariable and stepwise multivariable logistic regression analysis. Categorical variables are represented with frequencies. A validated patient satisfaction questionnaire.		None to declare.	4 out of 5 checked. Risk of performance bias.
(Heidemeyer et al., 2023)	[2]CASP for RCT JBI ROBIS	Good quality for an open-label RCT. Some concerns in ROBIS.	A randomized open-label trial. Good concealment.	An open-label trial. Blinding was not feasible due to the	Supported by an investigator-initiated research	4 out of 5. Risk of performance bias.

Table 4.8 Risk of Bias Assessments (Cont.)

Study Pre-onset	Checklist	Study quality	Positives	Negatives	Conflicts of interest	Rating
		Risk of bias due to deviation in interventions	An intention-to-treat analysis was carried out to account for missing data. Had a clearly defined study protocol. P values reported.	type of interventio n. Small sample size.	grant from Galderma	
(Weerapho n & Sirithanaba deekul, 2023)	JBI	Poor quality for an observational study	Study subjects were included only if they had experienced the use of the skin application. Descriptive statistics were used.	Observatio nal study, confounde rs not identified, nor attempts to deal with them. No statistical analysis	None to declare.	2 out of 5. Risk of Performanc e, attrition, and detection bias
(Damsin et al., 2023)	JBI	poor for a cross-sectional study	Outcomes measured Demographic data captured. Confounders identified, repeated logistic model analysis.	No clear criteria for the inclusion of patients into samples,	None to declare.	2 out of 5. Risk of Selection, performance , and attrition bias

[1]Joanna Briggs institute, [2]Critical Appraisal Skills Programme

Source: Researchers Computation, 2024.

From the tables, a total of four good-quality studies, three fair-quality studies, and three poor-quality studies were identified. Consequently, the poor-quality studies were all from the post-onset of the COVID-19 pandemic period. For this systematic review, data will not be pooled for a synthesis. Therefore, the risk of bias assessments will not be used to exclude studies. However, studies with a high risk of bias will be noted in any comparisons in which they are involved.

4.1.6 Included study characteristics

Table 4.9 Characteristics of Respondents

Study	**Technology used**	**[1]TD level**	**[2]n**	**Skin condition**	**country**	**Mean age**
Pre -COVID-19						
Wang et al. (2018)	MedX app Android smartphone.	Patient to dermatologist	28	General skin diseases,	Taiwan, Taipei, Urban setting	27.25
Po (Harvey) Chin et al. (2020)	Moleme app Line app, smartphone.	Patient to dermatologist	1231	Skin cancer triage.	Taiwan, Taipei. Urban setting	39
Gilling et al. (2020)	Fotofinder app, iPhone Dermoscope	Skin GP to dermatologist	287	Skin cancer triage.	Europe, Denmark, urban setting	73
Horsham et al. (2020)	Fotofinder app, iPhone Dermoscope	Patient to dermatologist	98	Skin cancer triage.	Queensland, Australia, urban setting	41.8
Post -COVID-19						
Handa et al. (2021)	android smartphone, WhatsApp.	Skin GP to dermatologist .	5229	General skin diseases.	North India, urban/rural setting	33.60

Table 4.9 Characteristics of Respondents. (cont.)

Study	Technology used	[1]TD level	[2]n	Skin condition	country	Mean age
Trinh et al. (2022)	iPad Pro, skin IO app, dermoscope.	Patient to dermatologist.	27	Skin cancer triage.	California, United States of America, urban setting	87
Yadav et al. (2022)	android smartphone, WhatsApp.	Skin GP to dermatologist.	201	General skin diseases.	North India, urban setting	38.41
Heidemeyer et al. (2023)	Evita application.	Patient to dermatologist.	24	Acne	Bern, Switzerland, urban setting	23
Weeraphon & Sirithanabadeekul, (2023)	skinX android application	Patient to dermatologist.	227	General skin diseases	Thailand, Urban setting	31.61
Damsin et al., 2023	iPod touch, dermoscope, smartphone.	Skin GP to dermatologist.	335	Skin cancer triage	Belgium Urban/rural setting	50.5

[1]Teledermatology, [2]number of participants

Source: Researchers Computation, 2024

Table 4.10 Characteristics of studies

Study title	Study design	[1]TD model	[3]Outcome	[4]Instruments	[5]Score	[6]associations
Pre-COVID-19						
Wang et al., (2018)	Cross-sectional survey.	[2]SAF	primary	Questionnaire,	86%	Nil
Po (Harvey) Chin et al. (2020)	cross-sectional survey.	SAF	primary outcome	Questionnaire,	94%	Nil

Table 4.10 Characteristics of studies (Cont.)

Study title	Study design	[1]TD Model	[3]outcome	[4]Instruments	[5]score	[6]associations
Gilling et al. (2020)	Cross-sectional survey.	SAF	primary outcome	Questionnaire,	59%	Nil
Horsham et al. (2020)	Cross-sectional survey.	SAF	primary outcome	Questionnaire	Nil	Nil
Post COVID-19						
Handa et al. (2021)	Retrospective observational study.	hybrid	primary outcome	Questionnaire, Subjective interview	61%	nil
Trinh et al. (2022)	Cross-sectional survey.	hybrid	secondary outcome	Questionnaire	89%	Urticaria, improved skin disease
Yadav et al. (2022)	Cross-sectional survey.	hybrid	primary outcome	Questionnaire, Interview.	84%	
Heidemeyer et al. (2023)	Randomized open-label study.	SAF	secondary outcome	visual analog scale.	8.2/11	
Weeraphon & Sirithanabadeekul. (2023)	Cross-sectional survey.	hybrid,	primary outcome	Questionnaire.	76%	nil
Damsin et al. (2023)	Cross-sectional survey.	SAF	secondary outcome	Questionnaire.	8.9/10	nil

[1]Teledermatology, [2]Store, and forward. [3]Satisfaction as a primary or secondary outcome of the study,[4] instruments for measurement of satisfaction, [5]general satisfaction scores, [6] statistically significant associations

Source: Researchers Computation, 2024

A summary of the study characteristics from Table 4.9 and Table 4.10 above is presented below.

Ten studies involving seven thousand, seven hundred and sixty-seven (7,767) patients' responses were included. Four were classified into the pre-COVID-19 onset period group while six were classified into the post-COVID-19 onset period group.

We had nine cross-sectional surveys, of which one (Horsham et al., 2020) spanned a period before and after the onset of the pandemic. One study was a randomized control open-label trial (Heidemeyer et al., 2023).

For the level of teledermatology, six studies (Horsham et al., 2020; Po (Harvey) Chin et al., 2020; Trinh et al., 2022; Wang et al., 2018; Weeraphon & Sirithanabadeekul, 2023, Heidemeyer et al., 2023) involved the interaction of the patient directly to a dermatologist, while four studies involved the secondary level (Damsin et al., 2020; Gilling et al., 2020; Handa et al., 2021; Yadav et al., 2022). Five studies used teledermatology for triage (Damsin et al., 2023; Gilling et al., 2020; Horsham et al., 2020; Po (Harvey) Chin et al., 2020; Trinh et al., 2022), four studies for consultation and treatment (Handa et al., 2021; Wang et al., 2018; Yadav et al., 2022; Weeraphorn & Sirithanabadeekul,2023), and one study for monitoring and follow-up (Heidemeyer et al., 2023). Nine studies (Damsin et al., 2020; Gilling et al., 2020; Heidemeyer et al., 2023; Horsham et al., 2020; Po (Harvey) Chin et al., 2020; Trinh et al., 2022; Wang et al., 2018; Yadav et al., 2022) were carried out on patients in an urban setting while one study was carried out in a setting of both Urban and rural dwellers (Handa et al., 2021). Five studies (Damsin et al., 2020; Gilling et al., 2020; Horsham et al., 2020; Po (Harvey) Chin et al., 2020; Wang et al., 2018) were concerned with skin cancer, four involved general dermatological diseases (Handa et al., 2021; Wang et al., 2018; Yadav et al., 2022; Weeraphon & Sirithanabadeekul, 2023), and one involved the treatment and follow-up for Acne vulgaris (Heidemeyer et al., 2023).

Three studies were from Europe (Damsin et al., 2020; Gilling et al., 2020; Heidemeyer et al., 2023), one from the American continent (Trinh et al., 2022), one from Australia (Horsham et al., 2020) , and five from Asia (Handa et al., 2021; Po (Harvey) Chin et al., 2020; Wang et al., 2018; Yadav et al., 2022; Weeraphorn & Sirithanabadeekul., 2023).

Six studies involved the asynchronous, SAF modality (Damsin et al., 2020; Gilling et al., 2020; Heidemeyer et al., 2023; Horsham et al., 2020; Po (Harvey) Chin et al., 2020; Wang et al., 2018) of teledermatology delivery while four involved a hybrid modality of delivery, involving both store and forward and live video visits (Handa et al., 2021; Trinh et al., 2022; Yadav et al., 2022; Weeraphorn & Sirithanabadeekul, 2023).

All the studies included mobile applications. Nine used smartphones, while one used an Apple iPad Pro (Damsin et al., 2020). Four studies used Apple platforms (Damsin et al., 2020; Gilling et al., 2020; Horsham et al., 2020; Trinh et al., 2022) while five used Android platforms (Handa et al., 2021; Po (Harvey) Chin et al., 2020; Wang et al., 2018; Yadav et al., 2022, Weeraphorn & Sirithanabadeekul, 2023). One study was not specific on the operating system of the smartphones used. Some of the apps are available on both Apple and Android stores, e.g., skinX (Weeraphorn & Sirithanabadeekul., 2023), line (Po (Harvey) Chin et al., 2020), and MedX (Wang et al., 2018). One study used the Evita application which is only available in Switzerland, but available on both the Apple and Android stores (Heidemeyer et al., 2023).

Seven studies (Wang et al., 2018; Handa et al., 2021; Yadav et al., 2022; Weeraphorn & Sirithanabadeekul, 2023; Po (Harvey) Chin et al., 2020; Horsham et al 2020; Gilling et al., 2020) measured satisfaction as a primary outcome while three studies (Trinh et al., 2022; Heidemeyer et al., 2023; Damsin et al., 2023) measured satisfaction as a secondary outcome. Nine studies used questionnaires to measure satisfaction, while one study used the visual analog scale (Heidemeyer et al., 2023). Most of the questionnaires used a modified LIKERT scale. Some studies divided questionnaires into sections concerning different domains of satisfaction (Wang et al.,

2018; Po (Harvey) Chin et al., 2020). A review of the questionnaires used showed the highest number of questions per questionnaire was twenty (Yadav et al., 2022) and the lowest number (Handa et al., 2021) was a 4-point questionnaire which rated general satisfaction among respondents.

A review of the questionnaires for the domains of satisfaction measured showed a total of eleven domains/dimensions measured. The domain of technical quality was considered in eight studies while accessibility/convenience was the least measured among the domains with only two studies considering it. Although not a domain, nine out of ten studies measured total satisfaction. The study with the highest number of questions (Yadav et al., 2022) not surprisingly measured the highest number of eight domains. Two studies (Heidemeyer et al., 2023; Handa et al., 2021) measured the least domains of four each. One study during the pre-onset period (Horsham et al., 2020), and two studies during the post-onset period (Handa et al., 2021; Yadav et al 2022) measured satisfaction qualitatively with open-ended questions.

Two studies (Wang et al., 2018; Po (Harvey) Chin et al., 2020) in the pre-COVID-19 period measured satisfaction within four domains of interaction, impact on daily life, usability, and total satisfaction, interestingly, both studies are from the same country, Taiwan, and both studies are classified in our pre-onset of COVID-19 period. However, the methods of presentation of data were different and the number of questions per questionnaire was different between the two studies. This shows the uniqueness of satisfaction measurements to the settings or locations in which they are to be made (Hawrysz, Gierszweka, & Bitkowska, 2021).

4.1.7 Qualitative data

Three studies included qualitative assessments of satisfaction. One study pre-COVID-19 onset (Horsham et al., 2020), and two studies post-COVID-19 onset (Handa et al., 2021; Yadav et al., 2022). Themes were created to obtain an inference from the patient's experiences.

For the pre-COVID-19 onset study, the qualitative responses began with the binary question “Did you experience any difficulties when photographing your moles or skin spots?’’ to which 70% of the respondents answered yes. Of these respondents, the highest number of individuals (29.65%) had difficulty taking photographs of moles or skin spots in hard-to-see locations or angles. This was followed by (25.5%) who had difficulty sending e-mails to study dermatologists. The lowest number (19%) had difficulty taking clear or close-up photos. Out of these participants, 74% had to enlist the help of others to assist them with taking pictures. For the actual open-ended responses, there was an 88% response rate.

A summary of the qualitative responses and themes is presented in Table 4.11 below.

Table 4.11 Qualitative questions, their responses, and themes of facilitators or barriers

Study	Questions	Theme of response	Facilitators	Barriers
Pre COVID-19 onset				
Horsham et al. (2020)	“Benefits of mobile teledermoscopy enhanced skin self-examination include?”	would benefit the rural underserved, a source of motivation that was easy to use.	The ease of use.	The underserved would need it more.
	“Issues with mobile teledermoscopy enhanced skin self-examination include?”	Unsure of lesions to photograph, needed assistance to operate dermoscope. The inconvenience of coupling and uncoupling attachments.	Feeling it was a good idea.	Lack of confidence. Technical Inconvenience.

Table 4.11 Qualitative questions, their responses, and themes of facilitators or barriers. (cont.)

Study	Questions	Theme of response	Facilitators	Barriers
Post COVID-19 onset				
Handa et al. (2021)	Subjective comparison of teledermatology vis-à-vis in-person visits?"	More patients felt in-person visits were better. Many patients did not have confidence problems can be handled via phone.	Nil	Preference for face-to-face visits.
Yadav et al. (2022)	Receiving Drs. Call. Buying medicine through a WhatsApp or SMS prescription. Quality of care.	Inconvenient timing, waiting for calls, no specific time for calls. Non-honoring of E-prescriptions. Doubts of care quality. inability to carry out medical procedures.	Prescription errors were avoided.	Inconvenient call timing, E-prescriptions were not acceptable. Quality of care is not the same as physical visits.
	Conveying problems to Dr., understanding his advice, and his understanding of the patient's problem	Limited consultation time, poor rapport, and inability to explain problems. Lack of confidence that the Dr. understands problems from pictures. yearning for video calls. Feels Dr. gives.	nil	Poor rapport. Lack of confidence in photographic assessment. Phone calls are not effective for communicating problems
	Clicking and sending photographs. Taking appointments.	Privacy issues for women, photos of hard-to-reach areas are difficult. Website keeps hanging	nil	Self-photography is difficult. Connectivity. Privacy for women.
	Taking appointments	Tedious and complex appointment booking process. Difficult for older individuals and those with low IT literacy.		Lack of IT literacy, Age
	Cost	Time-saving, increased productivity. The Higher cost of medications. No free medications	Reduced indirect cost.	Increased direct cost. Relative cost-effectiveness

Source: Researchers Computation, 2024

For the first post-onset study (Handa et al., 2021) the qualitative responses were obtained from patients who had experienced an in-person outpatient consultation before the pandemic, and a telemedicine consultation during the pandemic. This was a total of 1,914 patients of which 1,842 (96.2%) could be contacted for their subjective response. The second study (Yadav et al., 2022) conducted an elaborate structured interview.

4.1.8 Satisfaction data from domain-related questions

Table 4.12 below shows the different domains and the scores derived. The questions and where they can be found in the various questionnaires have been outlined in a Microsoft Excel sheet attached in the appendix titled "Questionnaire Comparison Domains". To do this, we picked the scores of questions that were close in meaning to each other and skewed toward specific domains of satisfaction and compared them.

Table 4.12 Satisfaction scores of different domains pre- and post-onset of the pandemic

Dimension/domain	**Study title (pre-pandemic)**	**% Satisfaction**	**Study title (post-pandemic)**	**% Satisfaction**
Cost/Finance	Wang et al. (2018)	100%	Weeraphorn & Sirithanabadeekul. (2023)	69.60%
Technical quality	Wang et al. (2018)	100%	Trinh et al. (2022)	92%
	Po (Harvey) Chin et al. (2020)	96%	Yadav et al. (2022)	92%
	Horsham et al. (2020)	70.4%	Weeraphorn & Sirithanabadeekul. (2023)	68.72%
			Damsin et al. (2023)	8.7/10
Continuity/reuse\	Wang et al. (2018)	100%	Yadav et al. (2022)	74.45%
	Po (Harvey) Chin et al. (2020)	94%	Weeraphorn & Sirithanabadeekul. (2023)	85%

Table 4.12 Satisfaction scores of different domains pre- and post-onset of the pandemic (Cont.)

Dimension/domain	Study title (pre-pandemic)	% Satisfaction	Study title (post-pandemic)	% Satisfaction
	Horsham et al. (2020)	71%	Trinh et al. (2022)	52%
			Damsin et al. (2023)	9.0/10
			Weeraphorn & Sirithanabadeekul. (2023)	77.09%
Interpersonal interactions	Wang et al. (2018)	96.4%		
	Po (Harvey) Chin et al. (2020)	94%	Yadav et al. (2022)	85%
			Trinh et al. (2022)	14% better, 67% same
Ease of use	Wang et al. (2018)	90.5%	Yadav et al. (2022)	77%
	Po (Harvey) Chin et al. (2020)	94%	Horsham et al. (2020)	54%
Impact on daily life	Wang et al. (2018)	100%	Yadav et al. (2022)	96%
	Po (Harvey) Chin et al. (2020)	95%	Handa et al. (2021) saved travel time.	135minutes
			Heidemeyer et al. (2023) Timesaving for consultation	1:21:39 hh:mm: ss

Source: Researchers Computation, 2024

Table 4.13 below shows the factors responsible for either facilitating or barring satisfaction that were retrieved from the study results, and discussions. They will be further elaborated on alongside the information retrieved from the qualitative responses.

Table 4.13 Factors facilitating or barring satisfaction from study results.

Study	Facilitating factors	Barring factors
Pre-COVID-19 onset		
(Wang et al., 2018)	Fast data transfer, images, and text are well displayed; the application starts promptly	None mentioned in the study

Table 4.13 Factors facilitating or barring satisfaction from study results. (Cont.)

Study	Facilitating factors	Barring factors
(Po (Harvey) Chin et al., 2020	Usability, technical quality. Fast transfer of results. Easy to use.	None stated
Gilling et al., 2020)	Faster response with less waiting time.	Not confident with diagnostic concordance compared to face-to-face encounters. Not comfortable with pictures of intimate areas e.g., genitals
(Horsham et al., 2020)	Motivation to carry out regular skin checks. Phone attachments are easy to use. High smartphone usage	Difficulty photographing hard-to-reach areas and selecting lesions. Difficulty capturing clear images and uploading, difficulty Coupling/uncoupling phone attachments.
Post- COVID-19 onset		
(Handa et al., 2021)	Diagnosis of fungal and ectoparasitic infections. Time saved traveling by road. Convenient and user-friendly WhatsApp application. Improved access to care.	Poor connectivity. Information technology illiteracy. Believe their condition cannot be managed over the phone. New and follow-up patients.
(Trinh et al., 2022)	Safer during the COVID-19 pandemic due to the ability to maintain social distancing. Reduced waiting time from 58 to 24 days. Assists Immobile patients.	New patients. Aged population.
(Yadav et al., 2022)	Time saved traveling to the hospital. Follow-up patients. Diagnosis of Urticaria and improvement of skin disease had a statistical association with satisfaction	Lack of confidence with photography diagnosis. Poor communication.
(Heidemeyer et al., 2023)	Follow-up patients. A lower incidence of side effects. Fast response from dermatologists. Less time spent on consultation.	None stated
(Weeraphon & Sirithanabadeekul., 2023)	SkinX app. is fast and convenient. Most patients were confident with skin doctors and most comfortable with the cost.	None stated
(Damsin et al., 2023)	Comfort with procedure. Trust in advice given via tele-consults. Faster response time. Convenience, easy implementation.	None stated

Source: Researchers Computation, 2024

Table 4.14 Satisfaction conclusions of included studies

Study title	Satisfaction conclusion
Pre - COVID-19 onset	
Wang et al. (2018)	"High satisfaction rate".
Po (Harvey) Chin et al. (2020)	Moleme is a highly acceptable and satisfactory tool among users.
Gilling et al., 2020	"Most participants reported being largely satisfied".
Horsham et al. (2020)	"Most participants were largely satisfied with mobile teledermoscopy".
Post – COVID-19 onset	.
Handa et al. (2021)	"Teledermatology is a valid alternative".
Trinh et al. (2022)	"Satisfaction was consistent with other studies".
Yadav et al. (2022)	"Satisfaction levels were generally high".
Heidemeyer et al. (2023)	Patient satisfaction did not change significantly over time and was generally quite high".
Weeraphon & Sirithanabadeekul (2023)	"Findings showed high patient satisfaction".
Damsin et al., (2023)	"Excellent satisfaction scores, stable between phases 1 and 2".

Source: Researchers Computation, 2024

4.2 Discussion

Introduction

In this section, we compared the included studies in three different ways. First, in section 4.2.i. We compared the study characteristics between the two periods using numbers from the study characteristics. Followed by a comparison of the general satisfaction scores in percentages in section 4.2.ii, and finally, in 4.3. iii we compared

the different factors responsible for satisfaction or dissatisfaction pre- and post-onset of the COVID-19 pandemic.

4.2.1 Comparison of the study characteristics between the two periods.

The four studies before the onset of the pandemic all used the store and forward method of teledermatology delivery, while two-thirds of the studies in the post-onset period used the hybrid method of teledermatology delivery showing a possible switch to the use of the hybrid method during the pandemic. A previous review (Hadeler et al., 2021) has ascertained that in periods before the pandemic, most studies, and probably users focused more on the SF method of teledermatology delivery.

We found only one study pre-onset of the pandemic (Wang et al., 2018) that used mobile devices for general dermatologic diseases. The remaining three studies were for skin cancer triage (Po (Harvey Chin et al., 2020; Horsham et al., 2020; Gilling, Mortz, & Vestergaard, 2020). In contrast, for the post-pandemic onset period, one-third of the studies were for skin cancer triage, half were for general dermatologic diseases, and one study (Heidemeyer et al., 2023) focused on acne. This shows that there could have been an increased use of mobile devices for general teledermatology consultations as an alternative to nearly impossible face-to-face encounters.

Pre-onset of the COVID-19 pandemic, three of the studies found used the patient direct-to-dermatologist level of teledermatology (Wang et al., 2018; Po (Harvey Chin) et al., 2020; Horsham et al., 2020), while one (Gilling et al., 2020) used the secondary level of interaction. Post-onset of the pandemic, there was an equal distribution of half of the studies for the level of patient direct to a dermatologist, while the other half used the secondary level of interaction.

All included studies for the pre-onset of the pandemic period were cross-sectional surveys. One study among them (Horsham et al., 2020), was a cross-sectional survey of patients randomized to teledermatology in a trial. Post-onset of the Pandemic, one study (Heidemeyer et al., 2023), was a randomized open-label controlled trial. It

was also the only study that involved follow-up of a pre-diagnosed condition, Acne vulgaris, and the only study that utilized the visual analog scale to measure satisfaction. All other studies post onset of the pandemic were cross-sectional studies and they measured satisfaction using questionnaires. Two studies post-onset of the pandemic (Weeraphorn & Sirithanabadeekul, 2023; Damsin et al., 2023) measured the satisfaction of patients and physicians alike.

4.2.2 General satisfaction scores comparison.

The primary aim of this systematic review was to compare the satisfaction of patients with teledermatology delivery using mobile devices before and after the onset of the COVID-19 pandemic. There is no standard set percentage of satisfied participants to determine or compare and state categorically that patients were generally satisfied with a study. Different studies have different set parameters (Hadeler et al., 2021).

To carry out this comparison, we extracted satisfaction scores in percentages from the general satisfaction questions within the questionnaires of studies that had such questions. From our study characteristics, eight articles had a question that measured the general satisfaction of the patients within their questionnaires. Seven of these studies either represented the scores as percentages or gave the number of patients' responses from which the percentage of general satisfaction could be calculated. The data on studies and their number of satisfied respondents/percentages can be found in an attached Microsoft Excel sheet titled "Satisfaction scores" in Appendix B.

A total of three studies pre-onset, and four studies post-onset of the pandemic period met the above criteria. The studies that did not meet the criteria are presented with reasons below.

a. Horsham et al. (2020) used a questionnaire but did not have a general satisfaction question.

b. Damsin et al. (2023) had a general satisfaction question, However, they did not measure satisfaction in percentages, rather they used a score out of ten.

c. Heidemeyer et al. (2023) used an eleven-point visual analog scale to measure general satisfaction.

For the seven studies that had general satisfaction questions in percentages, we must point out that their questionnaires were not homogenous even when they measured satisfaction within similar domains. For example, two studies,(Wang et al., 2018; Po (Harvey) Chin et al., 2020) both measured satisfaction within four domains but with different numbers and types of questions. Also, the potential for different types of bias in the studies should be noted.

It was not possible to pool studies as stated in Chapter 3 section 3.4. The pooling decision tree (Morton et al., 2018) was utilized to come to this conclusion. Studies could be identified that were methodologically similar but not clinically similar. For example, two of the pre-COVID onset studies (Wang et al., 2018; Po (Harvey Chin) 2020) are both cross-sectional satisfaction studies from the same country. However, they presented two completely different clinical scenarios with the former involving consultation, diagnosis, and treatment while the latter involved triage of patients for skin cancer. Likewise, different studies utilize different technologies and communication interfaces e.g., android OS (Trinh et al., 2022), apple iOS (Wang et al., 2018), and dermatoscopes (Gilling et al., 2020). Additionally, the questionnaires/tools to measure satisfaction were significantly different in question type number of questions, and domains/dimensions measured.

The general satisfaction scores between the two periods are presented using percentages in Figure 4.2 below.

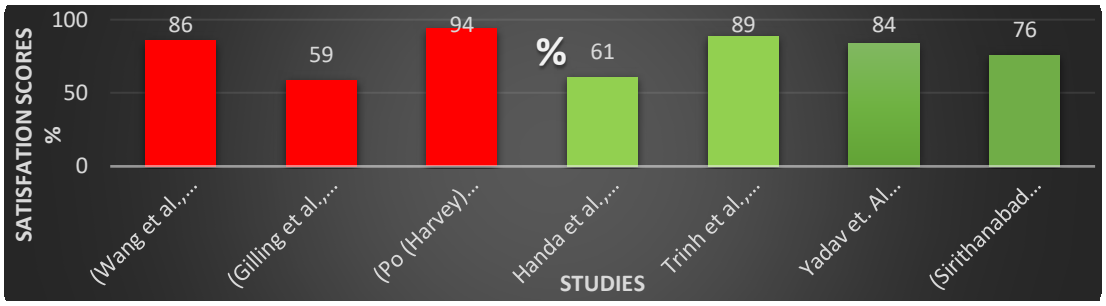

Figure 4.2 Chart of general satisfaction scores

Source: Researchers Computation, 2024

Legend y-axis = satisfaction scores
x-axis = studies

The range of general satisfaction scores before the COVID-19 onset spanned from 59% to 94% (lowest to highest score), whereas post-COVID-19 onset ranged from 61% to 89% (lowest to highest score).

It cannot be categorically stated that there is a significant difference or stability in the satisfaction scores between the pre- and post-pandemic onset periods based on this range of scores. A possible explanation might be the small number of eligible studies. The observed wide range of scores pre-onset of the pandemic might be due to the variability of experiences and opinions among the respondents.

One of the included studies (Damsin et al., 2023) utilized a general satisfaction question, albeit with scores presented as fractions rather than percentages. This study, conducted in two phases before and after the COVID-19 pandemic onset, demonstrated stable satisfaction scores throughout both phases: Factors contributing to positive satisfaction in this study included faster response times, convenience, and confidence in teleconsult advice provided via mobile teledermatology. Notably, no factors negatively impacting satisfaction were mentioned in this study, however, we note that this study has a high risk of bias from our checklist assessments.

Pre-onset of the COVID-19 pandemic, the highest score of 94% was seen in Po (Harvey) Chin et al. (2020), concerning skin cancer triage using a dermatoscope and aided by artificial intelligence; see Table 1. The factors that impacted positive satisfaction in this study included fast transmission of results, and reliable connectivity, which was also responsible for fast data transfer, as also seen in another study pre-pandemic onset (Wang et al., 2018), with a general score of 86%, and ease of use. The fast transfer of results was also emphasized in two other pre-pandemic onset studies (Wang et al., 2018; Gilling et al., 2020), thus buttressing the importance of speed in enhancing patient satisfaction. There were no factors responsible for dissatisfaction stated in this study and likewise (Wang et al., 2018); see Table 2.

The study with the lowest score of 59% pre-onset of the COVID-19 pandemic (Gilling et al., 2020) also involved skin cancer triage using a dermatoscope without the aid of artificial intelligence; see Table 1. Factors negatively affecting satisfaction were a lack of confidence in the diagnostic concordance between teledermatology and face-to-face consultations and privacy concerns with photography, especially of genital areas; see Table 2.

Post-onset of the COVID-19 pandemic, the study with the highest score of 89% (Trinh et al., 2022) also involved the use of a dermatoscope and an artificial intelligence-based application for skin cancer triage, as seen in Table 1. Factors positively affecting satisfaction, as detailed in the study, were related to the safety provided by teledermatology during the pandemic, reduced waiting time, and its ability to assist immobile patients. There were no factors mentioned to significantly reduce satisfaction, as indicated in Table 2. In another study (Yadav et al., 2022) with a score of 84%, factors positively affecting satisfaction included the ability to save time for patients and the type of diagnosis made using mobile teledermatology.

The study with the lowest score of 61% post-onset of the pandemic involved general dermatology diseases (Handa et al., 2021). Factors such as poor connectivity, a lack of information technology literacy, and a lack of confidence in photographic diagnosis and management negatively affected satisfaction. Another study post-pandemic onset (Yadav et al., 2022) cited inconvenient call timing, poor rapport, lack of confidence in diagnostic concordance with face-to-face consultations, connectivity issues, privacy concerns, lack of information technology literacy, and increased direct costs as factors that negatively impacted patient satisfaction.

We did not find any other reviews that compared the satisfaction scores of respondents accessing teledermatology specifically via mobile devices over a period. Therefore, we do not have previous studies to compare with. From the general study conclusions in Table 4.14, we can infer that most of the respondents across the included studies were satisfied with teledermatology using mobile devices pre- and post-onset of the COVID-19 pandemic. This has been a general trend across satisfaction with

teledermatology with most studies reporting patients being satisfied (Hadeler et al., 2021)

We also note that the study with the highest score post-pandemic onset (Trinh et al., 2022) had a high risk of bias from our checklist assessments. For the remaining three studies excluded from the comparison above, their findings are presented separately below.

Pre-onset of the COVID-19 pandemic the study by Horsham et al. (2020) used a three-question Likert scale and four additional binary questions. For ease of use of the dermatoscope attachment, 91.8% of participants were satisfied. For regular motivation, which we considered as an impact on daily life, 66.3% were satisfied. For the ease of conducting a whole-body exam (ease of use), 54% of participants were satisfied.

Post-onset of the COVID-19 pandemic the study by (Damsin et al., 2023) reported a global satisfaction score of 8.8/10 for the initial pilot phase which falls within the pre-onset period from September 2016 to May 2017, with sixteen participants, and six PHCs which were all close to a tertiary center. For the second phase, a score of 8.9/10 was reported. This phase fell into post- onset period from September 2020 to August 2022, with 64 participants and nine PHCs of which three of the PHCs were distant from the tertiary center. The difference in the satisfaction scores between the pilot phase and the final phase was 0.1 despite the difference in the number of participants and distance from the PHCs. We note that from our checklist assessments, this study had a high risk of bias.

The other study (Heidemeyer et al., 2023) reported no significant change in the visual analog scale score for satisfaction over six months for patients accessing teledermatology via a mobile device. An important aspect of the study was that all the patients had an initial face-to-face encounter before being randomized into their different interventions for monitoring and follow-up. This is significant to us because another study that we included (Yadav et al., 2022) which had follow-up patients also had higher satisfaction scores compared to a study with a similar methodology, in the

same country and region during the same period which involved both follow-up and new entrants.

4.2.3 Factors affecting satisfaction from study results and Discussions

The second objective of this review was to identify the factors pre- and post-onset of the COVID-19 pandemic that affected satisfaction with the use of mobile teledermatology. We outlined these factors concerning the different domains of satisfaction and made a comparison of the factors that affected the satisfaction of respondents between the two periods.

In comparing the two periods, we must acknowledge that these studies have differences in methodology, setting, number of respondents, patient demographics, and other factors that could affect satisfaction, apart from their different levels of Risk of Bias. Their similarity is based on the use of mobile devices, teledermatology, and satisfaction measurement using questionnaires. Below are the comparisons of the various factors pre- and post-onset of the pandemic

4.2.3.1 Technical quality

Pre onset of the Covid-19 pandemic, the domain of technical quality showed identifiable factors positively affecting satisfaction, such as fast transfer of images, and mobile applications with a good interface (Wang et al., 2018: Po (Harvey) Chin et al., 2020: Horsham et al., 2020). Post-pandemic onset, the fast and convenient nature of the teledermatology application was applauded by respondents (Weeraphorn and Sirithanabadeekul., 2023). However, the technical issue of connectivity contributed to the dissatisfaction of some individuals (Handa et al., 2021; Yadav et al., 2022). Some respondents found it complex to book appointments, pointing to the possibility of a difficult interface (Yadav et al., 2022). These negative impact could be attributed to an increased number of individuals post-pandemic onset using mobile devices (Handa et al., 2021), possibly straining such services and leading to poor bandwidth, which could affect the seamless utilization of the LI modality (Lee et al., 2018; Santiago & Lu, 2023)

which is stated to have seen more use post-pandemic onset (Santiago & Lu, 2023) as compared to the pre-pandemic onset period (Hadeler et al., 2021). An interesting point to note was that pre- and post-pandemic onset, studies incorporating artificial intelligence into applications (Po (Harvey) Chin et al., 2020; Trinh et al., 2023) to aid diagnostic capability had higher general satisfaction scores.

Technological ability can be a factor of age, and technical difficulties are directly linked to dissatisfaction with teledermatology as has been highlighted in an updated review on teledermatology which attributed the existence of a digital divide between individuals based on demographics, and digital literacy as inhibitors to access which leads to differences in the levels of utilization.

As seen in Table 4.1.2, most of the studies considered the technological domain of mobile teledermatology as should be for telemedicine satisfaction assessment (Langbecker et al., 2017).

4.2.3.2 Ease of use/usability

Pre-pandemic onset, the domain of ease of use positively impacted satisfaction, with easy-to-use mobile attachments for photography (Po Harvey Chin et al., 2020; Horsham et al., 2020), and overall ease of application usage, especially when younger patients were involved (Wang et al., 2018). Conversely, factors related to ease of use negatively affected satisfaction for some individuals, particularly difficulties in photographing hard-to-reach areas, capturing clear images, and uploading them, as well as challenges attaching and detaching phone accessories (Horsham et al., 2020). Following the pandemic onset, the ease of implementation of mobile interventions (Damsin et al., 2023) and the alleviation of patient responsibility for photography (Trinh et al., 2022) positively impacted satisfaction.

Despite no significant association found between age and satisfaction both in the pre-onset (Wang et al., 2018) and post-onset (Yadav et al., 2022) of the pandemic periods, it remains a factor to consider as seen with younger age groups demonstrating

a higher likelihood of utilizing mobile teledermatology due to greater familiarity with mobile phones (Mu et al., 2021), this as seen in another pre-pandemic study with individuals who had high prior usage of smartphones, more likely to prefer teledermoscopy (Gilling et al., 2020). This contrasts with a study post-pandemic onset where it was stated that older individuals might not be conversant with new technology (Handa et al., 2020) because they find it complex and difficult to use (Yadav et al., 2022). Conversely, older individuals may find new technology complex (Yadav et al., 2022), potentially affecting satisfaction. Previous research has indicated that older individuals' satisfaction may be hindered by their lack of IT proficiency (Garfan et al., 2021), with technological challenges directly linked to dissatisfaction with teledermatology (Santiago & Lu, 2023). However, Trinh et al.'s (2023) study, primarily comprising elderly individuals, reported high satisfaction, likely attributed to the method of teledermatology delivery employed, underscoring the importance and interconnectedness of various satisfaction domains.

It should be noted that ease of use does not always translate to satisfaction as other aspects relatable to the technological quality can affect it, this is as seen with respondents satisfied with the ease of use of a phone attachment, but in the same study, only over half were satisfied with taking pictures using the same attachment (Horsham et al., 2020). This once more shows that various aspects of the utilization of mobile devices can affect the level of satisfaction with them.

4.2.3.3 Cost/Finance

The domain of cost/finance was found to positively affect satisfaction pre-onset of the pandemic (Wang et al., 2018). However, post-onset of the pandemic, there was apparent dissatisfaction with the associated cost (Weeraphorn & Sirithanabadeekul, 2023); This can be attributed to the different geographical locations, and demographics of the respondents in both studies, with possible marked differences in income especially as satisfaction with teledermatology has been opined to have a relationship with socioeconomic status (Santiago & Lu, 2023). The negative impact of cost was associated with the fact that patients had to purchase medications at higher rates closer

to their homes, which would have been available for free in hospitals (Yadav et al., 2022). Additionally, due to the lockdowns, they had to rely on delivery services to access such medications, leading to additional costs, thus negating the expected direct cost reduction associated with telemedicine (Lee et al., 2018). Moreover, the non-honouring of e-prescriptions by drug dispensaries would have exacerbated the situation for patients, forcing them to travel and spend more on transportation to find a pharmacy willing to honour such prescriptions.

4.2.3.4 Interpersonal interactions

The domain of interpersonal interactions positively impacted satisfaction pre-pandemic onset, with ease of communication between patients and providers noted as a contributing factor (Wang et al., 2018). However, post-pandemic onset, respondents highlighted several factors that affected interpersonal interactions negatively, including hurried consultations, difficulty articulating concerns over the phone, apprehension about the understanding of concerns, and lack of continuity due to new providers for each follow-up consultation (Yadav et al., 2022) which can be attributed to non-synergy with electronic or physical medical records resulting in fragmentation of care and dissatisfaction (Chuchvara et al., 2020). Particularly, respondents expressed dissatisfaction with voice phone calls for hybrid visits, suggesting that a video component would enhance satisfaction by providing a pseudo-physical presence during encounters, a factor previously associated with improved satisfaction in teledermatology (Santiago & Lu., 2023).

The preference for in-person visits as seen post-pandemic onset (Handa et al., 2021) with the considerations that quality of care was not comparable to in-person visits, lack of confidence in photographic assessments, and the preference for teledermatology only during the COVID-19 pandemic (Yadav et al., 2022), although not peculiar to only that period as same was noted in studies before the pandemic (Hadeler et al., 2020). A rough comparison of the domain scores for interpersonal interactions shows a range of 94 - 96% pre-pandemic onset, compared to 14 - 85% post-pandemic onset. The lowest score obtained during the post-pandemic period (Trinh et al., 2023) concerned the

ability to connect with a dermatologist and make inquiries in comparison to an in-person interaction, only 14% of respondents felt it was better, 67% did not see a difference, and 19% felt it was worse. In contrast to this, 39% of respondents in the same study felt better about the quality of the initial assessment which involved taking pictures by trained personnel. The respondents in this study were satisfied with the physical part probably because the burden of self-photography had been taken off them, and they had a physical presence of the photographers, but were dissatisfied with the online aspect which was part of the hybrid process, showing the preference for a physical presence, and further supports the multidimensionality of satisfaction with different aspects of an intervention (Ofili, 2014).

Although no statistical relationship was explored regarding the impact of follow-up or new patients on satisfaction, studies conducted both pre- and post-pandemic onset revealed that populations consisting mainly of follow-up patients reported higher general satisfaction scores (Wang et al., 2018; Yadav et al., 2023; Heidemeyer et al., 2023) compared to those including new patients as well (Handa et al., 2021). This trend aligns with findings from a recent review, which suggests that satisfaction may be linked to the thoroughness of a physical examination, often only achievable during an initial in-person encounter (Santiago & Lu., 2023). Therefore, the higher satisfaction observed among follow-up patients may be attributed to the already-established rapport and the initial "personal touch" experienced during previous interactions.

4.2.3.5 Impact on daily life

The domain of impact on the daily lives of respondents was observed in the factor of time, which was a common consideration across both periods. Both the response time and the time-saving attributes of mobile teledermatology were influential. The swift response time was seen to enhance satisfaction pre-and post-onset of the pandemic, (Wang et al., 2018; Damsin et al 2023; Heidemeyer et al., 2023; Weeraphorn & Sirithanabadeekul, 2023). Post-pandemic onset, the time saved traveling to the hospital (Handa et al., 2021; Yadav et al., 2022), longer duration of consultations

(Heidemeyer et al., 2023), and shorter waiting times (Trinh et al., 2022) positively impacted satisfaction.

The post-pandemic onset period saw an increased number of patients registering for teledermatology care (Handa et al., 2021; Yadav et al., 2022). However, without sufficient time for proper planning on how to handle the increased load and schedule consultations, complaints of prolonged waiting times for doctor calls may have arisen, a factor known to negatively impact patient satisfaction (Gong et al., 2022). Additionally, the inconvenient timing of the calls would further exacerbate this negative impact on satisfaction (Yadav et al., 2022). Also considering the increased use of the LI method of teledermatology (Santiago & Lu, 2023) which has the disadvantage of less flexibility, and therefore more difficulty scheduling appointments.

Improvement in skin disease through teleconsultations post-onset of the pandemic increased satisfaction with teledermatology a factor which shows that the usefulness of teledermatology to individuals is reassuring only when a disease is improving (Yadav et al., 2022). If not, a switch to face-to-face becomes pertinent.

4.2.3.6 Efficacy

The domain of efficacy encompassed factors related to confidence in lesion selection for self-photography in skin cancer triage, which negatively impacted satisfaction pre-pandemic onset, mainly due to concerns about sending incorrect lesions for assessment and potentially missing problematic lesions (Horsham et al., 2020). Lack of confidence in photographic diagnosis was a recurring factor both pre- (Gilling et al., 2020) and post-pandemic (Handa et al., 2021; Yadav et al., 2022). This underscores the issue of diagnostic concordance which has been extensively studied and found to be comparable with in-person diagnosis (Lamel et al., 2012; Ebner et al., 2008) and is known to physicians, however, the patients do not have such knowledge and would have doubts.

Post-onset of the pandemic, a significant association was found between positive satisfaction and the diagnosis of urticaria, as well as in patients experiencing improvements in their skin conditions or treatment changes via teledermatology (Yadav et al., 2022). Higher satisfaction scores were noted in patients with acne, fungal, and ectoparasitic infections (Handa et al., 2022), likely because they are easier to diagnose via telemedicine.

4.2.3.7 Other factors

Other factors identified include privacy concerns arising from the necessity to photograph intimate areas, which negatively affected satisfaction both pre- (Gilling et al., 2020) and post- (Yadav et al., 2022) pandemic onset, particularly for women. This concern was previously observed, with a higher percentage of women expressing reservations about sending photographs of intimate areas (Kaliyadan et al., 2013) for both cultural and religious reasons. An important motivation for using teledermatology was the fear of contracting the COVID-19 virus, as telehealth ensured social distancing and facilitated access to care for immobile patients (Trinh et al., 2022).

One of the most important factors that motivated individuals to use teledermatology was the fear of contracting the COVID-19 virus as the use of teledermatology ensured social distancing and assisted immobile patients in accessing care (Trinh et al., 2022).

Mobile phone messaging applications are widely used and have a wide reach. As we have seen they can be readily deployed in times of need to achieve a level of dermatologic care that can be satisfactory, and medical applications can be incorporated into them to enhance their usability for dermatology care delivery. They can be used for telephony, video calls, and store and forward making it easier to surmount connectivity issues by switching from one modality of delivery to the other within the same application.

Chapter 5

Conclusion and recommendations

5.1 Conclusion

In conclusion, both pre- and post-onset of the COVID-19 pandemic, patients generally expressed satisfaction with teledermatology utilizing mobile devices. Factors contributing to positive satisfaction pre-pandemic onset included rapid transmission of results, prompt response times, and dependable connectivity. Conversely, post-pandemic onset, issues such as connectivity challenges, application complexity, age-related barriers, IT literacy, communication difficulties, fragmented care, cost concerns, and gaps in the health value chain were identified as contributors to diminished satisfaction. Common factors influencing satisfaction across both periods included follow-up patient care, time efficiency, challenges with self-photography, and extensive mobile phone usage.

Most of the factors affecting satisfaction with the use of mobile devices we found could be attributed to teleconsultations and teledermatology in general.

5.2 Recommendations

The recommendations proposed are based on both the findings from our search and our final analysis of the studies. We present the recommendations in three groups below.

5.2.1 Further research for teledermatology

a) There needs to be a generalized standard questionnaire to measure satisfaction with teledermatology that will cover the technical quality of the technology used e.g., camera quality, screen interface, and application complexity used.

b) Questionnaires should be standardized to be converted into different formats from different regions of the world, taking into cognizance regional, cultural, and demographic indices.

c) Satisfaction studies should be done based on domains with a general satisfaction question to enable comparisons.

d) There should always be a qualitative assessment in satisfaction studies, as it gives insight into the reasons for dissatisfaction.

e) There should be an acceptable percentage of patients satisfied with a service before classifying an intervention as satisfactory or not.

f) Further research should be carried out to find out if follow-up patients who have experienced face-to-face consultations before teledermatology are more satisfied than those who have not experienced face-to-face before teledermatology.

5.2.2 Improving the teledermatology consult system using mobile devices.

a) Mobile phones/smartphones are useful as a readily deployable tool for teledermatology, however, there is a need for synergy with electronic records to reduce fragmented care.

b) The hybrid delivery method should be used with mobile devices wherever possible to include a video visit. Telephony visits alone are not satisfactory.

c) There is a need to further streamline the process of teledermatology using mobile devices to include all aspects of the medical value chain to reduce difficulty for patients from the non-honoring e-prescriptions.

d) A simple patient interface for mobile devices should be used to improve the ease of accessing care through them.

e) Mobile chat applications can be improved to have features that can connect directly with teledermatologists, with strong considerations for patient data safety.

f) Mobile application developers and mobile phone manufacturers should be encouraged to ensure that applications for medical purposes can be used across different operating systems to ensure general accessibility.

5.2.3 Factors responsible for satisfaction

a) During non-disaster or pandemic periods, teledermatology should ideally be used for follow-up patients so that a proper assessment and establishment of rapport can be done at the initial face-to-face meeting while monitoring and follow-up can be done via teledermatology. except in situations where distance to care is a factor.

b) A standardized protocol for training physicians on how to conduct consultations via teledermatology should be carried out.

5.3 Limitations

5.3.1 limitations for the included evidence.

a) Small sample size of studies utilizing mobile devices for dermatology care.

b) Non-homogeneity of studies making pooling difficult, and comparisons difficult.

c) Different questionnaire modifications with different questions measuring the same domains of satisfaction.

d) Non-specification within studies on the type of technology used to deliver teledermatology. therefore, excluding such studies.

e) Most studies are questionnaire studies which are already methodologically prone to bias of unknown magnitude due to haphazard sampling methods [22].

f) Studies did not give the direct effects of mobile devices with satisfaction concerning the interface, camera capabilities, and other technological aspects.

5.3.2 Limitations of the review process.

a) Location bias, due to the inability to retrieve all studies identified from the initial search and no response after attempting communication with some authors.

b) Limited period for comparison as the period post onset of the pandemic had to end by March 2023, after which more studies about the subject during the pandemic could have been published.

c) No previous primary or secondary studies comparing satisfaction with teledermatology using mobile devices between two time periods, making it difficult to compare with known evidence.

5.4 Implications for Policy, Research, and Practice.

This review has implications for policymakers because it highlights some of the issues with emergency utilization of non-standardized methods of medical, and indeed dermatologic care delivery in situations where they must be deployed on a large scale. We could see lower satisfaction scores across the different domains in the post-pandemic period compared to the pre-pandemic period. It would be important to look at these factors and encourage/sponsor more research into fine-tuning the use of mobile devices and the inherent advantages they come with by legislation mandating streamlining of such devices, and their applications to have a digital handshake with electronic medical records, pharmaceutical chains, and other medical value chain components. This is to enable seamless deployment in times of disaster as seen during the pandemic.

For research, standardization of satisfaction questionnaires should be done, and any questionnaire that does not follow a standard protocol should generally not be accepted for publication of its findings as it will make it difficult to compare, contrast, and pool studies if need be. Questionnaires measuring satisfaction can ideally be divided into domains and culturally appropriate questions utilized. Additionally, the role of qualitative research to find out subjective feelings should be stressed for satisfaction research.

For practitioners, such factors as elucidated that can lead to satisfaction, and dissatisfaction that mostly deal with interpersonal relations should be considered. A healed and satisfied patient always wants the same practitioner, even though fatigue from seeing a larger number of patients via a modality a physician is not used to can lead to dissatisfaction on his part which is transferrable to patients. Therefore, there is a

need to incorporate teledermatology practice for routine training so it would be easier to shift in times of need on a large scale.

5.5 Protocol amendments.

The following amendments were made to the protocol.

a) Screening stage 3 was reversed for screening stage 4 and vice versa. This was done so that the studies that were to be put forth for checklist screening for risk of bias and study quality would be those that we are sure to be included.

b) Addition of the JBI checklist to accommodate for cross-sectional survey which formed the bulk of studies.

c) The date of commencement of the post-pandemic studies from March 2nd, 2023, not March 1st, 2023, as earlier proposed. To avoid studies that would fall on the same day and create confusion on which period to place a study.

d) Inability to pool studies and make comparisons using general satisfaction and comparison based on domains.

e) Microsoft Excel for the creation of characteristics of the studies table. And comparative tables.

f) Removal of the GRADEpro application.

g) Comparing general satisfaction and domains of satisfaction.

h) Non-exclusion of studies based on Risk of Bias.

There are no conflicts of interest or competing interests in this review.

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APPENDICES

APPENDIX A

Search Strategy Explanation

Search strategy explanation

SPIDER	Exclusion criteria	Explanation	Inclusion criteria	Explanation
Sample	Studies not relating to or including patients.	This systematic review will focus on only patient satisfaction.	Studies relating to and including patients.	Only the satisfaction of patients will be considered for comparison between the two periods.
	Studies commenced and concluded before March 1st, 2017. i.e., Studies commenced and completed before this start date, then published after the date will not be considered.	The pre-covid period will be considered to commence from March 1, 2017, to March 1, 2021. i.e., 3 years before the onset set of the COVID-19 pandemic.	Studies after March 1st, 2017, to March 1st, 2021.	Studies to be included for the pre-onset period should have been completed and published between the 1st of March 2017 to the 1st of March 2021. Three years before the Official declaration of COVID-19 as a pandemic by the WHO
		The post onset of COVID-19 period will be considered from March 2nd, 2021, to March 1st, 2023. Due to constraints of time and resources for translation, studies not in the English language will have to be excluded.	Studies from March 2nd, 2021, to March 1st 2023	Studies to be included for the post-onset period should have commenced after March 2nd, 2021, to have been completed before March 1st, 2023, even if published after the end date. Three years after the official

				declaration of COVID-19 as a pandemic by the WHO.
Phenomenon of Interest	Studies not using mobile devices or their applications to access dermatology care.	Mobile devices that cannot access the internet via mobile networks, or not handheld. If handheld, e.g. laptops because they mostly access the internet via LAN or WIFI only. And can utilize full software computer programs not just mobile applications. Studies using mobile devices for other purposes apart from triage, consultation, diagnosis, treatment, monitoring, and follow-up.	Studies using mobile devices and their applications to access dermatology care.	mobile phones, smartphones, tablets, and mobile applications. Apple, android, and Microsoft operating systems. Devices that have functionality for calls via mobile networks and the internet. Have the capacity for video calls, chat applications, and E-mail. Mobile applications dedicated to dermatology delivery will also be considered. Studies using mobile devices for triage, consultation,

				diagnosis, treatment, monitoring, and follow-up.
Design	Letters to the Editor without any specific methodology or study design.	Studies designated as letters to the Editor without a specific methodologic design or use of standardized or acceptable measurement tools.	Techniques/tools used to gather satisfaction data i. Questionnaires ii. scales e.g. Visual analog scale, iii. focused groups iv. interviews v. observations	Studies measuring patients' satisfaction with mobile devices for teledermatology using different standardized tools to measure satisfaction whether qualitatively or quantitatively.
Evaluation	Studies measuring other aspects of patient care with mobile devices e.g. DLQI. Technology acceptance.	The review aims to detail satisfaction as an evaluation, how it's measured and the factors affecting it.	Satisfaction	Studies measuring patient satisfaction, and dissatisfaction. Nonsatisfaction. Either as a primary or secondary outcome of the study.
Research type	i. Studies without a measure of satisfaction, whether quantitatively, qualitatively, or mixed. ii. systematic reviews.	i. studies without any measure of satisfaction. ii. Studies in which participants did not experience mobile devices for teledermatology care.	Qualitative, quantitative, mixed	All primary quantitative, qualitative, or mixed, research/ surveys on patient satisfaction with mobile devices only used for dermatology care will be sought.

Source: Researchers Computation, 2024

2. Database Search and Identification stage

2.1. PubMed

2.1.1 Initial search

("telemedicine"[Mesh] OR Telemed*[tiab] OR Teledermatology*) AND (patient satisfaction [tiab] AND (dermatology [Mesh] OR dermatology[tiab] OR skin[tiab])

Number of articles = 48 articles

Dates = from 1/3/2017 to 1/3/2023

2.1.2 Expanded search using advanced search combining keywords.

(((((((teledermatology [Title/Abstract]) OR (telemed* [Title/Abstract])) OR (smartphone [Title/Abstract])) OR (cellphone [Title/Abstract])) OR ("mobile application" [Title/Abstract])) OR ("store and forward"[Title/Abstract])) OR ("mobile health"[Title/Abstract])) AND ("patient satisfaction"[Title/Abstract])) AND ((skin [MeSH Terms]) OR (dermatology [MeSH Terms]))

Number of studies = 8 studies

Dates= from 1/3/2017 to 1/3/2023

2.1.3 Expanded search to include COVID–19 OR SARS-Cov-2.

("telemedicine"[Mesh] OR Telemed*[tiab] OR Teledermatology*) AND (patient satisfaction [tiab] AND (dermatology [Mesh] OR dermatology[tiab] OR skin[tiab]) AND ("COVID-19"[Mesh] OR SARS-CoV-2"[Mesh] OR COVID*[tiab]

Number of studies = 14 studies

Dates= from 1/3/2017 to 1/3/2023

Noted = All the above studies were already duplicates in the 1st search.

Search including keywords quantitative and qualitative did not yield any results.

2.2 COCHRANE

The advanced search function was used to search the Cochrane library using mesh terms and titles, abstracts, and keywords. With limits between 1st March 2017 and 1st March 2023. The search string is as depicted in the picture and further explained below:

The initial search was a combination of rows, #6, #9, and #16 (#6 AND #9 AND #16) which gave a total of 24 trials. As marked black in the picture.

The second search was a combination of rows #6, #28, #9, and 16 (#6 AND 28 AND #9 AND #16). As marked with red in the picture. The individual keywords are as depicted in the picture. A clearer explanation will be given.

2.2.1 Initial search

MeSH descriptor: [Telemedicine] explode all trees OR (telemedicine): ti,ab,kw OR (*telemed):ti,ab,kw OR (teledermatology):ti,ab,kw AND MeSH descriptor: [Patient Satisfaction] explode all trees OR (patient satisfaction):ti,ab,kw AND MeSH descriptor: [Dermatology] explode all trees OR ("dermatology"):ti,ab,kw OR MeSH descriptor: [Skin] explode all trees OR (*skin):ti,ab,kw

2.2.2 Expanded search.

MeSH descriptor: [Telemedicine] explode all trees OR (telemedicine):ti,ab,kw (*telemed):ti,ab,kw OR (teledermatology):ti,ab,kw AND MeSH descriptor: [Smartphone] explode all trees OR smartphone):ti,ab,kw AND MeSH descriptor: [Cell Phone] explode all trees OR (cell phone):ti,ab,kw (Word variations have been searched) OR MeSH descriptor: [Mobile Applications] explode all trees OR (mobile application*):ti,ab,kw OR (store and forward*):ti,ab,kw AND MeSH descriptor: [Patient Satisfaction] explode all trees OR (patient satisfaction):ti,ab,kw AND MeSH descriptor: [Dermatology] explode all trees OR ("dermatology"):ti,ab,kw OR MeSH descriptor: [Skin] explode all trees OR (*skin):ti,ab,kw

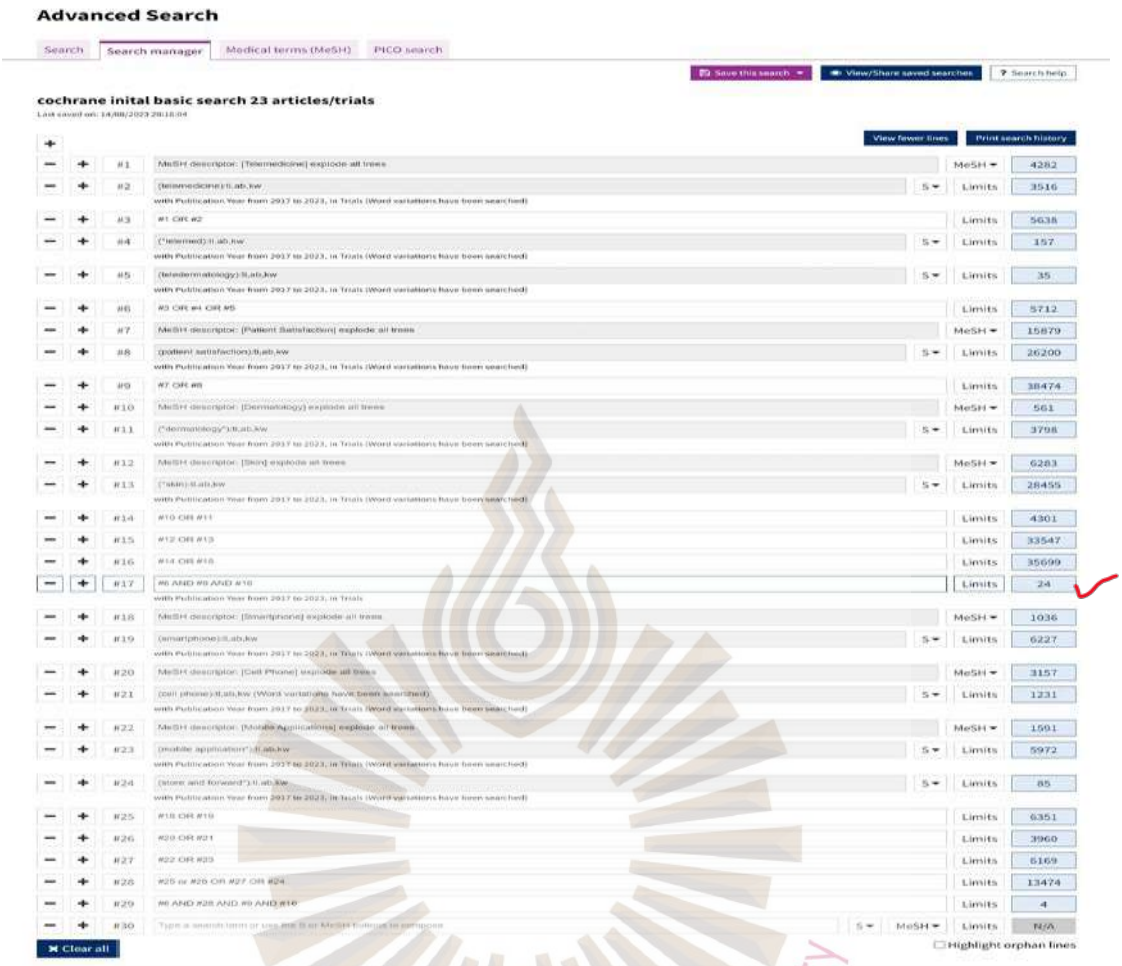


Figure 1 Cochrane search

Source: Cochrane Library, 2024.

2.3 CINAHL

The advanced search function was used to conduct a Boolean /phrase search of the CINAHL database. The search was edited to find all search terms and apply equivalent subjects and, all publication types within the time frame of 1/3/2017 to 1/3/2023.

The initial search yielded a total of 22 articles as seen in the picture below (S7 AND S4 AND S8).

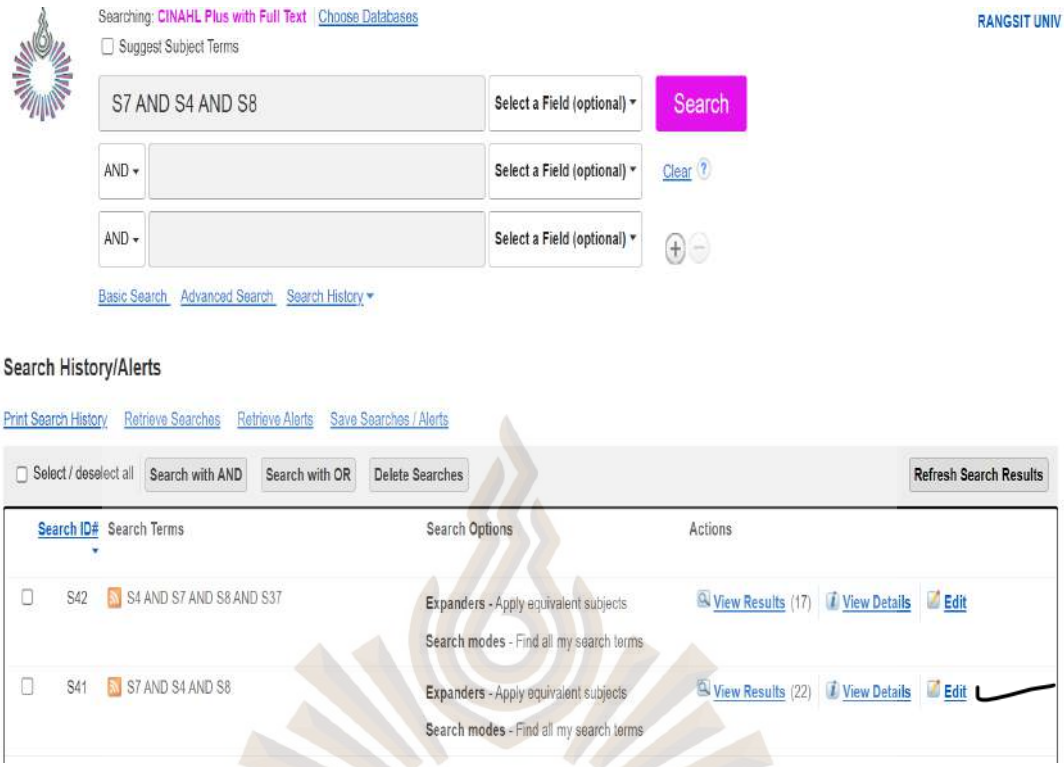


Figure 2. CINAHL initial search.

Source: Cochrane database, 2024.

2.3.1 Initial search

(MM "Patient Satisfaction+") OR "patient satisfaction" AND (MM "Telemedicine+") OR "telemed*" OR "teledermatology" AND (MM “Dermatology) OR “dermatology” OR (Skin+”) OR “skin”

2.3.2 Expanded search

S81 AND S84 AND S85 AND S114

S81 = (MM “Patient satisfaction+”) OR “patient satisfaction”

S84 = S78 OR S79 OR S80 **(**(MM “Telemedicine+”) OR “Telemed” OR “Teledermatology”)

S85 = S82 OR S83 **(**(“MM Dermatology) OR “dermatology”) OR (MM “skin+”) OR “Skin”**)**

S114= S107 OR S108 OR S109 OR S110 OR S111 OR S112 OR S113 ((MM “Smartphone” OR “smartphone”) OR (MM “Cellular phone+) OR “Cellular phone”) OR (“Mobile phone”) OR (“Mobile device”) OR (MM “mobile applications OR apps OR mobile apps”) OR (“store and forward”) OR (“mobile health”)**)**

This yielded 17 articles for a time frame between 1/3/2017 and 1/3/2023.

The result is marked below S4 AND S7 AND S8 AND S37.

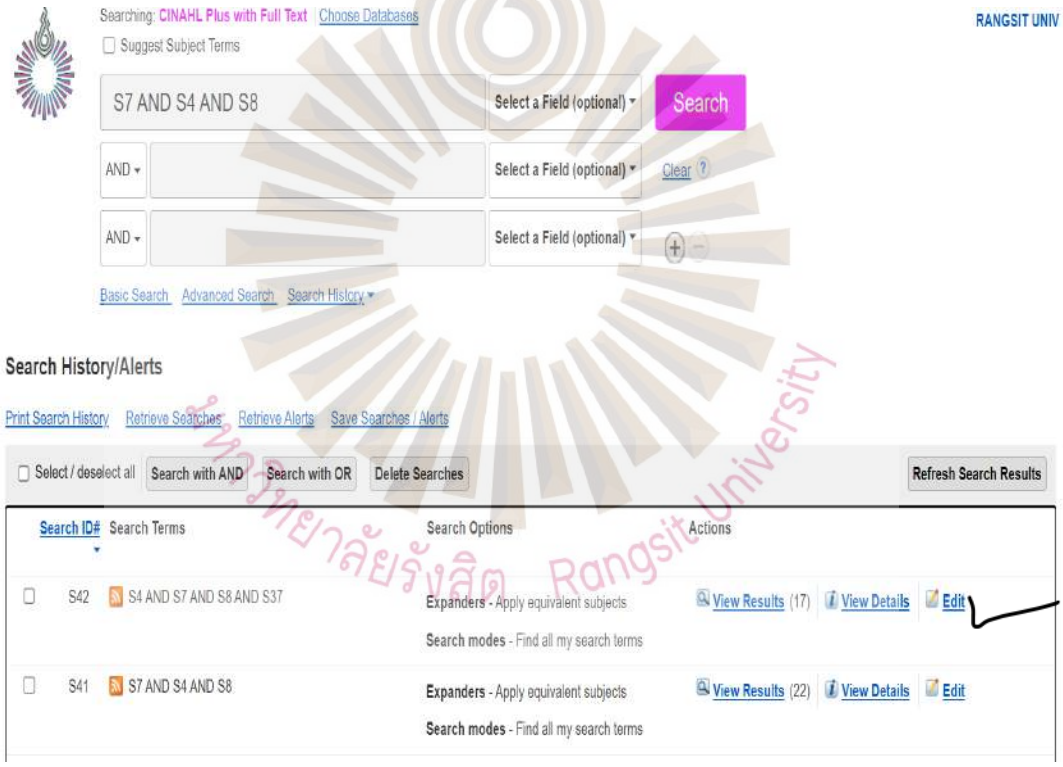


Figure 3. CINAHL expanded keyword search.

Source: Cochrane database, 2024.

2.4 Google Scholar

As stated in the protocol published, the Google Scholar search engine would be used for the supplementary search. It was used as a database in the initial keyword search. The initial search with Google Scholar returned many systematic reviews making it less specific for primary studies. For this reason, systematic reviews were excluded. The search terms below were used.

teledermatology* OR telemed* AND "mobile application*" OR smartphone OR Mobile health OR "store and forward" AND "patient satisfaction" AND dermatology OR skin -systematic review

This gave an initial total of 105 studies. Repeating the same keyword search returned 126 studies when checking for consistency. This shows the unreliability of Google Scholar as a database hence the use of it as a supplementary search database.

2.5 pooling decision tree (Morton et al.,2018)

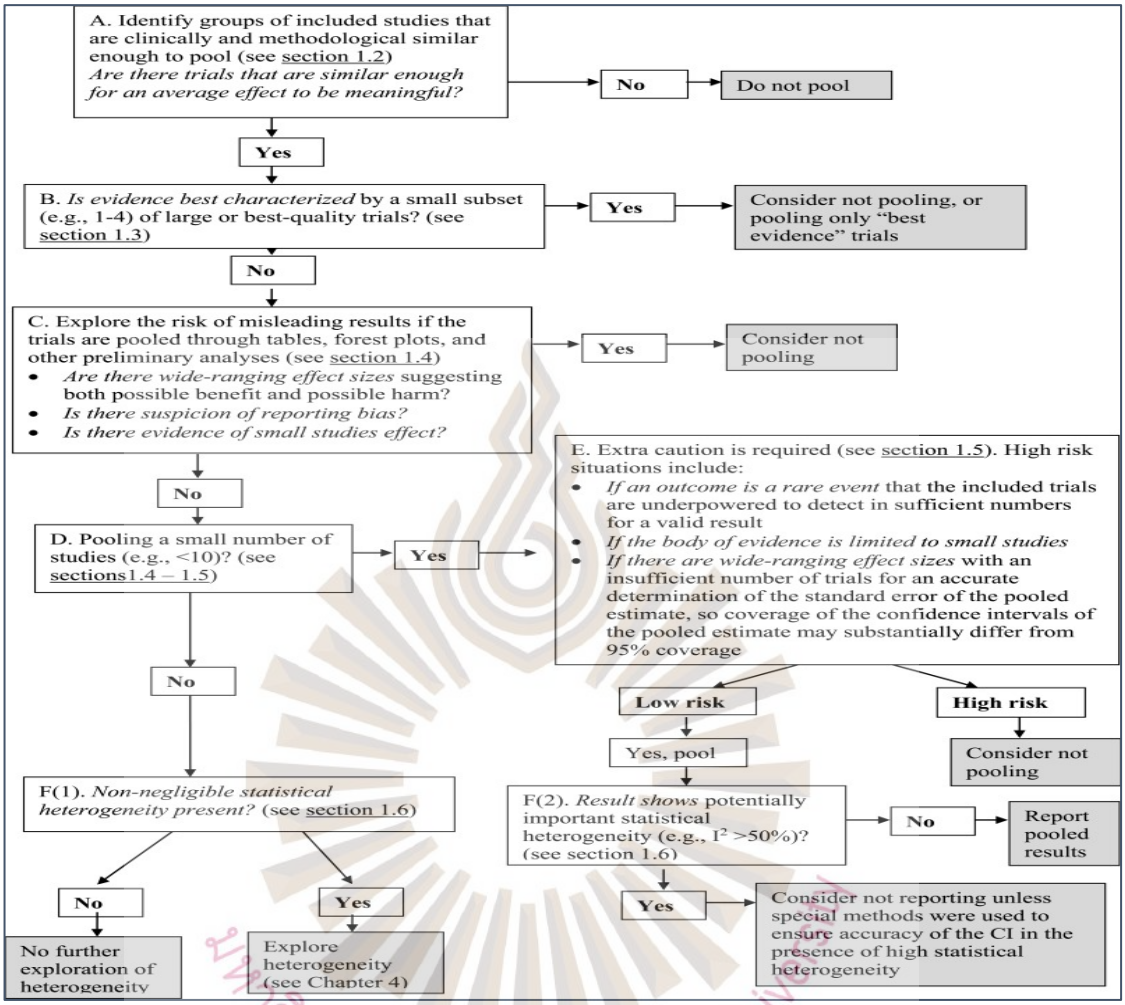


Figure 4. Pooling decision tree

Source: Morton et al., 2018

APPENDIX B

Result Sheets

Result sheets

i. Excluded studies from the title and abstract screening.
ii. Unretrieved clear studies.
iii. Excluded from clear studies
iv. Exclusions from un-retrieved studies
v. Exclusions from unclear studies
vi. Characteristics of study table.
vii. Questionnaire comparison of domains.
viii. Satisfaction scores
ix. Domains

model table for data extraction (Autosaved) (Autosaved) (Autosaved) (Autosaved) (Autosaved)(1).xlsx

APPENDIX C

Risk of Bias Checklist Forms

Risk of Bias Checklist Forms

The list below orders the methodology quality checklist screening for the various studies with the main checklists in blue below.

i. Wang et al. 2018
ii. Po (Harvey) Chin et al. 2020
iii. Gilling et al. 2020
iv. Horsham et al., 2020
v. Handa et al. 2021
vi. Trinh P. et al.
vii. Yadav et al. 2022
viii. Weeraphorn & Sirithanabadeekul, 2023.
ix. Damsin et al. 2023
x. Heidemeyer et al. 2023

JBI CRITICAL APPRAISAL CHECKLIST FOR ANALYTICAL CROSS-SECTIONAL STUDIES

Reviewer_Kishimi Ismaila_____ Date___26/9/23_____

Author___Wang et al. Patient satisfaction with dermatology teleconsultation by using MedX

Year_2018___ Record Number_1872-7565

	Yes	No	Unclear	Not applicable
1. Were the criteria for inclusion in the sample clearly defined?	■	☐	☐	☐
2. Were the study subjects and the setting described in detail?	■	☐	☐	☐
3. Was the exposure measured in a valid and reliable way?	■	☐	☐	☐
4. Were objective, standard criteria used for measurement of the condition?	■	☐	☐	☐

5. Were confounding factors identified?	■	☐	☐	☐
6. Were strategies to deal with confounding factors stated?	■	☐	☐	☐
7. Were the outcomes measured in a valid and reliable way?	■	☐	☐	☐
8. Was appropriate statistical analysis used?	■	☐	☐	☐

Overall appraisal: Include ☐ Exclude ■ Seek further info ☐

Comments (Including reason for exclusion)

Inclusion and exclusion criteria are well defined. Confounders identified. Pearson correlation was carried out. Standardized questionnaires were used to measure the outcomes and one way ANOVA test which is a non-parametric test was used

JBI CRITICAL APPRAISAL CHECKLIST FOR ANALYTICAL CROSS-SECTIONAL STUDIES

Reviewer _____Kishimi Ismaila_____ Date 21/9/2023_____

Author Po (Harvey) Chin et al_Year___2020_ Record Number___105649_____

	Yes	No	Unclear	Not applicable
1. Were the criteria for inclusion in the sample clearly defined?	☐	■	☐	☐
2. Were the study subjects and the setting described in detail?	■	☐	☐	☐
3. Was the exposure measured in a valid and reliable way?	■	☐	☐	☐

4. Were objective, standard criteria used for measurement of the condition? ☐ ☐ ☐ ☐

5. Were confounding factors identified? ☐ ☐ ☐ ☐

6. Were strategies to deal with confounding factors stated? ☐ ☐ ☐ ☐

7. Were the outcomes measured in a valid and reliable way? ☐ ☐ ☐ ☐

8. Was appropriate statistical analysis used? ☐ ☐ ☐ ☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

criteria for inclusion were well outlined based on having a mole, giving informed consent, and uploading an image of the mole which must be clear. A well-designed questionnaire which was classified was used for the measurement of satisfaction. Stratification was carried out and the association of demographic characteristics was carried out the Kruskal Wallis test and Wilcoxon ranked sum tests were used. These are non-parametric and fit for the ordinal data

JBI CRITICAL APPRAISAL CHECKLIST FOR ANALYTICAL CROSS-SECTIONAL STUDIES

Reviewer_Kishimi Ismaila_____ Date___26/9/23_____

Author___Gilling, S., et al. (2020). Patient Satisfaction and Expectations Regarding Mobile Teledermoscopy in General Practice for Diagnosis of Non-melanoma Skin Cancer and Malignant Melanoma.

Year_2020___ Record Number_1651-2057

	Yes	No	Unclear	Not applicable
1. Were the criteria for inclusion in the sample clearly defined?	■	☐	☐	☐
2. Were the study subjects and the setting described in detail?	■	☐	☐	☐

3. Was the exposure measured in a valid and reliable way?	■	☐	☐	☐
4. Were objective, standard criteria used for measurement of the condition?	■	☐	☐	☐
5. Were confounding factors identified?	■	☐	☐	☐
6. Were strategies to deal with confounding factors stated?	☐	■	☐	☐
7. Were the outcomes measured in a valid and reliable way?	■	☐	☐	☐
8. Was appropriate statistical analysis used?	■	☐	☐	☐

Overall appraisal: Include ■ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

The criteria for inclusion in the study were well described as age over 18 years of age with lesions suspicious for melanoma across 48 general hospitals seen by GPs. The study and settings were described in detail. The satisfaction questionnaire was translated from English to Danish. The questionnaire ranged from 34 to 67 questions and contained LIKERT and open-ended questions and dichotomous/free writing confounding factors were identified including IT skills level and stratified into 2 groups each. No regression analysis for confounding factors but an X2 test was done. The questionnaire was pilot-tested. The study is liable to recall bias because the questionnaire was sent 2 to 12 months after consultation.

JBI CRITICAL APPRAISAL CHECKLIST FOR ANALYTICAL CROSS-SECTIONAL STUDIES

Reviewer Kishimi Ismaila___

Date__25/9/2023_____

Author_Horsham et al., 2020 is teledermoscopy ready to replace face-to-face examinations in the early detection of skin cancer

Year 2023____ Record Number__

	Yes	No	Unclear	Not applicable
1. Were the criteria for inclusion in the sample clearly defined?	■	☐	☐	☐
2. Were the study subjects and the setting described in detail?	■	☐	☐	☐
3. Was the exposure measured in a valid and reliable way?	■	☐	☐	☐
4. Were objective, standard criteria used for measurement of the condition?	■	☐	☐	☐
5. Were confounding factors identified?	■	☐	☐	☐
6. Were strategies to deal with confounding factors stated?	■	☐	☐	☐
7. Were the outcomes measured in a valid and reliable way?	■	☐	☐	☐
8. Was appropriate statistical analysis used?	■	☐	☐	☐

Overall appraisal: Include ■ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion) Criteria for inclusion were those participants randomized into the intervention group of an RCT. Therefore, randomization had already been carried out on them. All participants lost to follow-up were accounted for. The telemedicine satisfaction questionnaire and the TAM domains questionnaire were used for measurement. Patient's characteristics were well identified, and stratification was done for Gender, educational attainment, work, marital status, skin type, previous skin spots, and number of moles. Confounders were identified, and regression analysis was carried out. Satisfaction scores were presented as percentages.

JBI CRITICAL APPRAISAL CHECKLIST FOR ANALYTICAL CROSS-SECTIONAL STUDIES

Reviewer_Kishimi Ismaila_____ Date___26/9/23_____

Author… Handa et al. Teledermatology during the COVID-19 pandemic. Experience at a a tertiary center in Northern India_____ Year_2021___ Record Number_ISSN 1529-8019

	Yes	No	Unclear	Not applicable

1. Were the criteria for inclusion in the sample clearly defined? ☐ ☐ ☐ ☐
2. Were the study subjects and the setting described in detail? ☐ ☐ ☐ ☐
3. Was the exposure measured in a valid and reliable way? ☐ ☐ ☐ ☐
4. Were objective, standard criteria used for measurement of the condition? ☐ ☐ ☐ ☐
5. Were confounding factors identified? ☐ ☐ ☐ ☐
6. Were strategies to deal with confounding factors stated? ☐ ☐ ☐ ☐
7. Were the outcomes measured validly and reliably? ☐ ☐ ☐ ☐
8. Was appropriate statistical analysis used? ☐ ☐ ☐ ☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

Criteria for inclusion = patients who had a successful teleconsultation, those without successful teleconsult were excluded, it contained any type of patient so far he/she had registered for TD between certain dates. With different diseases, which can lead to different confounders. Confounders include distance to care, travel time age, Sex, and type of visits were identified. The measurement of satisfaction was carried out using a valid questionnaire, however, there is a high risk of recall bias because the time lag between retrieving patients' information and contacting patients was not stated. Missing data was handled. Patients were called by independent persons not involved in clinical care. Kendall tau was used to analyse correlation which is appropriate as a non-parametric test for ordinal scale. There was no randomization, blocking, or matching to reduce the risk of confounders in the study design and the only statistical analysis used was the Kendalls tau. No multivariate regression or linear regression analysis used

JBI CRITICAL APPRAISAL CHECKLIST FOR ANALYTICAL CROSS-SECTIONAL STUDIES

Reviewer_Kishimi Ismaila_____ Date___26/9/23_____

Author_Trinh, P., et al., Partnering with a senior living community to optimize teledermatology via full body skin screening during the COVID-19 pandemic: A pilot programme._____ Year_2021___ Record Number_2690-442X

	Yes	No	Unclear	Not applicable
1. Were the criteria for inclusion in the sample clearly defined?	☐	■	☐	☐
2. Were the study subjects and the setting described in detail?	☐	■	☐	☐
3. Was the exposure measured validly and reliably?	■	☐	☐	☐
4. Were objective, standard criteria used for measurement of the condition?	■	☐	☐	☐
5. Were confounding factors identified?	☐	■	☐	☐
6. Were strategies to deal with confounding factors stated?	☐	■	☐	☐
7. Were the outcomes measured in a valid and reliable way?	■	☐	☐	☐
8. Was appropriate statistical analysis used?	☐	■	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ■

Comments (Including reason for exclusion)

The criteria for inclusion in the study were not properly spelled out. Confounders are not identified and no strategy to deal with confounders. No statistical analysis was carried out, however, means and standard deviations were used which are okay for ordinal data. The setting was described in detail but the subjects were not.

JBI CRITICAL APPRAISAL CHECKLIST FOR ANALYTICAL CROSS-SECTIONAL STUDIES

Reviewer_Kishimi Ismaila_____ Date___26/9/23_____

Author… Yadav et al. Year_2022___ Record Number_ISSN 1529-8019

	Yes	No	Unclear	Not applicable
1. Were the criteria for inclusion in the sample clearly defined?	☒	☐	☐	☐
2. Were the study subjects and the setting described in detail?	☒	☐	☐	☐
3. Was the exposure measured validly and reliably?	☒	☐	☐	☐
4. Were objective, standard criteria used for measurement of the condition?	☒	☐	☐	☐
5. Were confounding factors identified?	☒	☐	☐	☐
6. Were strategies to deal with confounding factors stated?	☒	☐	☐	☐
7. Were the outcomes measured validly and reliably?	☒	☐	☐	☐
8. Was appropriate statistical analysis used?	☒	☐	☐	☐

Overall appraisal: Include ☒ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

Study inclusion criteria patients > 18 years, specified date of receiving TD care. The time lag of 2 weeks within which they were interviewed for satisfaction was mentioned. An attempt to mitigate response bias was made by telling the respondents the interviewers were not part of the faculty. Demographic, clinical, and teleconsult data were taken. No stratification or matching for confounders is stated in the methodology. Also, if caregivers were used for teleconsultation. The questionnaire was administered to them. The satisfaction questionnaire was validated and back-translated to ensure no change in meaning. Multivariate logistics regression analysis was used

JBI CRITICAL APPRAISAL CHECKLIST FOR ANALYTICAL CROSS-SECTIONAL STUDIES

Reviewer_Kishimi Ismaila_____ Date___25/9/23_____

Author_Sirithanabadeekul et al.,

Year 2023_____ Record Number__1018-8665

	Yes	No	Unclear	Not applicable
1. Were the criteria for inclusion in the sample clearly defined?	■	☐	☐	☐
2. Were the study subjects and the setting described in detail?	■	☐	☐	☐
3. Was the exposure measured in a valid and reliable way?	■	☐	☐	☐
4. Were objective, standard criteria used for measurement of the condition?	■	☐	☐	☐
5. Were confounding factors identified?	☐	■	☐	☐
6. Were strategies to deal with confounding factors stated?	☐	■	☐	☐
7. Were the outcomes measured in a valid and reliable way?	■	☐	☐	☐
8. Was appropriate statistical analysis used?	☐	■	☐	☐

Overall appraisal: Include ■ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion) The study has a high risk of bias. Retrospective study, no statistical analysis was carried out. Confounding factors were not identified, and no attempts to adjust for the confounders.

JBI CRITICAL APPRAISAL CHECKLIST FOR ANALYTICAL CROSS-SECTIONAL STUDIES

Reviewer_Kishimi Ismaila_____ Date___25/9/23_____

Damsin et al. 2023

Year 2023____ Record Number__

	Yes	No	Unclear	Not applicable
1. Were the criteria for inclusion in the sample clearly defined?	☐	■	☐	☐
2. Were the study subjects and the setting described in detail?	■	☐	☐	☐
3. Was the exposure measured in a valid and reliable way?	■	☐	☐	☐
4. Were objective, standard criteria used for measurement of the condition?	■	☐	☐	☐
5. Were confounding factors identified?	■	☐	☐	☐
6. Were strategies to deal with confounding factors stated?	■	☐	☐	☐
7. Were the outcomes measured in a valid and reliable way?	■	☐	☐	☐
8. Was appropriate statistical analysis used?	■	☐	☐	☐

Overall appraisal: Include ■ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

They mention PHCS AND Physicians, However, there are no clear inclusion or exclusion criteria for the main participants whom the acquisitions are meant to represent. Demographic data of the participants were captured, confounding factors were identified, and the outcomes were analyzed by a repeated logistic model accounting for the fact that some PHCs are included in both phases. The types of PHCs are included in both phases. The type of PHC and the study phase were considered as fixed effects and PHC is a random effect. The study identified the variable to be used in statistical analysis.

Revised Cochrane risk-of-bias tool for randomized trials (RoB 2)
SHORT VERSION (CRIBSHEET)

Edited by Julian PT Higgins, Jelena Savović, Matthew J Page, Jonathan AC Sterne on behalf of the RoB 2 Development Group

Version of 22 August 2019

Heidemeyer et al. 2023. Randomized open label trial comparing teledermatology vs face to face consultations in the treatment of mild to moderate acne

The development of the RoB 2 tool was supported by the MRC Network of Hubs for Trials Methodology Research (MR/L004933/2- N61), with the support of the host MRC ConDuCT-II Hub (Collaboration and innovation for Difficult and Complex randomised controlled Trials in Invasive procedures - MR/K025643/1), by MRC research grant MR/M025209/1, and by a grant from The Cochrane Collaboration.

Preliminary considerations

Study design

- ☐ Individually randomized parallel-group trial
- ☐ Cluster-randomized parallel-group trial
- ☐ Individually randomized cross-over (or other matched) trial

For the purposes of this assessment, the interventions being compared are defined as

Experimental: teledermatology

Comparator: Pre-onset vs post-onset COVID-19 pandemic

Specify which outcome is being assessed for risk of bias

Patients Satisfaction

Specify the numerical result being assessed. In case of multiple alternative analyses being presented, specify the numeric result (e.g. RR = 1.52 (95% CI 0.83 to 2.77) and/or a reference (e.g. to a table, figure or paragraph) that uniquely defines the result being assessed.

Pearsons chi square test or fishers exact test

Is the review team's aim for this result…?

- ☐ to assess the effect of *assignment to intervention* (the 'intention-to-treat' effect)
- ✓ ☐ to assess the effect of *adhering to intervention* (the 'per-protocol' effect)

If the aim is to assess the effect of *adhering to intervention*, select the deviations from intended intervention that should be addressed (at least one must be checked):

- ✓ ☐ occurrence of non-protocol interventions
- ☐ failures in implementing the intervention that could have affected the outcome
- ✓ ☐ non-adherence to their assigned intervention by trial participants

Which of the following sources were obtained to help inform the risk-of-bias assessment? (tick as many as apply)

- ✓ ☐ Journal article(s)
- ☐ Trial protocol
- ☐ Statistical analysis plan (SAP)
- ☐ Non-commercial trial registry record (e.g. ClinicalTrials.gov record)
- ☐ Company-owned trial registry record (e.g. GSK Clinical Study Register record) ☐ "Grey literature" (e.g. unpublished thesis)
- ☐ Conference abstract(s) about the trial
- ☐ Regulatory document (e.g. Clinical Study Report, Drug Approval Package)
- ☐ Research ethics application
- ☐ Grant database summary (e.g. NIH RePORTER or Research Councils UK Gateway to Research) ☐ Personal communication with trialist
- ☐ Personal communication with the sponsor

Domain 1: Risk of bias arising from the randomization process

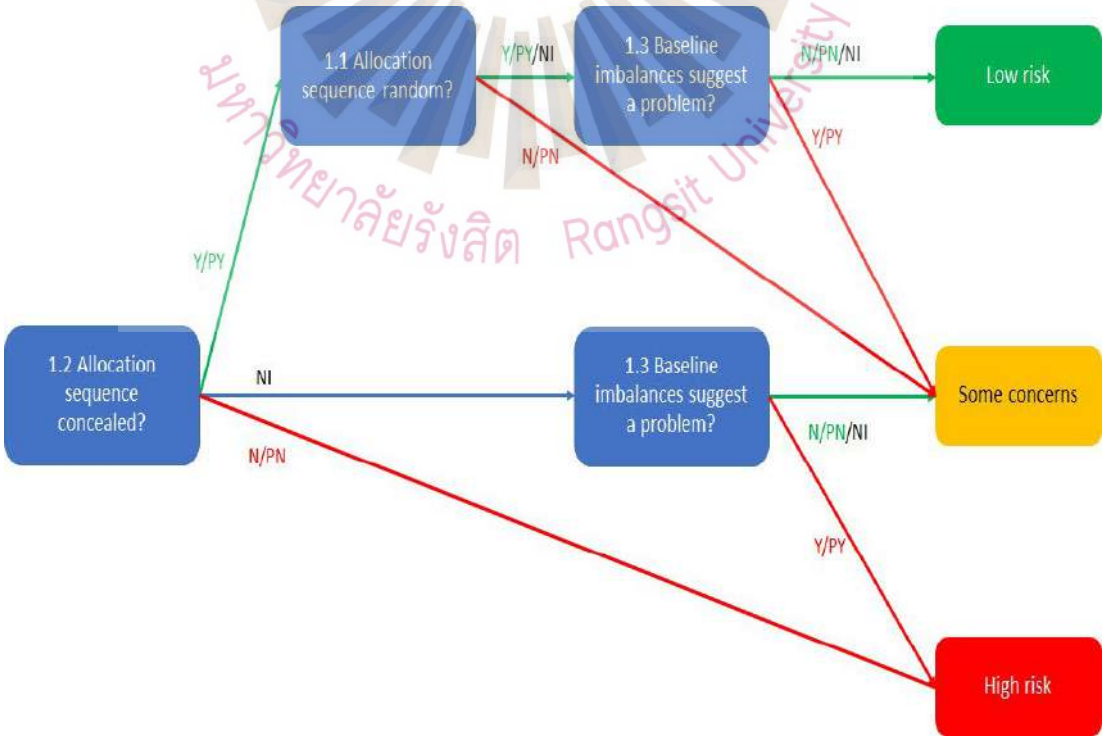
Signalling questions	Elaboration	Response options
1.1 Was the allocation sequence random?	Answer 'Yes' if a random component was used in the sequence generation process. Examples include computer-generated random numbers; reference to a random number table; coin tossing; shuffling cards or envelopes; throwing dice; or drawing lots. Minimization is	Y/PY/PN/N/NI Yes. After screening, participants were randomly assigned in a 1:1

	generally implemented with a random element (at least when the scores are equal), so an allocation sequence that is generated using minimization should generally be considered to be random. Answer 'No' if no random element was used in generating the allocation sequence or the sequence is predictable. Examples include alternation; methods based on dates (of birth or admission); patient record numbers; allocation decisions made by clinicians or participants; allocation based on the availability of the intervention; or any other systematic or haphazard method. Answer 'No information' if the only information about randomization methods is a statement that the study is randomized. In some situations a judgement may be made to answer 'Probably no' or 'Probably yes'. For example, , in the context of a large trial run by an experienced clinical trials unit, absence of specific information about generation of the randomization sequence, in a paper published in a journal with rigorously enforced word count limits, is likely to result in a response of 'Probably yes' rather than 'No information'. Alternatively, if other (contemporary) trials by the same investigator team have clearly used non-random sequences, it might be reasonable to assume that the current study was done using similar methods.	ratio using a balanced random allocation sequence using a pseudo random number generation algorithm with stratification for acne severity. This is a simple stratified allocation with the subsets of acne severity into mild or moderate.
1.2 Was the allocation sequence concealed until participants were enrolled and assigned to interventions?	Answer 'Yes' if the trial used any form of remote or centrally administered method to allocate interventions to participants, where the process of allocation is controlled by an external unit or organization, independent of the enrolment personnel (e.g. independent central pharmacy, telephone or internet-based randomization service providers).	Y/PY/PN/N/NI YES. The authors were able to confirm that allocation concealment was performed by telephone call to a third

	Answer 'Yes' if envelopes or drug containers were used appropriately. Envelopes should be opaque, sequentially numbered, sealed with a tamper-proof seal and opened only after the envelope has been irreversibly assigned to the participant. Drug containers should be sequentially numbered and of identical appearance, and dispensed or administered only after they have been irreversibly assigned to the participant. This level of detail is rarely provided in reports, and a judgement may be required to justify an answer of 'Probably yes' or 'Probably no'. Answer 'No' if there is reason to suspect that the enrolling investigator or the participant had knowledge of the forthcoming allocation.	person not directly involved in the clinical treatment and judgement of the patients. same person handled the random allocation sequence and gave progressive assignment whenever a patient was recruited. No Information. The trial method was silent on the concealment until assignment of interventions. There was also no evidence of foreknowledge of the assigned interventions by the participants or investigators
1.3 Did baseline differences between intervention groups suggest a problem with the randomization process?	*Note that differences that are compatible with chance do not lead to a risk of bias. A small number of differences identified as 'statistically significant' at the conventional 0.05 threshold should usually be considered to be compatible with chance.* Answer 'No' if no imbalances are apparent or if any observed imbalances are compatible with chance. Answer 'Yes' if there are imbalances that indicate problems with the randomization process, including: (1) substantial differences between intervention group sizes,	Y ./PY/PN/N/NI At the onset of the trial, there was an equal balance of number of participants between the two groups. With 12 each making 24.

	compared with the intended allocation ratio; or (2) a substantial excess in statistically significant differences in baseline characteristics between intervention groups, beyond that expected by chance; or (3) imbalance in one or more key prognostic factors, or baseline measures of outcome variables, that is very unlikely to be due to chance and for which the between-group difference is big enough to result in bias in the intervention effect estimate. Also answer 'Yes' if there are other reasons to suspect that the randomization process was problematic: (4) excessive similarity in baseline characteristics that is not compatible with chance. Answer 'No information' when there is no *useful* baseline information available (e.g. abstracts, or studies that reported only baseline characteristics of participants in the final analysis). The answer to this question should not influence answers to questions 1.1 or 1.2. For example, if the trial has large baseline imbalances, but authors report adequate randomization methods, questions 1.1 and 1.2 should still be answered on the basis of the reported adequate methods, and any concerns about the imbalance should be raised in the answer to the question 1.3 and reflected in the domain-level risk-ofbias judgement. Trialists may undertake analyses that attempt to deal with flawed randomization by controlling for imbalances in prognostic factors at baseline. To remove the risk of bias caused by problems in the randomization process, it would be necessary to know,	

	and measure, all the prognostic factors that were imbalanced at baseline. It is unlikely that all important prognostic factors are known and measured, so such analyses will at best reduce the risk of bias. If review authors wish to assess the risk of bias in a trial that controlled for baseline imbalances in order to mitigate failures of randomization, the study should be assessed using the ROBINS-I tool.	
Risk-of-bias judgement	See algorithm.	Low / High / Some concerns
Optional: What is the predicted direction of bias arising from the randomization process?	If the likely direction of bias can be predicted, it is helpful to state this. The direction might be characterized either as being towards (or away from) the null, or as being in favour of one of the interventions.	NA / Favours experimental / Favours comparator / Towards null /Away from null / Unpredictable



Algorithm for suggested judgement of risk of bias arising from the randomization process

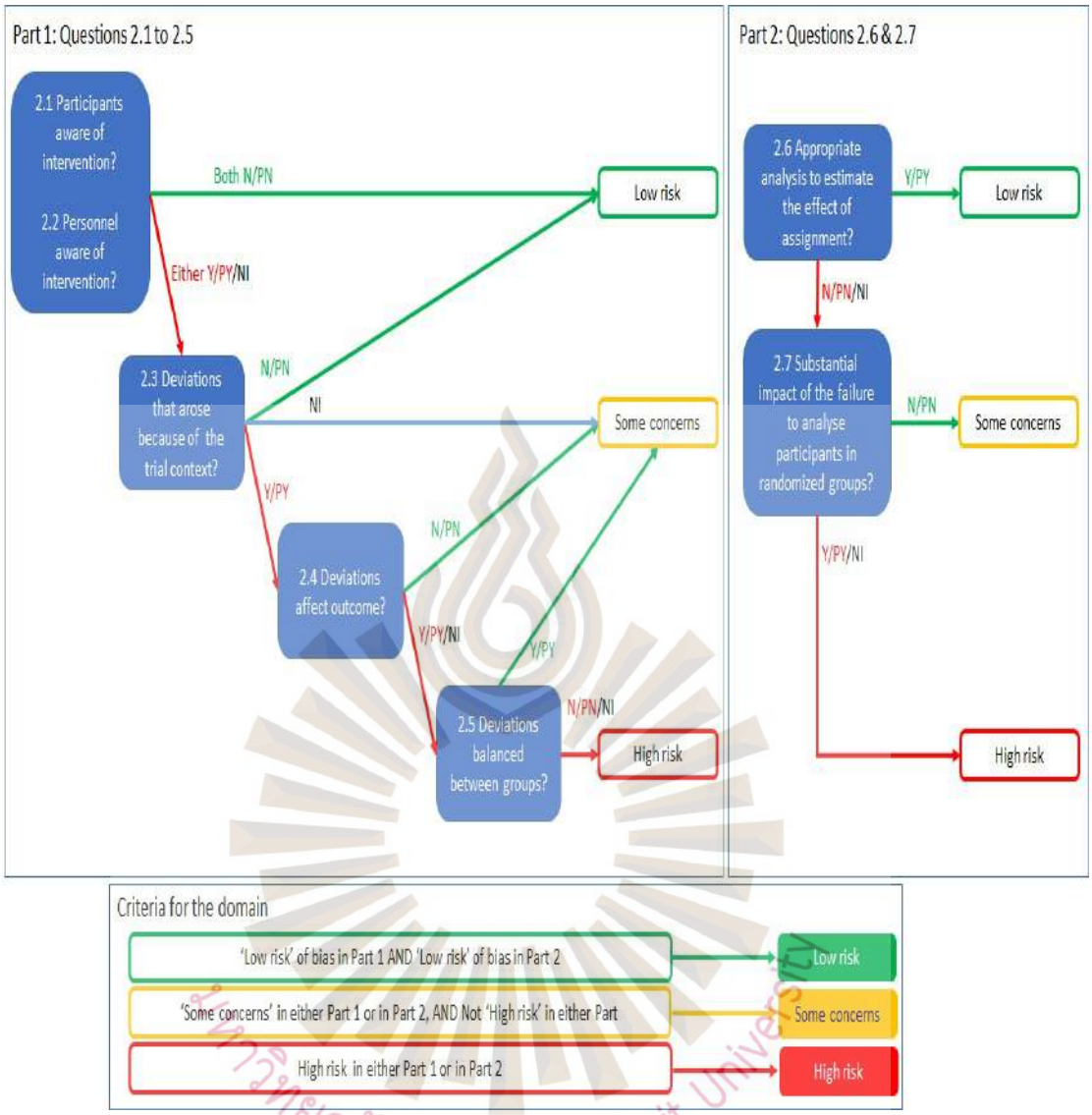
Domain 2: Risk of bias due to deviations from the intended interventions (*effect of assignment to intervention*)

Signalling questions	**Elaboration**	**Response options**
2.1. Were participants aware of their assigned intervention during the trial?	If participants are aware of their assigned intervention it is more likely that health-related behaviours will differ between the intervention groups. Blinding participants, most commonly through use of a placebo or sham intervention, may prevent such differences. If participants experienced side effects or toxicities that they knew to be specific to one of the interventions, answer this question 'Yes' or 'Probably yes'.	Y/PY/PN/N/NI Yes. partcipants where awer of their assigned interventions. This is due to the nature of the intervention (teledermatology).
2.2. Were carers and people delivering the interventions aware of participants' assigned intervention during the trial?	If carers or people delivering the interventions are aware of the assigned intervention then its implementation, or administration of non-protocol interventions, may differ between the intervention groups. Blinding may prevent such differences. If participants experienced side effects or toxicities that carers or people delivering the interventions knew to be specific to one of the interventions, answer question 'Yes' or 'Probably yes'. If randomized allocation was not concealed, then it is likely that carers and people delivering the interventions were aware of participants' assigned intervention during the trial.	Y/PY/PN/N/NI YES. For this study. Blinding would have been difficult due to the nature of the intervention which requires the participants in the intervention group to use of a specific modality of teledermatology access.
2.3. If Y/PY/NI to 2.1 or 2.2: Were there deviations from the intended intervention that arose because of the trial context?	For the effect of assignment to intervention, this domain assesses problems that arise when changes from assigned intervention that are inconsistent with the trial protocol arose because of the trial context. We use the term **trial context** to refer to effects of recruitment and engagement activities on trial participants and when trial personnel (carers or people delivering the interventions) undermine the implementation of the trial protocol in ways that would not	NA/Y/PY/PN/N/NI NO. There were no deviations from the intended intervention due to the trial context.

	happen outside the trial. For example, the process of securing informed consent may lead participants subsequently assigned to the comparator group to feel unlucky and therefore seek the experimental intervention, or other interventions that improve their prognosis. Answer 'Yes' or 'Probably yes' **only** if there is evidence, or strong reason to believe, that the trial context led to failure to implement the protocol interventions or to implementation of interventions not allowed by the protocol. Answer 'No' or 'Probably no' if there were changes from assigned intervention that are inconsistent with the trial protocol, such as non-adherence to intervention, but these are consistent with what could occur outside the trial context. Answer 'No' or 'Probably no' for changes to intervention that are consistent with the trial protocol, for example cessation of a drug intervention because of acute toxicity or use of additional interventions whose aim is to treat consequences of one of the intended interventions. If blinding is compromised because participants report side effects or toxicities that are specific to one of the interventions, answer 'Yes' or 'Probably yes' only if there were changes from assigned intervention that are inconsistent with the trial protocol and arose because of the trial context. The answer 'No information' may be appropriate, because trialists do not always report whether deviations arose because of the trial context.	

2.4 If Y/PY to 2.3: Were these deviations likely to have affected the outcome?	Changes from assigned intervention that are inconsistent with the trial protocol and arose because of the trial context will impact on the intervention effect estimate if they affect the outcome, but not otherwise.	NA/Y/PY/PN/N/NI Not applicable This question is not applicable because 2.3 had an answer of No.
2.5. If Y/PY/NI to 2.4: Were these deviations from intended intervention balanced between groups?	Changes from assigned intervention that are inconsistent with the trial protocol and arose because of the trial context are more likely to impact on the intervention effect estimate if they are not balanced between the intervention groups.	NA/Y/PY/PN/N/NI Not applicable
2.6 Was an appropriate analysis used to estimate the effect of assignment to intervention?	Both intention-to-treat (ITT) analyses and modified intention-to-treat (mITT) analyses excluding participants with missing outcome data should be considered appropriate. Both naïve 'per-protocol' analyses (excluding trial participants who did not receive their assigned intervention) and 'as treated' analyses (in which trial participants are grouped according to the intervention that they received, rather than according to their assigned intervention) should be considered inappropriate. Analyses excluding eligible trial participants post-randomization should also be considered inappropriate, but postrandomization exclusions of ineligible participants (when eligibility was not confirmed until after randomization, and could not have been influenced by intervention group assignment) can be considered appropriate.	Y/PY/PN/N/NI Yes. An intention to treat Analysis was used to estimate the effect of assignment to intervention for this study
2.7 If N/PN/NI to 2.6: Was there potential for a substantial impact (on the result) of the failure to analyse participants in	This question addresses whether the number of participants who were analysed in the wrong intervention group, or excluded from the analysis, was sufficient that there could have been a substantial impact on the result. It is not possible to specify a precise rule: there may be potential for	NA/Y/PY/PN/N/NI NOT APPLICABLE

the group to which they were randomized?	substantial impact even if fewer than 5% of participants were analysed in the wrong group or excluded, if the outcome is rare or if exclusions are strongly related to prognostic factors.	
Risk-of-bias judgement	See algorithm.	Low / High / Some concerns
Optional: What is the predicted direction of bias due to deviations from intended interventions?	If the likely direction of bias can be predicted, it is helpful to state this. The direction might be characterized either as being towards (or away from) the null, or as being in favour of one of the interventions.	NA / Favours experimental / Favours comparator / Towards null /Away from null / Unpredictable



Algorithm for suggested judgement of risk of bias due to deviations from the intended interventions (effect of assignment to intervention)

Domain 2: Risk of bias due to deviations from the intended interventions (*effect of adhering to intervention*)

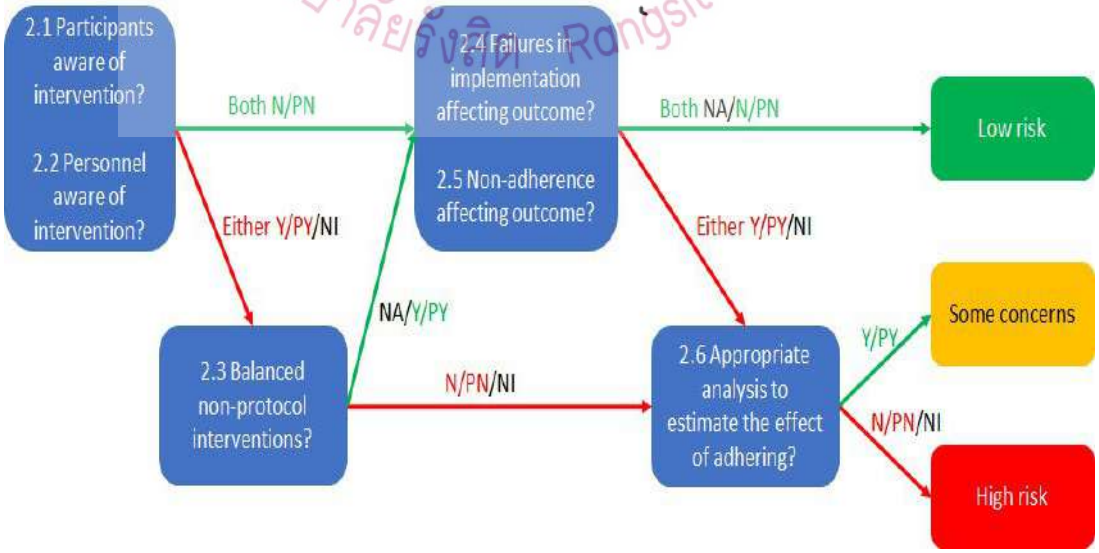
Signalling questions	**Elaboration**	**Response options**
2.1. Were participants aware of their assigned intervention during the trial?	If participants are aware of their assigned intervention it is more likely that health-related behaviours will differ between the intervention groups. Blinding participants, most commonly through use of a placebo or sham intervention, may prevent such differences. If participants	Y/PY/PN/N/NI YES. Partcipants where aware of their interventions during the trial. This was ineveitable due to the

	experienced side effects or toxicities that they knew to be specific to one of the interventions, answer this question 'Yes' or 'Probably yes'.	nature of the intervention.
2.2. Were carers and people delivering the interventions aware of participants' assigned intervention during the trial?	If carers or people delivering the interventions are aware of the assigned intervention then its implementation, or administration of non-protocol interventions, may differ between the intervention groups. Blinding may prevent such differences. If participants experienced side effects or toxicities that carers or people delivering the interventions knew to be specific to one of the interventions, answer 'Yes' or 'Probably yes'. If randomized allocation was not concealed, then it is likely that carers and people delivering the interventions were aware of participants' assigned intervention during the trial.	Y/PY/PN/N/NI Probably NO. Carers or deliverers of the interventions were aware of the assigned interventions. There were no non protocol interventions administered in the study. The authors have confirmed that there was allocation concealment by telephone call to a third person who was not directly involved in the clinical treatment and judgement of the patients random allocation sequence and give progressive assignment whenever each patient was recruited. The nature of this study makes it difficult to conceal the intervention during the trial, therefore it will not be justifiable to give a negative response based on concealment during the trial
2.3. [If applicable:] If Y/PY/NI to 2.1 or 2.2: Were important nonprotocol interventions balanced across	This question is asked only if the preliminary considerations specify that the assessment will address imbalance of important non-protocol interventions between intervention groups. Important nonprotocol interventions are the additional	NA/Y/PY/PN/N/NI Not applicable. There were no non protocol intervention in the study.

intervention groups?	interventions or exposures that: (1) are inconsistent with the trial protocol; (2) trial participants might receive with or after starting their assigned intervention; and (3) are prognostic for the outcome. Risk of bias will be higher if there is imbalance in such interventions between the intervention groups.	
2.4. [If applicable:] Were there failures in implementing the intervention that could have affected the outcome?	This question is asked only if the preliminary considerations specify that the assessment will address failures in implementing the intervention that could have affected the outcome. Risk of bias will be higher if the intervention was not implemented as intended by, for example, the health care professionals delivering care. Answer 'No' or 'Probably no' if implementation of the intervention was successful for most participants.	NA/Y/PY/PN/N/NI NO. There were no failures. Intervention implementation was successful for most participants.
2.5. [If applicable:] Was there non-adherence to the assigned intervention regimen that could have affected participants' outcomes?	This question is asked only if the preliminary considerations specify that the assessment will address nonadherence that could have affected participants' outcomes. Non-adherence includes imperfect compliance with a sustained intervention, cessation of intervention, crossovers to the comparator intervention and switches to another active intervention. Consider available information on the proportion of study participants who continued with their assigned intervention throughout follow up, and answer 'Yes' or 'Probably yes' if the proportion who did not adhere is high enough to raise concerns. Answer 'No' for studies of interventions that are	NA/Y/PY/PN/N/NI Probably No. All patients that were in the trial to the end adhered to their intervention groups.

	administered once, so that imperfect adherence is not possible, and all or most participants received the assigned intervention.	
2.6. If N/PN/NI to 2.3, or Y/PY/NI to 2.4 or 2.5: Was an appropriate analysis used to estimate the effect of adhering to the intervention?	Both ‘ naïve ‘per-protocol’ analyses (excluding trial participants who did not receive their allocated intervention) and ‘as treated’ analyses (comparing trial participants according to the intervention they actually received) will usually be inappropriate for estimating the effect of adhering to intervention (the ‘per-protocol’ effect). However, it is possible to use data from a randomized trial to derive an unbiased estimate of the effect of adhering to intervention. Examples of appropriate methods include: (1) instrumental variable analyses to estimate the effect of receiving the assigned intervention in trials in which a single intervention, administered only at baseline and with all-or-nothing adherence, is compared with standard care; and (2) inverse probability weighting to adjust for censoring of participants who cease adherence to their assigned intervention, in trials of sustained treatment strategies. These methods depend on strong assumptions, which should be appropriate and justified if the answer to this question is ‘Yes’ or ‘Probably yes’. It is possible that a paper reports an analysis based on such methods without reporting information on the deviations from intended intervention, but it would be hard to judge such an	NA/Y/PY/PN/N/NI Not applicable as the 2 preceding questions were neither N/PN OR Y/PY respectively. Also, there was no deviation from the interventions necessitating a need for an appropriate analysis as such.

	analysis to be appropriate in the absence of such information. If an important non-protocol intervention was administered to all participants in one intervention group, adjustments cannot be made to overcome this. Some examples of analysis strategies that would not be appropriate to estimate the effect of adhering to intervention are (i) 'Intention to treat (ITT) analysis', (ii) 'per protocol analysis', (iii) 'as-treated analysis', (iv) 'analysis by treatment received'.	
Risk-of-bias judgement	See algorithm.	Low / High / Some concerns
Optional: What is the predicted direction of bias due to deviations from intended interventions?	If the likely direction of bias can be predicted, it is helpful to state this. The direction might be characterized either as being towards (or away from) the null, or as being in favour of one of the interventions.	NA / Favours experimental / Favours comparator / Towards null /Away from null / Unpredictable



Algorithm for suggested judgement of risk of bias due to deviations from the intended interventions (effect of adhering to intervention)

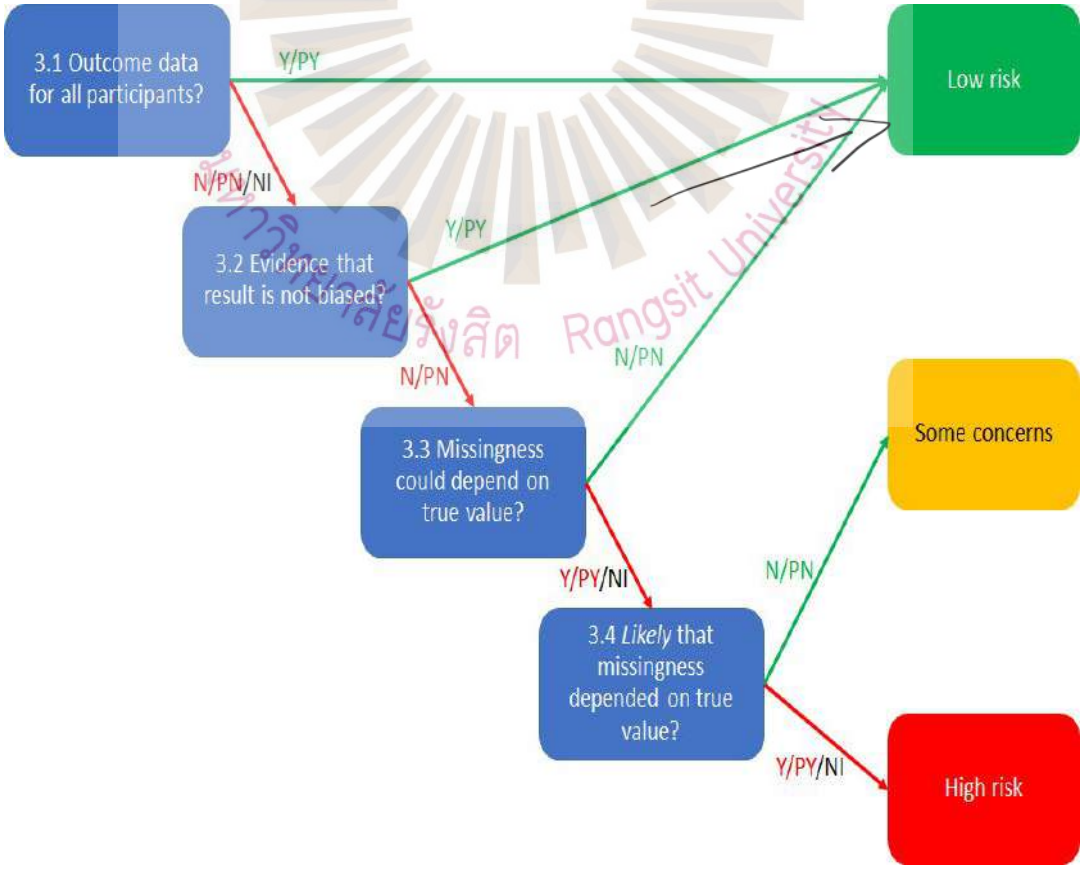
Domain 3: Risk of bias due to missing outcome data

Signalling questions	Elaboration	Response options
3.1 Were data for this outcome available for all, or nearly all, participants randomized?	The appropriate study population for an analysis of the intention to treat effect is all randomized participants. "Nearly all" should be interpreted as that the number of participants with missing outcome data is sufficiently small that their outcomes, whatever they were, could have made no important difference to the estimated effect of intervention. For continuous outcomes, availability of data from 95% of the participants will often be sufficient. For dichotomous outcomes, the proportion required is directly linked to the risk of the event. If the observed number of events is much greater than the number of participants with missing outcome data, the bias would necessarily be small. Only answer 'No information' if the trial report provides no information about the extent of missing outcome data. This situation will usually lead to a judgement that there is a high risk of bias due to missing outcome data. Note that imputed data should be regarded as missing data, and not considered as 'outcome data' in the context of this question.	Y/PY/PN/N/NI NO. The data from the satisfaction survey is dichotomous. However, in the intervention group there was a significant loss of 4 respondents. 2 to follow up and 2 discontinued the intervention with reasons of compliance and wrong visit/allocation. This number constitutes 33% of the total number of 12 patients randomized into the intervention group for teledermatology. as compared to the only two patients lost to follow up in the comparator group. Comparing the two groups this difference could be a potential source of bias due to the differing proportion of missing outcome data between the two groups which is more in the intervention group (6.1.4.1)
3.2 If N/PN/NI to 3.1: Is there evidence that the result was not biased by missing outcome data?	Evidence that the result was not biased by missing outcome data may come from (1) analysis methods that correct for bias; or (2) sensitivity analyses showing that results are little changed under a range of plausible assumptions about the relationship	NA/Y/PY/PN/N Yes. Multiple Imputation method was used to correct for bias due to missing outcome data

	between missingness in the outcome and its true value. However, imputing the outcome variable, either through methods such as 'last-observation-carriedforward' or via multiple imputation based only on intervention group, should not be assumed to correct for bias due to missing outcome data.	in this study. This was done for both randomized groups and included in the intention to treat analysis.
3.3 If N/PN to 3.2: Could missingness in the outcome depend on its true value?	If loss to follow up, or withdrawal from the study, could be related to participants' health status, then it is possible that missingness in the outcome was influenced by its true value. However, if all missing outcome data occurred for documented reasons that are unrelated to the outcome then the risk of bias due to missing outcome data will be low (for example, failure of a measuring device or interruptions to routine data collection). In time-to-event analyses, participants censored during trial follow-up, for example because they withdrew from the study, should be regarded as having missing outcome data, even though some of their follow up is included in the analysis. Note that such participants may be shown as included in analyses in CONSORT flow diagrams.	NA/Y/PY/PN/N/NI NA. y/pn in preceding question. However, the documented missing outcome data are for a total of 4 patients in both groups lost to follow up without any reasons and two patients in the intervention group who discontinued the intervention due to a compliance issue and a wrong visit/allocation. These are not related to the outcome and hence it can be deduced to be of low risk of bias.
3.4 If Y/PY/NI to 3.3: Is it likely that missingness in the outcome depended on its true value?	This question distinguishes between situations in which (i) missingness in the outcome could depend on its true value (assessed as 'Some concerns') from those in which (ii) it is likely that missingness in the outcome depended on its true value (assessed as 'High risk of bias'). Five reasons for answering 'Yes' are: 1. Differences between intervention groups in the proportions of missing outcome data. If there is a difference between the effects of the	NA/Y/PY/PN/N/NI

	experimental and comparator interventions on the outcome, and the missingness in the outcome is influenced by its true value, then the proportions of missing outcome data are likely to differ between intervention groups. Such a difference suggests a risk of bias due to missing outcome data, because the trial result will be sensitive to missingness in the outcome being related to its true value. For time-to-event-data, the analogue is that rates of censoring (loss to follow-up) differ between the intervention groups. 2. Reported reasons for missing outcome data provide evidence that missingness in the outcome depends on its true value; 3. Reported reasons for missing outcome data differ between the intervention groups; 4. The circumstances of the trial make it likely that missingness in the outcome depends on its true value. For example, in trials of interventions to treat schizophrenia it is widely understood that continuing symptoms make drop out more likely. 5. In time-to-event analyses, participants' follow up is censored when they stop or change their assigned intervention, for example because of drug toxicity or, in cancer trials, when participants switch to second-line chemotherapy. Answer 'No' if the analysis accounted for participant characteristics that are likely to explain the relationship between	

	missingness in the outcome and its true value.	
Risk-of-bias judgement	See algorithm.	Low / High / Some concerns
Optional: What is the predicted direction of bias due to missing outcome data?	If the likely direction of bias can be predicted, it is helpful to state this. The direction might be characterized either as being towards (or away from) the null, or as being in favour of one of the interventions.	NA / Favours experimental / Favours comparator / Towards null /Away from null / Unpredictable



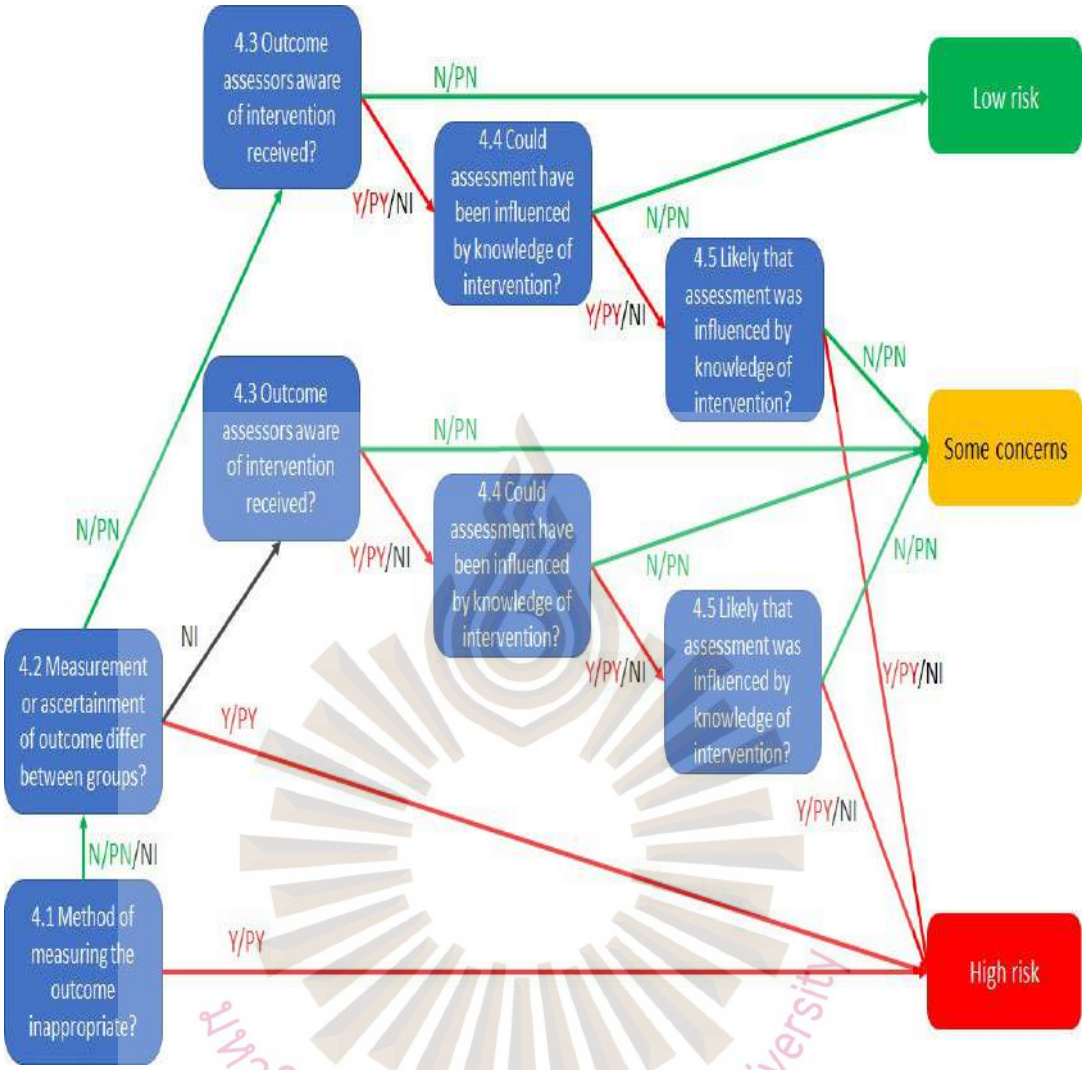
Algorithm for suggested judgement of risk of bias due to missing outcome data

Domain 4: Risk of bias in measurement of the outcome

Signalling questions	Elaboration	Response options
4.1 Was the method of measuring the outcome inappropriate?	This question aims to identify methods of outcome measurement (data collection) that are unsuitable for the outcome they are intended to evaluate. The question *does not* aim to assess whether the choice of outcome being evaluated was sensible (e.g. because it is a surrogate or proxy for the main outcome of interest). In most circumstances, for pre-specified outcomes, the answer to this question will be 'No' or 'Probably no'. Answer 'Yes' or 'Probably yes' if the method of measuring the outcome is inappropriate, for example because: (1) it is unlikely to be sensitive to plausible intervention effects (e.g. important ranges of outcome values fall outside levels that are detectable using the measurement method); or (2) the measurement instrument has been demonstrated to have poor validity.	Y/PY/PN/N/NI
4.2 Could measurement or ascertainment of the outcome have differed between intervention groups?	Comparable methods of outcome measurement (data collection) involve the same measurement methods and thresholds, used at comparable time points. Differences between intervention groups may arise because of 'diagnostic detection bias' in the context of passive collection of outcome data, or if an intervention involves additional visits to a healthcare provider, leading to additional opportunities for outcome events to be identified.	Y/PY/PN/N/NI

4.3 If N/PN/NI to 4.1 and 4.2: Were outcome assessors aware of the intervention received by study participants?	Answer 'No' if outcome assessors were blinded to intervention status. For participant-reported outcomes, the outcome assessor is the study participant.	NA/Y/PY. m/PN/N/NI
4.4 If Y/PY/NI to 4.3: Could assessment of the outcome have been influenced by knowledge of intervention received?	Knowledge of the assigned intervention could influence participant-reported outcomes (such as level of pain), observer-reported outcomes involving some judgement, and intervention provider decision outcomes. They are unlikely to influence observer-reported outcomes that do not involve judgement, for example all-cause mortality.	NA/Y/PY/PN/N/NI
4.5 If Y/PY/NI to 4.4: Is it likely that assessment of the outcome was influenced by knowledge of intervention received?	This question distinguishes between situations in which (i) knowledge of intervention status could have influenced outcome assessment but there is no reason to believe that it did (assessed as 'Some concerns') from those in which (ii) knowledge of intervention status was likely to influence outcome assessment (assessed as 'High'). When there are strong levels of belief in either beneficial or harmful effects of the intervention, it is more likely that the outcome was influenced by knowledge of the intervention received. Examples may include patient-reported symptoms in trials of homeopathy, or assessments of recovery of function by a physiotherapist who delivered the intervention.	NA/Y/PY/PN/N/NI
Risk-of-bias judgement	See algorithm.	Low / High / Some concerns

Optional: What is the predicted direction of bias in measurement of the outcome?	If the likely direction of bias can be predicted, it is helpful to state this. The direction might be characterized either as being towards (or away from) the null, or as being in favour of one of the interventions.	NA / Favours experimental / Favours comparator / Towards null /Away from null / Unpredictable



Algorithm for suggested judgement of risk of bias in measurement of the outcome

Domain 5: Risk of bias in selection of the reported result

Signalling questions	**Elaboration**	**Response options**
5.1 Were the data that produced this result analysed in accordance with a pre-specified analysis plan that was finalized before unblinded outcome data were available for analysis?	If the researchers' pre-specified intentions are available in sufficient detail, then planned outcome measurements and analyses can be compared with those presented in the published report(s). To avoid the possibility of selection of the reported result, finalization of the analysis intentions must precede availability of unblinded outcome data to the trial investigators. Changes to analysis plans that were made before unblinded outcome data were available, or that were clearly unrelated to the results (e.g. due to a broken machine making data collection impossible) do not raise concerns about bias in selection of the reported result.	Y/PY/PN/N/NI
Is the numerical result being assessed likely to have been selected, on the basis of the results, from...		

5.2. ... multiple eligible outcome measurements (e.g. scales, definitions, time points) within the outcome domain?	A particular outcome domain (i.e. a true state or endpoint of interest) may be **measured** in multiple ways. For example, the domain pain may be measured using multiple scales (e.g. a visual analogue scale and the McGill Pain Questionnaire), each at multiple time points (e.g. 3, 6 and 12 weeks posttreatment). If multiple measurements were made, but only one or a subset is reported on the basis of the results (e.g. statistical significance), there is a high risk of bias in the fully reported result. Attention should be restricted to outcome measurements that are eligible for consideration by the RoB 2 tool user. For example, if only a result using a specific measurement scale is eligible for inclusion in a meta-analysis (e.g. Hamilton Depression Rating Scale), and this is reported by the trial, then there would not be an issue of selection even if this result was reported (on the basis of the results) in preference to the result from a different measurement scale (e.g. Beck Depression Inventory). Answer 'Yes' or 'Probably yes' if: There is clear evidence (usually through examination of a trial protocol or statistical analysis plan) that a domain was measured in multiple eligible ways, but data for only one or a subset of measures is fully reported (without justification), and the fully reported result is likely to have been selected on the basis of the results. Selection on the basis of the results can arise from a desire for findings to be newsworthy, sufficiently noteworthy to merit publication, or to confirm a prior hypothesis. For example, trialists who have a	Y/PY/PN/N/NI

	preconception, or vested interest in showing, that an experimental intervention is beneficial may be inclined to report outcome measurements selectively that are favourable to the experimental intervention. Answer 'No' or 'Probably no' if: There is clear evidence (usually through examination of a trial protocol or statistical analysis plan) that all eligible reported results for the outcome domain correspond to all intended outcome measurements. or There is only one possible way in which the outcome domain can be measured (hence there is no opportunity to select from multiple measures). or Outcome measurements are inconsistent across different reports on the same trial, but the trialists have provided the reason for the inconsistency and it is not related to the nature of the results. Answer 'No information' if: Analysis intentions are not available, or the analysis intentions are not reported in sufficient detail to enable an assessment, and there is more than one way in which the outcome domain could have been measured.	

5.3 ... multiple eligible analyses of the data?	A particular outcome measurement may be analysed in multiple ways. Examples include: unadjusted and adjusted models; final value vs change from baseline vs analysis of covariance; transformations of variables; different definitions of composite outcomes (e.g. 'major adverse event'); conversion of continuously scaled outcome to categorical data with different cut-points; different sets of covariates for adjustment; and different strategies for dealing with missing data. Application of multiple methods generates multiple effect estimates for a specific outcome measurement. If multiple estimates are generated but only one or a subset is reported on the basis of the results (e.g. statistical significance), there is a high risk of bias in the fully reported result. Attention should be restricted to analyses that are eligible for consideration by the RoB 2 tool user. For example, if only the result from an analysis of post-intervention values is eligible for inclusion in a meta-analysis (e.g. at 12 weeks after randomization), and this is reported by the trial, then there would not be an issue of selection even if this result was reported (on the basis of the results) in preference to the result from an analysis of changes from baseline. Answer 'Yes' or 'Probably yes' if:	Y/PY/PN/N/NI
	There is clear evidence (usually through examination of a trial protocol or statistical analysis plan) that a measurement was analysed in multiple eligible ways, but data for only one or a subset of analyses is fully reported (without justification), and the fully reported result is likely to have been selected on the basis of the results.	

	Selection on the basis of the results arises from a desire for findings to be newsworthy, sufficiently noteworthy to merit publication, or to confirm a prior hypothesis. For example, trialists who have a preconception or vested interest in showing that an experimental intervention is beneficial may be inclined to selectively report analyses that are favourable to the experimental intervention. Answer 'No' or 'Probably no' if: There is clear evidence (usually through examination of a trial protocol or statistical analysis plan) that all eligible reported results for the outcome measurement correspond to all intended analyses. or There is only one possible way in which the outcome measurement can be analysed (hence there is no opportunity to select from multiple analyses). or Analyses are inconsistent across different reports on the same trial, but the trialists have provided the reason for the inconsistency and it is not related to the nature of the results. Answer 'No information' if: Analysis intentions are not available, or the analysis intentions are not reported in sufficient detail to enable an assessment, and there is more than one way in which the outcome measurement could have been analysed.	
Risk-of-bias judgement	See algorithm.	Low / High / Some concerns
Optional: What is the predicted	If the likely direction of bias can be predicted, it is helpful to state this. The direction might be	NA / Favours experimental / Favours

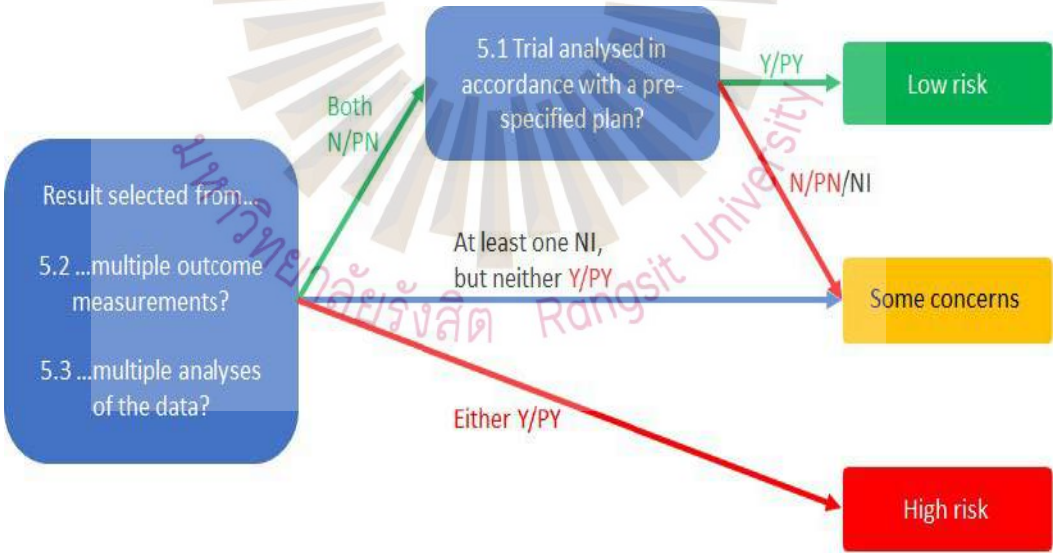
direction of bias due to selection of the reported result?	characterized either as being towards (or away from) the null, or as being in favour of one of the interventions.	comparator / Towards null /Away from null / Unpredictable

	experimental intervention is beneficial may be inclined to report outcome measurements selectively that are favourable to the experimental intervention. Answer 'No' or 'Probably no' if: There is clear evidence (usually through examination of a trial protocol or statistical analysis plan) that all eligible reported results for the outcome domain correspond to all intended outcome measurements. or There is only one possible way in which the outcome domain can be measured (hence there is no opportunity to select from multiple measures). or Outcome measurements are inconsistent across different reports on the same trial, but the trialists have provided the reason for the inconsistency and it is not related to the nature of the results. Answer 'No information' if: Analysis intentions are not available, or the analysis intentions are not reported in sufficient detail to enable an assessment, and there is more than one way in which the outcome domain could have been measured.	

5.3 ... multiple eligible analyses of the data?	A particular outcome measurement may be analysed in multiple ways. Examples include: unadjusted and adjusted models; final value vs change from baseline vs analysis of covariance; transformations of variables; different definitions of composite outcomes (e.g. 'major adverse event'); conversion of continuously scaled outcome to categorical data with different cut-points; different sets of covariates for adjustment; and different strategies for dealing with missing data. Application of multiple methods generates multiple effect estimates for a specific outcome measurement. If multiple estimates are generated but only one or a subset is reported on the basis of the results (e.g. statistical significance), there is a high risk of bias in the fully reported result. Attention should be restricted to analyses that are eligible for consideration by the RoB 2 tool user. For example, if only the result from an analysis of post-intervention values is eligible for inclusion in a meta-analysis (e.g. at 12 weeks after randomization), and this is reported by the trial, then there would not be an issue of selection even if this result was reported (on the basis of the results) in preference to the result from an analysis of changes from baseline. Answer 'Yes' or 'Probably yes' if:	Y/PY/PN/N/NI

	There is clear evidence (usually through examination of a trial protocol or statistical analysis plan) that a measurement was analysed in multiple eligible ways, but data for only one or a subset of analyses is fully reported (without justification), and the fully reported result is likely to have been selected on the basis of the results. Selection on the basis of the results arises from a desire for findings to be newsworthy, sufficiently noteworthy to merit publication, or to confirm a prior hypothesis. For example, trialists who have a preconception or vested interest in showing that an experimental intervention is beneficial may be inclined to selectively report analyses that are favourable to the experimental intervention. Answer 'No' or 'Probably no' if: There is clear evidence (usually through examination of a trial protocol or statistical analysis plan) that all eligible reported results for the outcome measurement correspond to all intended analyses. or There is only one possible way in which the outcome measurement can be analysed (hence there is no opportunity to select from multiple analyses). or Analyses are inconsistent across different reports on the same trial, but the trialists have provided the reason for the inconsistency and it is not related to the nature of the results. Answer 'No information' if: Analysis intentions are not available, or the analysis intentions are not reported in sufficient detail to enable	

	an assessment, and there is more than one way in which the outcome measurement could have been analysed.	
Risk-of-bias judgement	See algorithm.	Low / High / Some concerns
Optional: What is the predicted direction of bias due to selection of the reported result?	If the likely direction of bias can be predicted, it is helpful to state this. The direction might be characterized either as being towards (or away from) the null, or as being in favour of one of the interventions.	NA / Favours experimental / Favours comparator / Towards null /Away from null / Unpredictable



Algorithm for suggested judgement of risk of bias in selection of the reported result

Overall risk of bias

Risk-of-bias judgement		Low / High / Some concerns
Optional: What is the overall predicted direction of bias for this outcome?		Favours experimental / Favours comparator / Towards null /Away from null / Unpredictable / NA

Overall risk-of-bias judgement	**Criteria**
Low risk of bias	The study is judged to be at **low risk of bias for all domains** for this result.
Some concerns	The study is judged to raise **some concerns** in at least one domain for this result, but not to be at high risk of bias for any domain.
High risk of bias	The study is judged to be at **high risk of bias** in at least one domain for this result. Or The study is judged to have **some concerns** for **multiple domains** in a way that substantially lowers confidence in the result.

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