BMJ Open

Diagnostic Reliability in Teledermatology: A Systematic Review and a Meta-Analysis

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2022-068207
Article Type:	Original research
Date Submitted by the Author:	09-Sep-2022
Complete List of Authors:	Bourkas, Adrienn; Queen's University School of Medicine Barone, Natasha; McGill University Bourkas, Matthew; University of Toronto, Department of Biochemistry Mannarino, Matthew; McGill University, Department of Surgery Fraser, Robert; Western University Arthur Labatt Family School of Nursing, Nursing Lorincz, Amy; Swift Medical Inc Wang, Sheila; McGill University Ramirez-GarciaLuna, Jose; McGill University, Experimental Surgery
Keywords:	Telemedicine < BIOTECHNOLOGY & BIOINFORMATICS, DERMATOLOGY, PRIMARY CARE, Information technology < BIOTECHNOLOGY & BIOINFORMATICS, STATISTICS & RESEARCH METHODS

I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our licence.

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which Creative Commons licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

Title: Diagnostic Reliability in Teledermatology: A Systematic Review and a Meta-Analysis

Authors

Adrienn N. Bourkas*[1] (MSc), Natasha Barone*[2] (MSc), Matthew E.C. Bourkas[3] (PhD), Matthew Mannarino[5] (PhD), Robert D. J. Fraser[4,6] (RN, MN), Amy Lorincz[4] (MSc), Sheila C. Wang[4,7] (MD, PhD), Jose L. Ramirez-GarciaLuna[4,5] (MD, PhD)

* Authors contributed equally

Affiliations

[1]Faculty of Health Sciences, Queen's University School of Medicine, Kingston, Ontario, Canada

[2]Faculty of Medicine and Health Sciences, McGill University, Montreal, Quebec, Canada

[3]Temerty Faculty of Medicine, Department of Biochemistry, University of Toronto, Toronto, Ontario, Canada

[4]Swift Medical Inc., Toronto, Ontario, Canada

[5]Department of Surgery, McGill University, Montreal, Canada

[6]Arthur Labatt Family School of Nursing, Western University, London, Ontario Canada

[7]Department of Medicine, Division of Dermatology, McGill University Health Centre, Montreal, Quebec, Canada

Corresponding author

Jose L. Ramirez-GarciaLuna, MD, PhD

Research Institute-McGill University Health Centre

Montreal General Hospital 1650 Cedar Ave, Montreal, Quebec, Canada H3G 1A4

Tel: 514-934-1934 ext 44522

Email: jose.ramirezgarcialuna@mail.mcgill.ca

Abstract

Objectives: To compare TD and F2F agreement in primary diagnoses of dermatological conditions.

Design: Systematic review and Meta-Analysis

Methods: MEDLINE, Embase, Cochrane Library (Wiley), CINAHL, and medRxiv were searched between January 2010 and May 2022. Observational studies and randomized clinical trials that reported percentage agreement or kappa concordance for primary diagnoses between TD and F2F physicians were included. Titles, abstracts, and full-text articles were screened in duplicate. From 6,945 citations, 44 articles were included. A random-effects meta-analysis was conducted to estimate pooled estimates. The QUADAS-2 tool and the Cochrane RoB2 tool were used to evaluate the risk of bias. Primary outcome measures were mean percentage and kappa concordance for assessing diagnostic matches between TDs and F2F. Secondary outcome measures included agreement between TDs, F2F dermatologists, and TD and histopathology results.

Results: 44 studies were extracted and reviewed. The pooled agreement rate was 68.9%, and kappa concordance was 0.67. When both F2F and TD consults were conducted by dermatologists, the overall diagnostic agreement was significantly higher at 71%, compared to 44% for non-specialists. Kappa concordance was 0.69 for TD vs specialist, and 0.52 for non-specialists. Higher diagnostic agreements were also noted with image acquisition training, and the use of digital photography. Agreement rate was 76.4% between TDs, 82.4% between F2F physicians, and 55.7% between TD and histopathology.

Conclusions and Relevance: TD can be an attractive option particularly in resource poor settings. Future efforts should be placed on incorporating image acquisition training and access to high quality imaging technologies.

Registration number: 10.17605/OSF.IO/FJDVG

Keywords: teledermatology, dermatology consultations, store-and-forward, telemedicine, remote consultation, dermatology hospitalists

Article Summary:

Strengths and limitations of this study:

- This is the most comprehensive systematic review and meta-analysis of the topic to date without language restrictions applied.
- Inclusion criteria was broad, permitting the inclusion of all types of dermatological diseases, imaging technologies, in person physician specializations (GPs, hospitalists, and dermatologists), and presence or absence of image acquisition training.
- Article search was limited to 2010 and later due to the recent incorporation of smartphones in teledermatology practices.
- Due to considerable heterogeneity between studies, meta-analysis and synthesis of predictors for accurate diagnoses remotely was limited even after subgrouping.

Introduction

With the emergence of COVID-19, the introduction of virtual consults in healthcare settings, especially dermatology, has been expanded to allow many patients the opportunity for equitable access to care when in-person appointments pose a challenge and risk to patients.[1] Different modalities were introduced to support Teledermatology (TD). This involves the remote sharing of patient data, which includes synchronous video-streaming TD, and asynchronous sharing of still images- via emails, or text messages, or store-and-forward TD (SFTD).

Although both synchronous and asynchronous approaches have been shown to be cost effective, SFTD is particularly popular as it requires fewer resources and less coordination than synchronous TD.[2, 3] With the advent of higher resolution smartphone cameras, relatively minimal training is required to correctly capture data for remote dermatologists; multiple SFTD studies opted to provide no training in image capture and still found value in TD.[4, 5]

There is valid concern over the reliability of TD given the significant variability in diagnostic accuracy predicted across pre-pandemic research.[6] This is expected given the lack of standardization across studies and the potential for confounds across TD methodologies and applications, e.g., level of training or skin lesion type. This variability in approach may benefit from an increased demand, which could provide greater impetus to optimize and standardize TD.

To our knowledge, this is the first and most inclusive meta-analysis (MA) that compares dermatology TD consults to face-to-face (F2F) that looked at all relevant studies without overly exclusive inclusion criteria. The primary objective of this study was to compare the reliability of

TD diagnoses to F2F consults, as determined by Cohen's kappa interrater agreement and total agreement rates. TD can assume important roles as a routine complement to primary care and an alternate route to the typical in-person referrals. Consequently, we wanted to determine agreement for TD and all F2F consults, TD and F2F primary care consults, and finally TD and F2F dermatologist consults, which would arguably best capture the limitations introduced by the change in medium from F2F to TD.

Additional subset analyses were performed to control for potential confounds (e.g., inflammatory vs. malignant, staff training for image acquisition, teledermoscopy, and smartphone vs digital cameras) introduced by the heterogenous methodology. The secondary objectives sought to determine the agreement rate within TD diagnoses and within F2F consults to provide an idea of each medium's consistency, and for the agreement rate between TD and histopathology, provides the best estimate of accuracy.

Methods

Protocol Registration

This study was performed in accordance with the Preferred Reporting Items for Systematic review and Meta-Analysis Protocols (PRISMA-P) 2015 guidelines.[7] The protocol for this review was registered on Open Science Framework (https://osf.io/fjdvg).

Search Strategy

A comprehensive search of major bibliographic databases, MEDLINE, Embase, Cochrane Library (Wiley), CINAHL, and medRxiv was performed in August 2021, and MEDLINE was searched again between August 2021 and May 2022 to screen any new articles published after our protocol was registered. The search strategy was developed by a medical librarian at Queen's University (Kingston, ON).

No restrictions were placed on language or status of the publications. Search results were limited to studies published between January 2010 and May 2022 due to the novelty of incorporating smartphones in teledermatology remote consultations.[8] The International Prospective Register of Systematic Reviews (PROSPERO) and OSF were searched up to May 2022 for relevant ongoing systematic reviews using the terms 'telemedicine', 'teledermatology', 'dermatology', 'diagnostic accuracy', and 'diagnostic concordance'. Reference lists of included studies were screened to identify additional studies not identified in the search.

Eligibility Criteria

Studies evaluating the diagnostic reliability of TD that reported on patients with dermatological conditions who were evaluated by a clinician using SFTD (asynchronous) or live video-based (synchronous) telemedicine systems were included. It was required that all articles compared the tele- to a F2F diagnosis conducted by a physician. Inclusion and exclusion criteria are summarized in **eTable 1,** available in the supplementary appendix.

Data Selection & Extraction

Following the removal of duplicated citations, the titles and abstracts were screened. Following this step, a full text assessment was conducted. At both stages, screening was performed independently by two reviewers [AB and NB]. Any disagreements were resolved through consensus by two reviewers and when necessary, through discussion with a third reviewer [JLRG].

A data collection form was created on the *Covidence* website and piloted by two reviewers [AB, NB]. Three additional reviewers assisted with data extraction [JLRG, MB, MM]. Two reviewers were assigned to each paper. One reviewer extracted all characteristics of the included literature, and the second reviewer validated the characteristics for accuracy. Any disagreements were resolved by consensus. In the supplementary appendix, **eTable 2** summarizes the information extracted from full-text articles.

Data Synthesis

This MA assessed the effectiveness of SFTD technologies and live video conferencing in diagnosing skin conditions. Outcomes regarding complete diagnostic percentage agreement rates

and Cohen's kappa concordance were assessed separately, with some studies being part of both analyses if they reported both variables. The patient, intervention type, lesion, and geographic characteristics were summarized qualitatively. Please see supplementary appendix and **eTable 3** for more details on data synthesis and nomenclature for each study grouping.

Risk of Bias

Three reviewers [AB, NB, MB] completed the risk of bias assessment; all studies were independently reviewed. Version 2 of the Cochrane risk-of-bias tool for randomized trials (RoB 2) was used to assess the risk of bias in three randomized trials.[9-11] RoB 2 is structured into a fixed set of domains of bias, focusing on different aspects of trial design, conduct, and reporting.[12] The Quality Assessment of Diagnostic Assessment of Diagnostic Accuracy (2nd Edition, QUADAS-2) was used to assess risk of bias. Uncertain risk of bias was assigned to studies with insufficient information except for studies that were likely to be biased due to missing data. In the latter case, high risk of bias was assigned.

Search Strategy, and Data Analysis

Please see supplementary appendix for additional information on search strategy and interpretation of kappa values.

Patient and Public Involvement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

Results

6,945 studies were screened for eligibility of which 44 were included in this study. Of these, 40 studies reported diagnostic agreement rates[4, 5, 9-11, 13-47] and 21 studies reported kappa concordance.[5, 9, 13, 14, 19, 22, 25, 28-33, 35-37, 48-52] Further details are provided in the PRISMA diagram in **Figure 1**. Full list of excluded studies can be found in the supplementary appendix, **eTable 4**.

Study and patient characteristics

Table 1 summarizes study characteristics for the 44 papers that were included. Forty-one (93%) of the included studies were observational, of which 31 (76%) were prospective, nine (22%) were retrospective. One (2%) study was ambispective. Three studies were randomized controlled trials and one study was a quasi-randomized trial. Thirteen studies (30%) were from the United States of America (USA), where one study looked at patients living in Botswana who were evaluated by TDs based in the USA. Thirteen (30%) from Europe, eleven (25%) from South America, and seven (16%) from other countries. There were ten primary studies published after January 2020 where a pre and post pandemic analysis was performed.

Table 2 summarizes participant characteristics. Studies selected for the review included a total of 52,075 patients (Range: 26 to 24,210 patients). Some patients had multiple lesions and the total number of lesions included in the study was 57,222 (Range: 26 to 27,519 lesions). Thirty-seven (83%) of papers examined less than 500 skin lesions.

The mean age reported in 27 (61%) studies was 54.78 ± 15.69 years (Range: 0 to 100 years old). Thirty-four (77%) studies reported participant gender, with a mean of 57% females (Range: 3.2%

to 74%). Only 13 (29%) of studies reported information on Fitzpatrick skin types, ethnicity, or race. The dermatoses included in this study were grouped as "all types of skin lesions", "skin cancers only", and inflammatory or benign skin conditions. Twenty-seven studies (62%) included in this analysis were inclusive to all types of dermatoses, 13 (29%) studies looked specifically at suspicious lesions, and three (6.8%) studies excluded skin cancers completely. Results on the diagnostic reliability between TDs and F2F (specialist and non-specialists combined) and diagnostic agreement between TDs, F2F dermatologists, and TD vs Histopathology are included in the supplementary appendix.

Diagnostic reliability of TD when compared to F2F (specialist and non-specialists) evaluation

Agreement was assessed by measuring the complete agreement of primary diagnoses between TD and F2F physicians (both specialist and non-specialists) by analyzing diagnostic agreement rates (percentage) and concordance (Cohen's kappa coefficient). The overall diagnostic agreement rate and concordance were 68.9% (CI 64.4% to 73.1%), and 0.67 (CI 0.60 to 0.74). See **eFigure 1** and the supplementary appendix for further details.

Diagnostic agreement between TD and TD, F2F and F2F, and TD and Histopathology

Diagnostic agreement rates were also compared within rater groups, as well as between TD and histopathology, when values were available. Diagnostic agreement rate between TDs, F2F dermatologists, and TD vs histopathology were: 76.4% (CI 69% to 82.5%), 82.4% (CI 76.7% to 87.0%), and 55.7% (CI 53% to 58.4%). See **eFigure 2** and the supplementary appendix for further details.

Sub-group analyses

Diagnostic reliability of TD when compared to the current gold standard (F2F evaluation by a dermatologist) vs non-specialist

Thirty-five studies reported diagnostic agreement rates.[4, 5, 9-11, 13-20, 22, 25-33, 35-46] **Figure 2A** shows that the percentage agreement between TD and F2F dermatologists ranged from 38% to 98%, with 44 out of 64 comparisons having percentage agreement above 60% and seven studies having over 90% agreement. The diagnostic agreement rate between TD and F2F dermatologist was 70.96% (CI 69.8% to 72.1%) while the diagnostic agreement rate between TD and F2F of non-specialists was 44.1% (CI 39.9% to 48.4%). When non-specialists were compared to dermatologists for F2F vs. TD the agreement rate was significantly lower among non-specialists ($p < 0.001$, heterogeneity: $I^2 = 98\%$). The percent agreement ranged from 13.9% to 71.7%, with six out of eight having concordance values below 50%.[20, 21, 23, 24, 30, 32, 34, 47]

Thirteen studies with 28 unique comparisons made between TD and F2F dermatologists that reported concordance values.[9, 13, 14, 19, 22, 28, 31-33, 37, 42, 49, 51] When kappa concordance values were compared, **Figure 2B** shows diagnostic agreement between TD and F2F dermatologists had a mean of 0.69 (CI 0.60 to 0.75) and it ranged between 0.213 (CI 0.20 to 0.23) to 0.96 (CI 0.92 to 0.98). When comparing TDs to non-specialists, the mean concordance value for diagnostic agreement from four studies had a mean of 0.52 (CI 0.25 to 0.71).[30, 32, 48, 50] When non-specialists were compared to dermatologists for F2F vs. TD, diagnostic concordance was significantly lower among non-specialists ($p = 0.031$, heterogeneity: $I^2 = 100\%$).

Diagnostic reliability of TD vs F2F by training involved and type of technology used related to image acquisition

Twenty studies with 37 unique comparisons that compared TDs with F2F physicians stated explicitly that training was provided to those in charge of image acquisition shown in **Figure 3**.[9-11, 14-16, 19, 20, 23, 26, 29, 32, 35-41, 43, 44] The mean agreement rate shown in **Figure 3A** was higher at 75.9% (CI 74.4% to 77.27%) compared to no training provided 62.1% (CI 60.5% to 63.7%), and this difference was statistically significant (p = 0.033, heterogeneity: I^2 = 98%). Concordance values in **Figure 3B** were also higher between TD and F2F when training was provided, with a mean 0.77 (CI 0.66-0.84), and 0.60 (CI 0.49-0.69) without training. This difference was statistically significant (p = 0.01, I^2=98%).

Other sub-group analyses

Statistically significant trends related to diagnostic agreement by image capturing technologies (**eFigure 5**) were also identified. No statistically significant patterns could be identified with the use of teledermoscopy, lesion type, grouping studies as pre- or post-pandemic, or risk of bias. Please see supplementary appendix for further details.

Quality assessment

The results of quality assessment for risk of bias and applicability in individual studies are displayed in the supplementary appendix and **eTable 5**.

Discussion:

This study constitutes the largest systematic review and MA on TD to our knowledge, including 44 studies across four languages.

We noted an overall agreement rate of 68.9% and overall concordance of kappa = 0.67 between TDs and F2F physicians. Through sub-group analyses, we found that the agreement was significantly higher for studies that compared TD to in-person assessments by dermatologists compared to non-specialists (difference of 26.86%, p <0.001). The lower concordance when F2F non-specialists are used suggests that lowered reference test accuracy reduces agreement rates: and for the purposes of clinical practice, it implies a greater need for TD to supplement primary over specialist care.

We noted greater agreement rates (p = 0.033) between in-person and remote care when standardized training on image acquisition was incorporated into clinical workflow – suggesting a benefit to training primary care providers supporting TD.[24, 53, 54] Digital photography was also associated with more frequent agreement rates between TD and F2F physicians (p = 0.029). Although the exact reason for this trend is less clear, this could be attributed to better image resolution and more experienced staff taking clinical images in a standardized manner for virtual consultations.

Pathological assessment of skin lesions is the cornerstone of skin cancer diagnosis. This MA found a 55.7% (CI 53.0% to 58.4%) agreement rate between TD and histopathology. This low agreement rate reflects all skin biopsies, and specific diagnostic accuracy rates could not be calculated by

lesion type due to the small number of studies that reported this value. Through sub-group analyses, we were able to compare cancerous and non-cancerous lesions; slightly higher concordance was seen with skin cancers compared to studies that also included non-suspicious lesions like dermatitis and psoriasis. However, data was too heterogeneous for any significant conclusions. We also looked at the use of teledermoscopy, another technique that could help improve diagnostic accuracy of TD for suspicious lesions, but no significant trends could be identified. These findings reflected the results of a 2016 systematic review on TD.[6]

Many teledermoscopy studies grouped statistics from lesions analyzed with and without dermoscopy, preventing the assessment of the dermatoscope's incremental contributions without the influence of potentially less accurate, dermatoscope-free analysis. Supporting this explanation, the three teledermoscopy studies that focused on cancer lesions demonstrated greater concordance rates than the teledermoscopy studies targeting broader lesions. One study identified agreement rates between TD and F2F dermatology of 92.3% (24/26) and between TD and histopathology of 66.7% (17/26), both above our identified median.[45] Another study found an agreement rate of 90% (37/41) when targeting pigmented lesions, although the rate may have been inflated due to recall bias introduced by having the same dermatologist perform TD and F2F consults.[16] Finally, one study diagnosed keratotic lesions in sun-exposed areas, finding a high agreement rate of 92% (915/1000).[37] However, this study also risked bias from its experimental design, which excluded lesions with poor image quality. This fails to recapitulate the complexities of practical TD, which must contend with potentially difficult image acquisition.

The 68.9% (CI 64.4% to 73.05%) combined agreement rate between TD and F2F is lower than the agreement rates outlined in a recent review.[55] This suggests our greater sample size introduces more studies with poor agreement, which may better reflect the reality of adopting TD at a larger scale and signal risk from a lack of standardization.[54, 55] Our date cut-off of 2010 means our dataset has little overlap with existing reviews, and more heavily features new relevant technologies like smartphone apps for image acquisition.[6, 56] The most recent MA[56] on TD limited its dataset to studies with multiple TD and F2F consults, and variably choosing to filter low-frequency diagnoses from certain studies.[46] Our results had greater heterogeneity compared to this MA, drawing attention to a key issue in the literature: unless results are heavily filtered – introducing bias, omitting most research, and weakening statistical power, the data is too heterogenous for effective metanalytic inferences. However, messy and heterogeneous data likely reflects real-world evidence and clinical practices.

A possible source of heterogeneity in our analysis could be due to lack of stratification by study design given the minute number of randomized controlled trials available for analysis. However, filtering biased studies did not improve the suitability of our data for our proposed random-effects MA model. Our review also risked publication bias by not actively seeking out unpublished materials in conference proceedings. This likely reflects the nature of clinical work, highlighting the variability across different providers and settings and reinforcing the need to develop a standardized framework for employing and assessing TD.

Current trends suggest that TD will continue to expand, there have been many recent studies examining its accuracy without the design considerations necessary to allow comparisons beyond

siloed investigations.[1] The implementation of evidence-informed processes is critical to the success of TD services, and the accurate assessment of TD will be required to assess which contexts it should be employed in, e.g., suspected malignancy vs. erythema.

The factors targeted by our sub analysis are undoubtedly important to standardize with best practices requiring the inclusion of primary care provider training in image acquisition, explicitly outlined conditions where dermatoscope attachments are required, and standardized reporting with a lesion's anatomical site, size, distribution, morphology, and colour. Additional guidelines for data reporting could be designed with a mind to future research goals, e.g., the inclusion of Fitzpatrick grading to identify gaps in medical care. Finally, both clinical and research guidelines must address privacy concerns, as the integration of EMR and the sharing of patient images or videos presents potential vulnerabilities.

Conclusion:

This MA indicates that diagnostic agreement between remote and in person dermatologists is acceptable in select conditions (i.e., when training for image acquisition is provided and technologies for high-quality images are used). Telemedicine adoption rates are accelerating globally, and TD must be considered for enhanced accessibility, flexibility, reduced costs, and safer environments it can provide patients.

The results of this MA represent significant evidence to indicate the suitability of TD for remote care, particularly as a complement to primary care, where it can serve as an intermediate step before F2F specialist consultations. Furthermore, the categorisation of diagnostic concordance highlights important factors to further improve diagnostic accuracy. Additionally, it highlights the lack of standardization in TD studies, calling for greater structure in clinical practice and conducting primary research.

Acknowledgements:

The authors would like to acknowledge Heba Tallah Mohammed affiliated with Swift Medical for reviewing the manuscript, and for adding their valuable insight. The search strategies were developed with Abdul Kareem Pullattayil (AKP), a health science librarian at Bracken Health Sciences Library Botterell Hall at Queen's University.

Author Contributions:

JLRG is the guarantor of the review and supervised study design. JLRG also contributed to data analysis and provided statistical expertise. AB and NB oversaw study design, data collection, data analysis, and original draft preparation. AB designed the search strategy with the guidance

of the medical librarian, AKP. AB, NB, MB, MM participated in the abstract and full text screen, data extraction, and risk of bias assessment. RDJF, AL, and SCW contributed to draft review and editing. All authors read, provided feedback and approved the final manuscript.

Funding:

This work was supported by the Digital Technology Supercluster as part of the Telewound Care Canada project. The funder was not involved in the design or analysis of this study.

Competing interests:

JLRG, RDJF, AL are employees, and SCW is a co-founder, medical chief officer, and shareholder of Swift Medical. No funding bodies have any role in study design, data collection and analysis, decision to publish, or preparation of the manuscript. All other authors declare no conflict of interest.

Data availability statement:

Data are available in a public, open access repository. All data relevant to the study are included in the article, uploaded as supplementary information, or deposited on Open Science Framework: https://osf.io/fjdvg. Data are available under the terms of the Creative Commons Zero "No rights reserved" data waiver (CC0 1.0 Public domain dedication). Our systematic review produced a large amount of information, and the arising database is available for future collaboration on additional analyses. Please contact the corresponding author with any inquiries.

Patient consent for publication:

Not required.

Abstract word count: 292 words; **Manuscript word count:** 3104 words

References

1. Mohammed HT, Hyseni L, Bui V, et al. Exploring the use and challenges of implementing virtual visits during COVID-19 in primary care and lessons for sustained use. *PLoS One*. 2021;16(6):e0253665. doi:10.1371/journal.pone.0253665
2. Armstrong AW, Chambers CJ, Maverakis E, et al. Effectiveness of Online vs In-Person Care for Adults With Psoriasis: A Randomized Clinical Trial. *JAMA Network Open*. 2018;1(6):e183062-e183062. doi:10.1001/jamanetworkopen.2018.3062
3. Wang RH, Barbieri JS, Nguyen HP, et al. Clinical effectiveness and cost-effectiveness of teledermatology: Where are we now, and what are the barriers to adoption? *Journal of the American Academy of Dermatology*. 2020;83(1):299-307. doi:10.1016/j.jaad.2020.01.065
4. Okita AL, Molina Tinoco LJ, Criado PR, et al. Use of Smartphones in Telemedicine: Comparative Study Between Standard and Teledermatological Evaluation of High-Complex Care Hospital Inpatients. *Telemedicine journal and e-health : the official journal of the American Telemedicine Association*. 2016;22(9):755-760. doi:http://dx.doi.org/10.1089/tmj.2015.0086
5. Saleh N, Abdel Hay R, Hegazy R, Hussein M, Gomaa D. Can teledermatology be a useful diagnostic tool in dermatology practice in remote areas? An Egyptian experience with 600 patients. *Journal of telemedicine and telecare*. 2017;23(2):233-238. doi:http://dx.doi.org/10.1177/1357633X16633944
6. Finnane A, Dallest K, Janda M, Soyer HP. Teledermatology for the Diagnosis and Management of Skin Cancer: A Systematic Review. *JAMA Dermatol*. Mar 1 2017;153(3):319-327. doi:10.1001/jamadermatol.2016.4361
7. Moher D, Shamseer L, Clarke M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Syst Rev*. Jan 1 2015;4(1):1. doi:10.1186/2046-4053-4-1
8. Brewer AC, Endly DC, Henley J, et al. Mobile applications in dermatology. *JAMA Dermatol*. Nov 2013;149(11):1300-4. doi:10.1001/jamadermatol.2013.5517
9. Rios-Yuil JM. [Correlation between face-to-face assessment and telemedicine for the diagnosis of skin disease in case conferences]. *Actas dermo-sifiliograficas*. 2012;103(2):138-43. doi:https://dx.doi.org/10.1016/j.ad.2011.05.011
10. Romero Aguilera G, Cortina De La Calle P, Vera Iglesias E, Sanchez Caminero P, Garcia Arpa M, Garrido Martin JA. Interobserver reliability of store-and-forward teledermatology in a clinical practice setting. *Actas Dermo-Sifiliograficas*. 2014;105(6):605-613. doi:http://dx.doi.org/10.1016/j.adengl.2014.05.018
11. Romero G, Sanchez P, Garcia M, Cortina P, Vera E, Garrido JA. Randomized controlled trial comparing store-and-forward teledermatology alone and in combination with web-camera videoconferencing. *Clinical and Experimental Dermatology*. 2010;35(3):311-317. doi:http://dx.doi.org/10.1111/j.1365-2230.2009.03503.x
12. Sterne JAC, Savović J, Page MJ, et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. *BMJ*. 2019;366:l4898. doi:10.1136/bmj.l4898
13. Altieri L, Hu J, Nguyen A, et al. Interobserver reliability of teledermatology across all Fitzpatrick skin types. *Journal of telemedicine and telecare*. 2017;23(1):68-73. doi:http://dx.doi.org/10.1177/1357633X15621226
14. Castelo-Soccio L, Kovarik CL, Azfar RS, et al. Reliability and validity of mobile teledermatology in human immunodeficiency virus-positive patients in botswana a pilot study.

JAMA Dermatology. 2014;150(6):601-607. doi:http://dx.doi.org/10.1001/jamadermatol.2013.7321
15. Barbieri JS, Nelson CA, James WD, et al. The reliability of teledermatology to triage inpatient dermatology consultations. *JAMA Dermatology*. 2014;150(4):419-424. doi:http://dx.doi.org/10.1001/jamadermatol.2013.9517
16. Barcaui CB, Lima PMO. Application of teledermoscopy in the diagnosis of pigmented lesions. *International Journal of Telemedicine and Applications*. 2018;2018((Barcaui) Adjunct Professor of Dermatology, Faculty of Medical Sciences, State University of Rio de Janeiro, PhD in Medicine (Dermatology), University of Sao Paulo, Dermatology Department, Pedro Ernesto University Hospital, Rio de Janeiro State University):1624073. doi:http://dx.doi.org/10.1155/2018/1624073
17. Batalla A, Suh-Oh HJ, Abalde T, Salgado-Boquete L, de la Torre C. Teledermatology in Paediatrics. Observations in daily clinical practice. *Anales de pediatria (Barcelona, Spain : 2003)*. 2016;84(6):324-330. doi:http://dx.doi.org/10.1016/j.anpedi.2015.07.005
18. Borve A, Holst A, Gente-Lidholm A, Molina-Martinez R, Paoli J. Use of the mobile phone multimedia messaging service for teledermatology. *Journal of Telemedicine and Telecare*. 2012;18(5):292-296. doi:http://dx.doi.org/10.1258/jtt.2012.120206
19. Borve A, Terstappen K, Sandberg C, Paoli J. Mobile teledermoscopy-there's an app for that! *Dermatology practical & conceptual*. 2013;3(2):41-8. doi:https://dx.doi.org/10.5826/dpc.0302a05
20. Carter ZA, Li X, Goldman S, et al. Creation of an internal teledermatology store-and-forward system in an existing electronic health record: A pilot study in a safety-net public health and hospital system. *JAMA Dermatology*. 2017;153(7):644-650. doi:http://dx.doi.org/10.1001/jamadermatol.2017.0204
21. Chen TS, Goldyne ME, Mathes EFD, Frieden IJ, Gilliam AE. Pediatric teledermatology: Observations based on 429 consults. *Journal of the American Academy of Dermatology*. 2010;62(1):61-66. doi:http://dx.doi.org/10.1016/j.jaad.2009.05.039
22. Clarke EL, Reichenberg JS, Ahmed AM, et al. The utility of teledermatology in the evaluation of skin lesions. *Journal of telemedicine and telecare*. 2021;(9506702, cpj):1357633X20987423. doi:https://dx.doi.org/10.1177/1357633X20987423
23. Costello CM, Cumsky HJL, Maly CJ, et al. Improving Access to Care Through the Establishment of a Local, Teledermatology Network. *Telemedicine journal and e-health : the official journal of the American Telemedicine Association*. 2020;26(7):935-940. doi:https://dx.doi.org/10.1089/tmj.2019.0051
24. Duong TA, Cordoliani F, Julliard C, et al. Emergency department diagnosis and management of skin diseases with real-time teledermatologic expertise. *JAMA Dermatology*. 2014;150(7):743-747. doi:http://dx.doi.org/10.1001/jamadermatol.2013.7792
25. Gabel CK, Nguyen E, Karmouta R, et al. Use of teledermatology by dermatology hospitalists is effective in the diagnosis and management of inpatient disease. *Journal of the American Academy of Dermatology*. 2021;84(6):1547-1553. doi:https://dx.doi.org/10.1016/j.jaad.2020.04.171
26. Gatica JL, Bertolo S, Morales E, Espinoza M, Contreras C. Store-and-forward teledermatogy in Chile: A contribution to primary health care. *Piel*. 2015;30(3):148-154. doi:http://dx.doi.org/10.1016/j.piel.2014.07.007

27. Gerhardt CA, Foels R, Grewe S, Baldwin BT. Assessing the Diagnostic Accuracy of Teledermatology Consultations at a Local Veterans Affairs Dermatology Clinic. *Cureus*. 2021;13(6):e15406. doi:https://dx.doi.org/10.7759/cureus.15406
28. Giavina-Bianchi M, Azevedo MFD, Sousa RM, Cordioli E. Part II: Accuracy of Teledermatology in Skin Neoplasms. *Frontiers in medicine*. 2020;7(101648047):598903. doi:https://dx.doi.org/10.3389/fmed.2020.598903
29. Giavina-Bianchi M, Sousa R, Cordioli E. Part I: Accuracy of Teledermatology in Inflammatory Dermatoses. *Frontiers in medicine*. 2020;7(101648047):585792. doi:https://dx.doi.org/10.3389/fmed.2020.585792
30. Keller JJ, Johnson JP, Latour E. Inpatient teledermatology: Diagnostic and therapeutic concordance among a hospitalist, dermatologist, and teledermatologist using store-and-forward teledermatology. *Journal of the American Academy of Dermatology*. 2020;82(5):1262-1267. doi:https://dx.doi.org/10.1016/j.jaad.2020.01.030
31. Lamel SA, Haldeman KM, Ely H, Armstrong AW, Kovarik CL, Pak H. Application of mobile teledermatology for skin cancer screening. *Journal of the American Academy of Dermatology*. 2012;67(4):576-581. doi:http://dx.doi.org/10.1016/j.jaad.2011.11.957
32. Muir J, Xu C, Singh P, et al. Incorporating teledermatology into emergency medicine. *EMA - Emergency Medicine Australasia*. 2011;23(5):562-568. doi:http://dx.doi.org/10.1111/j.1742-6723.2011.01443.x
33. Nami N, Rubegni P, Fimiani M, Massone C, Hofmann-Wellenhof R, Cevenini G. Concordance and Time Estimation of Store-and-Forward Mobile Teledermatology Compared to Classical Face-to-Face Consultation. *Acta Dermato-Venereologica*. 2015;95(1):35-39. doi:http://dx.doi.org/10.2340/00015555-1876
34. Patro BK, Tripathy JP, De D, Sinha S, Singh A, Kanwar AJ. Diagnostic agreement between a primary care physician and a teledermatologist for common dermatological conditions in North India. *Indian dermatology online journal*. 2015;6(1):21-6. doi:https://dx.doi.org/10.4103/2229-5178.148927
35. Ribas J, Schettini APM, Ribas CBDR, Cunha MDGS. Agreement between dermatological diagnoses made by live examination compared to analysis of digital images. *Anais Brasileiros de Dermatologia*. 2010;85(4):441-447. doi:http://dx.doi.org/10.1590/s0365-05962010000400004
36. Rubegni P, Nami N, Poggiali S, et al. Geriatric teledermatology: Store-and-forward vs. face-to-face examination. *Journal of the European Academy of Dermatology and Venereology*. 2011;25(11):1334-1339. doi:http://dx.doi.org/10.1111/j.1468-3083.2011.03986.x
37. Sola-Ortigosa J, Munoz-Santos C, Masat-Tico T, Isidro-Ortega J, Guilabert A, Grup d'Estudi de Teledermatologia del Valles O. The Role of Teledermatology and Teledermoscopy in the Diagnosis of Actinic Keratosis and Field Cancerization. *The Journal of investigative dermatology*. 2020;140(10):1976-1984.e4. doi:https://dx.doi.org/10.1016/j.jid.2020.02.013
38. Tan E, Yung A, Oakley A, Rademaker M, Jameson M. Successful triage of patients referred to a skin lesion clinic using teledermoscopy (IMAGE IT trial). *British Journal of Dermatology*. 2010;162(4):803-811. doi:http://dx.doi.org/10.1111/j.1365-2133.2010.09673.x
39. Tran K, Ayad M, Monir S, et al. Mobile teledermatology in the developing world: Implications of a feasibility study on 30 Egyptian patients with common skin diseases. *Journal of the American Academy of Dermatology*. 2011;64(2):302-309. doi:http://dx.doi.org/10.1016/j.jaad.2010.01.010

40. Vano-Galvan S, Aguayo-Leiva I, Rios-Buceta L, et al. Store-and-forward teledermatology: Assessment of validity in a series of 2000 observations. *Actas Dermo-Sifiliograficas*. 2011;102(4):277-283. doi:http://dx.doi.org/10.1016/S1578-2190(11)70803-4
41. Vestergaard T, Prasad SC, Schuster A, Laurinaviciene R, Andersen MK, Bygum A. Diagnostic accuracy and interobserver concordance: teledermoscopy of 600 suspicious skin lesions in Southern Denmark. *Journal of the European Academy of Dermatology and Venereology : JEADV*. 2020;34(7):1601-1608. doi:https://dx.doi.org/10.1111/jdv.16275
42. Gravely AA, Warshaw EM, Nelson DB. Reliability of store and forward teledermatology for skin neoplasms. *Journal of the American Academy of Dermatology*. 2015;72(3):426-435. doi:http://dx.doi.org/10.1016/j.jaad.2014.11.001
43. Zanini M. Analyze of diagnostic concordance between face-to-face and teledermatology diagnosis. *Medicina Cutanea Ibero-Latino-Americana*. 2013;41(2):60-62. doi:http://dx.doi.org/10.4464/MC.2013.41.2.5058
44. Zink A, Kolbinger A, Leibl M, et al. The value of teledermatology using a mobile app compared to conventional dermatology. *European Journal of Dermatology*. 2017;27(4):429-431. doi:http://dx.doi.org/10.1684/ejd.2017.3044
45. Zink A, Kolbinger A, Leibl M, et al. Teledermoscopy by mobile phones: Reliable help in the diagnosis of skin lesions? *Hautarzt*. 2017;68(11):890-895. doi:http://dx.doi.org/10.1007/s00105-017-4042-0
46. Marchell R, Locatis C, Liu W-L, Ackerman M, Burges G, Maisiak R. Comparing High Definition Live Interactive and Store-and-Forward Consultations to In-Person Examinations. *Telemedicine journal and e-health : the official journal of the American Telemedicine Association*. 2017;23(3):213-218. doi:http://dx.doi.org/10.1089/tmj.2016.0093
47. Jones L, Jameson M, Oakley A. Remote Skin Cancer Diagnosis: Adding Images to Electronic Referrals Is More Efficient Than Wait-Listing for a Nurse-Led Imaging Clinic. *Cancers (Basel)*. Nov 20 2021;13(22)doi:10.3390/cancers13225828
48. Gonzalez Coloma F, Sandoval Garces M, Gedda Quiroga V, Bley Banda C. Teledermatology in Remote Parts of Chile: Experience in 4 Isolated Rural Areas. *Actas dermo-sifiliograficas*. 2019;110(8):653-658. doi:https://dx.doi.org/10.1016/j.ad.2019.01.009
49. Goulart Silveira CE, Carcano C, Mauad EC, Faleiros H, Longatto-Filho A. Call phone usefulness to improve the skin cancer screening: preliminary results and critical analysis of mobile app development. *Rural & Remote Health*. 2019;19(1):1-7. doi:10.22605/RRH4895
50. Piccoli MF, Amorim BDB, Wagner HM, Nunes DH. Teledermatology protocol for screening of Skin cancer. *Anais Brasileiros de Dermatologia*. 2015;90(2):202-210. doi:http://dx.doi.org/10.1590/abd1806-4841.20153163
51. Senel E, Baba M, Durdu M. The contribution of teledermatoscopy to the diagnosis and management of non-melanocytic skin tumours. *Journal of Telemedicine and Telecare*. 2013;19(1):60-63. doi:http://dx.doi.org/10.1177/1357633X12474961
52. Gravely AA, Nelson DB, Warshaw EM. Accuracy of teledermatology/teledermoscopy and clinic-based dermatology for specific categories of skin neoplasms. *Journal of the American Academy of Dermatology*. 2010;63(2):348-352. doi:http://dx.doi.org/10.1016/j.jaad.2009.10.037
53. Massone C, Javor S, Amato I, Biondo G, Brunasso AMG, Hofmann-Wellenhof R. Training of primary care physicians enhances performance of mobile teledermatology. *Anais brasileiros de dermatologia*. 2021;96(4):514-516. doi:https://dx.doi.org/10.1016/j.abd.2020.07.017

54. Finnane A, Curiel-Lewandrowski C, Wimberley G, et al. Proposed Technical Guidelines for the Acquisition of Clinical Images of Skin-Related Conditions. *JAMA Dermatol*. May 1 2017;153(5):453-457. doi:10.1001/jamadermatol.2016.6214
55. Lee JJ, English JC, 3rd. Teledermatology: A Review and Update. *Am J Clin Dermatol*. Apr 2018;19(2):253-260. doi:10.1007/s40257-017-0317-6
56. Bastola M, Locatis C, Fontelo P. Diagnostic Reliability of In-Person Versus Remote Dermatology: A Meta-Analysis. *Telemed J E Health*. Mar 2021;27(3):247-250. doi:10.1089/tmj.2020.0043

Figure Legends

Figure 1. **PRISMA Flow diagram of study selection.**

Figure 2. Forest plot representing F2F and TD primary diagnostic agreement by specialization status of the F2F physician. Studies were sorted into two groups, a) F2F diagnosis completed by a board-certified dermatologist; b) F2F diagnosis completed by a non-specialist (e.g., general practitioner). **(A)** Forest plot representing percentage agreement and 95% C.I. for overall concordance across 40 studies with a total of 72 unique number of comparisons, N of events and total included participants. **(B)** Forest plot representing kappa concordance and 95% C.I. for overall concordance across 21 studies with a total of 45 unique number of comparisons, N of total included participants.

Figure 3. Forest plot representing F2F and TD primary diagnostic agreement by whether imaging acquisition training was indicated by the study.
Forest plot representing F2F and TD primary diagnostic agreement when image acquisition training is involved. Studies were sorted into two groups, a) Did not conduct or did not report training personnel on image acquisition; b) Stated that person in charge of image acquisition was trained. **(A)** Forest plot representing percentage agreement and 95% C.I. for overall concordance across 39 studies with a total of 71 unique number of comparisons, N of events and total included participants. **(B)** Forest plot representing kappa concordance and 95% C.I. for overall concordance across 21 studies with a total of 45 unique number of comparisons, N of total included participants.

Tables

A

TD vs Derm					
Source	**Study design**	**Country of publ., Study reported funding (Y/N)**	**Intervention** Assessment of diagnostic agreement between...	**Outcomes** Comparing complete primary diagnostic agreement between **F2F and TD** (and between Histo and TD if applicable)	**Quality rating**
Standard of reference: F2F					
Azfar, et al, 2014	Prospective Cohort Study	Botswana, N	TD and F2F dermatologists via smartphone images	Diagnostic agreement rate (TD1 46.6%, TD2 56.8%, TD3 48.6%) concordance (TD1 0.41, TD2 0.51, TD3 0.43), N=136	Low
Barcaui, et al, 2018	Prospective Cohort Study	Brazil, N	TD and F2F consult by the same dermatologist via digital photography and dermoscopy images stored in WhatsApp	Diagnostic agreement rate (90%, N=41)	High
Batalla, 2015	Retrospective Cohort Study	Spain, N	TD and F2F dermatologists by via clinical images	Diagnostic agreement rate (55%, N=65)	Moderate
Borve, et al, 2012	Prospective Cohort Study	Sweden, Y	TD and F2F consults by the same dermatologist via smartphone images stored in Tele-Dermis	Diagnostic agreement rate (78%, N=40)	High
Gatica, et al, 2015	Prospective Cohort Study	Chile, N	TD and F2F dermatologists via clinical images taken by digital photography	Diagnostic agreement rate (82%, N=125)	Moderate
Gerhardt, et al, 2021	Observational study	USA, Y	TD and F2F dermatologists via clinical images	Diagnostic agreement rate (75.3%, N=809)	High
Keller, et al, 2020	Prospective Cohort Study	USA, Y	TD and F2F dermatologists or hospitalists on clinical images taken by smartphones and tablets	Derm vs TD: Diagnostic agreement rate (52.5%), concordance (0.45)	Low
Marchell, et al., 2017	Quasi RCT	USA, Y	TD and F2F dermatologists via digital photography, compressed and uncompressed video	SFTD: Diagnostic agreement rate (76%, N=213); uncompressed video (76%, N=101), compressed video (72%, N=112)	Low
Muir, et al,	Prospective	Australia,	TD and F2F	Derm vs TD:	High

Skin cancer, and other common dermatological lesions

2011	Cohort Study	N	emergency derms and non-specialists via clinical images taken by digital photography	Diagnostic agreement rate (98%), concordance (0.93)		
Nami, et al, 2015	Prospective Cohort Study	Italy and Austria, Y	TD and F2F dermatologists via smartphone images stored in MugDerma	Diagnostic agreement rate (91.05%), concordance (0.906), N=391	High	
Okita, et al, 2016	Prospective Cohort Study	Brazil, N	TD and F2F dermatologists via smartphone images	Diagnostic agreement rate (54%, N=100)	High	
Ribas, et al, 2010	Prospective Study	Brazil, Y	TD and F2F dermatologists via digital photography	Diagnostic agreement rate (81.5%) concordance (0.8), N=174	High	
Romero Aguilera, et al, 2014	Prospective Cohort Study	Spain, Y	TD and F2F dermatologists via clinical images taken by digital photography stored in DERMARED. A small portion of patients were seen by the same Derm for F2F and TD consult.	Diagnostic agreement rate (77.8%, N=170)	Moderate	
Romero, et al, 2010	Randomized Controlled Trial	Spain, Y	TD and F2F consults by the same dermatologist via digital photography and videoconferences via DERMARED software	Diagnostic agreement rate (85%, N=368)	Moderate	
Rubegni, et al, 2011	Prospective Cohort Study	Italy, N	TD and F2F dermatologists via digital photography and dermoscopy images stored in Dermo-image.	Diagnostic agreement rate (87.7%), concordance (0.863), N=130	Low	
Saleh, et al, 2017	Prospective Cohort Study	Egypt, Y	TD and F2F dermatologists via clinical images taken by digital photography stored in Dropbox	Diagnostic agreement rate (81.3%), concordance (0.46-0.52), N=600	Low	
Vano-Galvan, et al, 2010	Retrospective, Cross-sectional study	Spain, N	TD and F2F dermatologists via clinical images taken by digital photography for case conferences	Diagnostic agreement rate (69.05%, N=2000)	High	
Zanini, 2013	Prospective Cohort Study	Brazil, N	TD and F2F dermatologists via clinical images taken by digital photography	Diagnostic agreement rate (76.3%, N=100)	Moderate	
Carter, et al, 2017	Prospective and retrospective	USA, Y	TD and F2F dermatologists, as well as F2F PCP via	Derm vs TD: Diagnostic agreement rate	High	Skin ca lesions

	cohort study		clinical images stored using Epic EHR software	(38%)		
Lamel, et al, 2012	Prospective Cohort Study	USA, N	TD and F2F dermatologists via smartphone images stored in ClickDerm	Diagnostic agreement rate (62%), concordance (0.6) N=107	Moderate	
Vestergaard, et al, 2020	Prospective Cohort Study	Denmark, N	TD and F2F dermatologists via smartphone and dermoscopy images using FotoFinder Systems	F2F: Diagnostic agreement rate (TD1 62%, TD2 60.2%), concordance (TD1 0.58, TD2 0.57), N=600 Histo: Diagnostic agreement rate (TD1 58.2%, TD2 53.6%), N=292	High	
Warshaw, et al, 2015	Prospective, Cross-sectional study	USA, N	TD and F2F dermatologists via digital photography and dermoscopy images	Diagnostic agreement rate and concordance* A1 (75.70%, 0.56), N=753 A2 (75.30%, 0.56), N=752 A3 (80.10%, 0.62), N=684 B1 (52.80%, 0.44), N=651 B2 (53.40%, 0.45), N=652 B3 (60.00%, 0.52), N=595 C1 (51.50%, 0.38), N=583 C2 (50.20%, 0.38), N=579 D1 (45.70%, 0.32), N=1,034 D2 (50.10%, 0.37), N=1,020	Moderate	
Zink, et al, 2017, Sept	Prospective Cohort Study	Germany, Y	TD and F2F dermatologists via smartphone and dermoscopy images using Handyfotos	F2F: Diagnostic agreement rate (92.3%) Histo: Diagnostic agreement rate (66.7%), N=26	Low	
Giavina-Bianchi, et al, 2020 Oct	Retrospective Cohort Study	Brazil, N	TD and F2F dermatologists via smartphone images	Diagnostic agreement rate (78%) concordance (0.743), N=739	High	Skin lesions other than neoplasms
Standards of reference: F2F and Histopathology						

Rios-Yuil, 2011	Randomized Controlled Trial	Panama	TD and F2F dermatologists via clinical images taken by digital photography for case conferences	F2F: Diagnostic agreement rate (83.3%), concordance (0.652) Histo: Diagnostic agreement rate (66.7%) N=30	Moderate	Skin cancer and other dermatoses
Zink, et al, 2017, July	Prospective Cohort Study	Germany, Y	TD and F2F dermatologists via smartphone images stored in the KLARA app	F2F: Diagnostic agreement rate (58.9%, N=195) Histo: Diagnostic agreement rate (55.6%, N=195)	High	
Giavina-Bianchi, et al, 2020 Nov	Retrospective Cohort Study	Brazil, N	TD and F2F dermatologists via smartphone images	F2F: Diagnostic agreement rate (61%), concordance (0.213), N=803 Histo: Diagnostic agreement rate (54%), concordance (0.087), N=289	High	Skin cancer lesions only
Senel, et al, 2013	Prospective Cohort Study, Repeated measures	Turkey, N	TD and F2F dermatologists via digital photography and dermoscopy images	**Without dermoscopy:** Concordance (TD1 0.77, TD2 0.75), N=150 **With dermoscopy**: Concordance (TD1 0.85, TD2: 0.86), N=150	High	
Sola-Ortigosa, et al, 2020	Prospective Cohort Study	Spain, N	TD and F2F consults by the same dermatologist via dermoscopy and clinical images taken by digital photography and tablets	**Without dermoscopy** F2F: Diagnostic agreement rate (TD1 82.1%, TD2 83.2%, TD3 81.3%), concordance (TD1 0.87, TD2 0.83, TD3 0.89) Histo: Diagnostic agreement rate (TD1 87.5%, TD2 83.5%, TD3 88.4%), N=1000 **With dermoscopy** F2F: Diagnostic agreement rate (TD1 91.5%, TD2 90.2%, TD3 89.9%), concordance (TD1 0.91, TD2 0.90, TD3 0.89) Histo: Diagnostic agreement rate (TD1 91.5%, TD2 91.2%, TD3 90.3%), N=1000	High	

Tan, et al, 2010	Prospective Cohort Study, Repeated measures	New Zealand, Y	TD and F2F consults by the same dermatologist via digital photography	F2F: Diagnostic agreement rate (73.7%, N=681), accuracy (Sn, Sp, PPV)**	High	
Standards of reference: Histopathology						
Borve, et al, 2013	Prospective Cohort Study	Sweden, Y	TD and F2F consults by the same dermatologist via smartphone and dermoscopy images stored in iDoc 24 app	F2F: Diagnostic agreement rate (TD1 55%, TD2 57%), concordance (TD1 0.47, TD2 0.48), accuracy (TD1 51%, TD2 61%) Histo: Concordance (TD1 0.51, TD2 0.51), N=69	High	Skin cancer lesions only
Clarke, et al, 2021	Prospective Cohort Study	USA, Y	TD and F2F dermatologists via clinical images taken by digital photography stored in Research Electronic Data Capture	F2F: Diagnostic agreement rate (66.6%), concordance (0.6), N=308 Histo: Diagnostic agreement rate (65%), N=62	High	
Goulart-Silveira et al, 2019	Prospective Cohort Study	Brazil, N	TD and F2F dermatologists via smartphone images acquired and stored via Telederma app	F2F: Concordance (0.958), accuracy (Sn, Sp, PPV, NPV) Histo: Concordance (0.556), N=39	High	
Standards of reference: No clear standard						
Altieri, et al, 2017	Prospective Cohort Study	USA, Y	TD and F2F dermatologists via clinical images taken by digital photography	Diagnostic agreement rate (TD1 58.1%, N=160; TD2 53.3%, N=152; TD3 52.6%, N=152), concordance (TD1 0.51, N=160; TD2 0.51, N=152; TD3 0.57, N=152)	Low	Skin cancer, and other common dermatological lesions
Barbieri, et al, 2014	Prospective Cohort Study	USA, N	TD and F2F dermatologists via smartphone images using the AccessDerm smartphone platform	Diagnostic agreement rate (TD1 64%, TD2 56%), N=50	Moderate	
Gabel, et al, 2021	Prospective Cohort Study	USA Y	TD and F2F dermatologists via clinical images taken by digital photography and tablets	Diagnostic agreement rate (66.7%), concordance (0.33), N=41	High	
Tran, et al, 2011	Prospective Cohort Study	Egypt, Y	TD and F2F dermatologists via smartphone images stored in ClickDoc	Diagnostic agreement rate (75%, N=30)	High	

Carter, et al, 2017	Prospective and retrospective cohort study	USA, Y	TD and F2F dermatologists, as well as F2F PCP via clinical images stored using Epic EHR software	Derm vs TD: Diagnostic agreement rate (38%)	High	Skin cancer
*A1 (non-biopsied pigmented lesions, Macro A2 (non-biopsied pigmented lesions, Macro+PLD) A3 (non-biopsied pigmented lesions, Macro+PLD) B1 (biopsied pigmented lesions, Macro) B2 (biopsied pigmented lesions, Macro+PLD) B3 (biopsied pigmented lesions, Macro+PLD) C1 (non-biopsied non-pigmented lesions, Macro) C2 (non-biopsied non-pigmented lesions,, Macro+PLD) D1 (biopsied non-pigmented lesions, Macro) D2 (biopsied non-pigmented lesions, Macro+PLD) PLD = polarized light dermoscopy						

B

Source	Study design	Country of publ., Study reported funding (Y/N)	Intervention Assessment of diagnostic agreement between...	Outcomes Comparing complete primary diagnostic agreement between **F2F and TD** (and between Histo and TD if applicable)	Quality rating	
Costello, et al, 2019	Prospective Cross-sectional study	USA, Y	TD and F2F PCP via smartphone and dermoscopy images using the Photo Exam app	Diagnostic agreement rate (31.6%, N=37)	High	Skin cancer and other dermatoses
Duong, et al, 2014	Observational study	France, Y	TD and F2F emergency physicians via smartphone images and videoconferences	Videoconference: diagnostic agreement rate (68.7%, N=83) SFTD: diagnostic agreement rate (30.9%, N=110)	High	
Gonzalez-Coloma, et al, 2019	Prospective, Cross-sectional study	Chile, N	TD and F2F PCP via clinical images	Diagnostic concordance (0.50, N=326)	High	
Keller, et al, 2020	Prospective Cohort Study	USA, Y	TD and F2F dermatologists or hospitalists on clinical images taken by smartphones and tablets	ED vs TD: Diagnostic agreement rate (45.3%), concordance (0.4), N=53	Low	
Muir, et al, 2011	Prospective Cohort Study	Australia, N	TD and F2F emergency physicians via clinical images taken by digital photography	ED vs TD: Diagnostic agreement rate (72%),	High	

				concordance (0.42), N=60		
Carter, et al, 2017	Prospective and retrospective cohort study	USA, Y	TD and F2F dermatologists, as well as F2F PCP via clinical images stored using Epic EHR software	PCP vs TD: Diagnostic agreement rate (14%), N=79	High	Skin cancer lesions only
Jones, et al, 2021	Retrospective Cohort Study	New Zealand, Y	TD and F2F PCP via digital photography and dermoscopy images	PCP vs TD (SSC Matched*)	Moderate	
Piccoli, et al, 2015	Retrospective Cross-sectional study	Brazil, Y	TD and F2F PCP via digital photography and dermoscopy images	Diagnostic concordance (0.69, N=184), accuracy		
Chen, et al, 2010	Retrospective Cohort Study	USA, Y	TD and F2F PCP via clinical images stored in Second Opinion Software	Diagnostic agreement rate (48%, N=405)	High	Skin lesions other than malignancies
Patro, et al 2015	Prospective Cohort Study	India, Y	TD and F2F PCP via digital photography	Diagnostic agreement rate (56%, N=206)	High	

*A1 (non-biopsied pigmented lesions, Macro
A2 (non-biopsied pigmented lesions, Macro+PLD)
A3 (non-biopsied pigmented lesions, Macro+PLD)
B1 (biopsied pigmented lesions, Macro)
B2 (biopsied pigmented lesions, Macro+PLD)
B3 (biopsied pigmented lesions, Macro+PLD)
C1 (non-biopsied non-pigmented lesions, Macro)
C2 (non-biopsied non-pigmented lesions,, Macro+PLD)
D1 (biopsied non-pigmented lesions, Macro)
D2 (biopsied non-pigmented lesions, Macro+PLD)
PLD = polarized light dermoscopy

*Suspected Skin Cancer Pathway matched for age, sex, and ethnicity.

Table 1. Study characteristics for all included studies. (A) Studies that compared TD with F2F dermatologists. **(B)** Studies that compared TD with F2F non-specialists. Studies are in alphabetical order and are grouped according to lesion type reported.

Source	Patient demographics Country where patients resided, number of patients included, percentage by gender/sex, age, number of lesions included	Special inclusions, and exclusions
Skin cancer, and other common dermatological lesions		
Altieri, et al, 2017	USA, 232 p., sex N/A, age: 18+, 232 l.	Inclusion: Adults
Azfar, et al, 2014	Botswana, 76 p., 57% female, 43% male, mean age: 39, 159 l.	Inclusion: HIV+ adults

Barbieri, et al, 2014	USA, 50 p., 64% female, 36% male, mean age: 55.2, 50 l.	Inclusion: Adults
Barcaui, et al, 2018	Brazil, 31 p., 71% female, 29% male, mean age: 56.5, 41 l.	Inclusion: Adults with pigmented lesions only
Batalla, 2015	Spain, 183 p., 66% female, 34% male, mean age: 9, 65 l.	Inclusion: Pediatric patients
Borve, et al, 2012	Sweden, 40 p., 57.5% female, 42.5% male, mean age: 49, 40 l.	Inclusion: Adults
Costello, et al, 2019	USA, 37 p., 65% female, 35% male, mean age: 47.9, 37 l.	Inclusion: Adults who were under or uninsured
Duong, et al, 2014	France, 111 p. SFTD, 83 p. videoconference, sex N/A, age: 18+, 110 l. SFTD, 68 l. videoconference	Inclusion: Adults presenting to emergency department
Gabel, et al, 2021	USA, 41 p. sex N/A, age N/A, 41 l.	N/A
Gatica, et al, 2015	Chile, 125 p., 57.6% female, 42.4% male, mean age: 37.7, 125 l.	
Gerhardt, et al, 2021	USA, 809 p., sex N/A, age N/A, 809 l.	Inclusion: Veteran population; Exclusion: Patients whose lesions resolved early
Gonzalez-Coloma, et al, 2019	Chile, 326 p., 59% female, 41% male, mean age: 35.8, 326 l.	N/A
Keller, et al, 2020	USA, 100 p., 43.2% female, 56.8% male, age N/A,100 l.	N/A
Marchell, et al, 2017	USA, 216 p., sex N/A, age N/A, 216 l.	N/A
Muir, et al, 2011	Australia, 60 p. where F2F was an ED physician, 50 p. where F2F was a derm, 65% female, 35% male, mean age: 47, 60 and 50 l.	Inclusion: Adults; Exclusion: Lesions caused by accident or trauma
Nami, et al, 2015	Italy and Austria, 391 p., 52.2% female, 47.8% male, mean age: 54, 391 l.	Exclusion: Pigmented skin lesions
Okita, et al, 2016	Brazil, 100 p., sex N/A, age N/A, 100 l.	N/A
Ribas, et al, 2010	Brazil, 174 p., 53.4% female, 46.6% male, mean age: 34.7, 174 l.	
Rios-Yuil, 2011	Panama, 30 p., 63.3% female, 36.7% male, age range for 30% of patients: 50-59, 30 l.	
Romero Aguilera, et al, 2014	Spain, 457 p., 56% female, 44% male, mean age: 36, 170 l.	
Romero, et al, 2010	Spain, 158 p. SFTD with videoconference, 170 p. SFTD only, 56% female, 44% male, mean age: 36, 510 l.	
Rubegni, et al, 2011	Italy, 130 p., 53.9% female, 46.1% male, mean age: 80.6, 130 l.	Inclusion: Geriatric patients
Saleh, et al, 2017	Egypt, 600 p., 50.7% female, 49.3% male, age: 38% >20, 17.3% >10-20, 31.7% 2-10, 13% <2; 600 l.	N/A
Tran, et al, 2011	Egypt, 30 p., sex N/A, all ages, 30 l.	N/A

Vano-Galvan, et al, 2010	Spain, 100 p. (50 from derm outpatient clinic, 50 from the ED), sex N/A, age N/A, 100 l.	N/A
Zanini, 2013	Brazil, 100 p., sex N/A, age N/A, 100 l.	
Zink, et al, 2017, July	Germany, 195 p., 20.5% female, 79.5% male, age range: 1-89 years, 195 l.	
Skin cancer lesions only		
Borve, et al, 2013	Sweden, 62 p., 38.7% female, 60.3% male, mean age: 64, 69 l.	Inclusion: Adults whose lesions could be biopsied
Carter, et al, 2017	USA, 79 patients, 74% female, 26% male, mean age: 47, 79 l.	Inclusion: Adults with mild-to-moderate cases; Exclusion: Patients with melanocytic lesions or emergencies
Clarke, et al, 2021	USA, 206 p., 49.5% female, 50.5% male, mean age: 56.9, 308 l.	Inclusion: Adults with a lesion of concern reported by anyone (e.g., patient, family, referring GP) except a dermatologist
Giavina-Bianchi, et al, 2020 Nov	Brazil, 17, 233 p., 71.4% female, 28.6% male, age N/A, 803 l.	Exclusions: Mild/complex cases, diagnoses without ICD10 code, and only looked at the 10 most frequent neoplasms
Goulart-Silveira et al, 2019	Brazil, 39 p., 69% female, 31% male, mean age: 68, 39 l.	Inclusion: Adults; Exclusion: Patients with bad quality images
Jones, et al, 2021	New Zealand, 481p., 64% female, 36% male, age range: 0-90+, 528 l.	Inclusion: Adults and children with suspected skin cancers.
Lamel, et al, 2012	USA, 86 p., 58.1% female, 41.9% male, mean age: 45.2, 107 l.	N/A
Piccoli, et al, 2015	Brazil, 184 p., 73.4% female, 26.6% male, mean age: 54.7, 184 l.	Exclusions: Patients with poorly taken images, patients under concurrent treatment
Senel, et al, 2013	Turkey, 150 p., 49% female, 51% male, mean age: 55, 150 l.	Inclusion: Adults with non-melanocytic lesions only
Tan, et al, 2010	New Zealand, 200 p., 63% female, 37% male, age range: 11-94, 491 l.	N/A
Vestergaard, et al, 2020	Denmark, 519 p., 57% female, 42% male, mean age: 55, 600 l.	Inclusion: Adults
Warshaw, et al, 2015	USA, 2,152 p., 3.2% female, 96.8% male, mean age: 68, 3021 l.	Inclusion: Adults
Zink, et al, 2017, Sept	Germany, 26 p., sex N/A, age N/A, 26 l.	
Sola-Ortigosa, et al, 2020	Spain, 636 p., 43.2% female, 56.8% male, mean age: 72.8, 1000 l.	Inclusion: Adults with keratotic skin lesions only; Exclusion: Patients with poorly taken images
Skin lesions other than skin neoplasms		
Chen, et al, 2010	USA, 405 p., 50.6% female, 49.4% male, mean age: 5.9, 405 l.	Inclusion: 12 or younger; Exclusion: Lesions caused by an accident or trauma

Giavina-Bianchi, et al, 2020 Oct	Brazil, 24,210 p., 70% female, 30% male, age N/A, 739 l.	Exclusions: Mild/complex cases, diagnoses without ICD10 code, and only looked at the 20 most frequent inflammatory dermatoses
Patro, et al 2015	India, 206 p., 58.7% female, 41.3% male, age range: 1+, 206 l.	Exclusions: Pregnant women and patients with concurrent diseases

Table 2. patient characteristics for all 44 included studies. Studies in alphabetical order and are grouped according to lesion type reported. Last column describes special inclusion and exclusion criteria that could impact quality of the studies included. NA or N/A: Not available, l.: lesion, SFTD: Store And Forward Technology, GP: General practitioner.

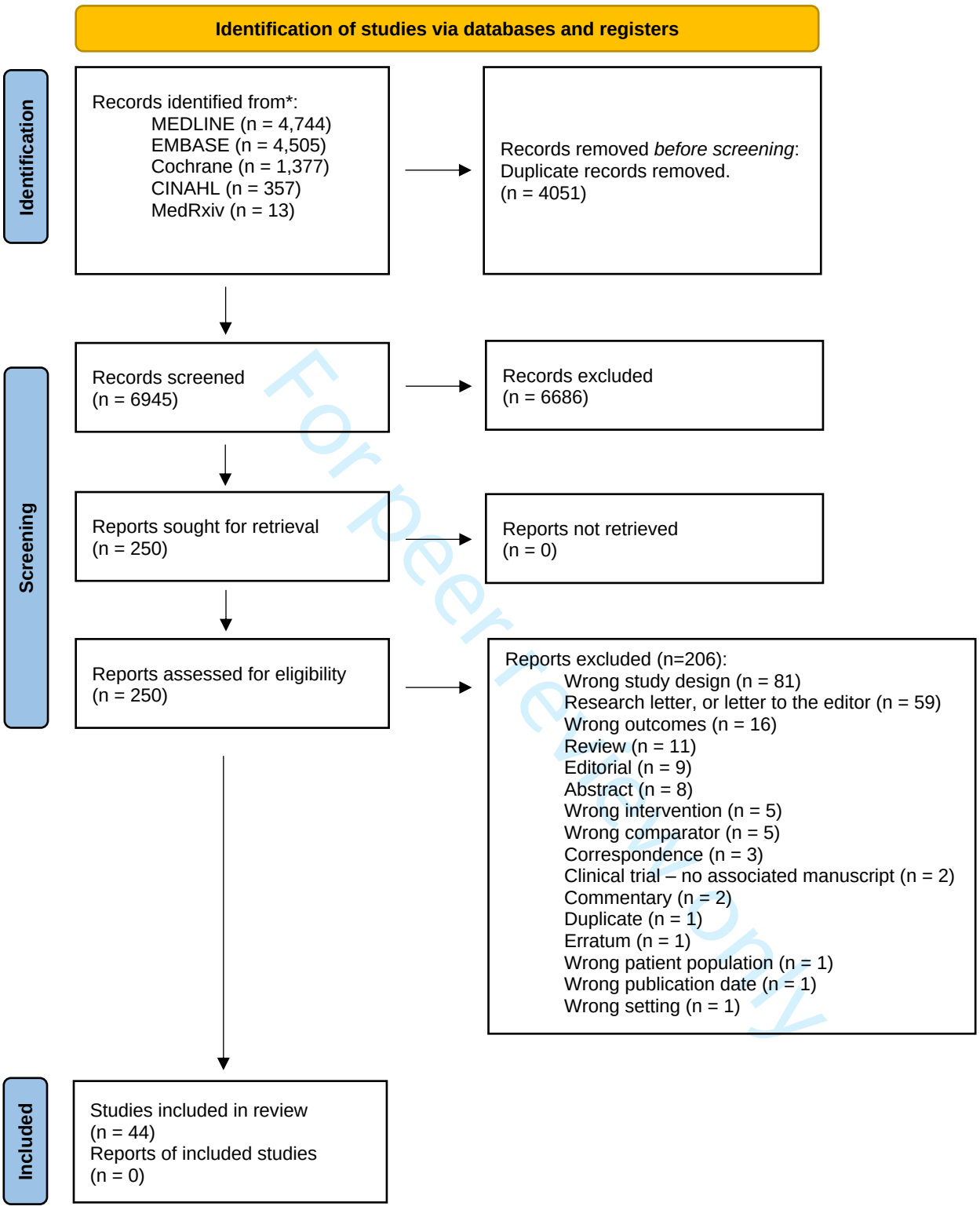


Figure 1. PRISMA Flow diagram of study selection.

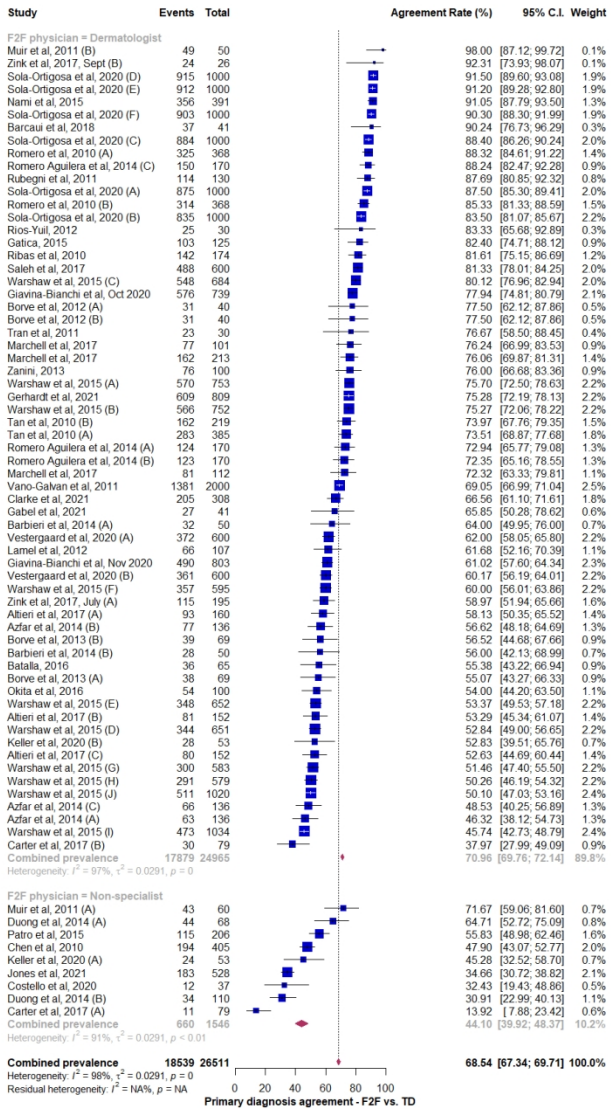


Figure 2. Forest plot representing F2F and TD primary diagnostic agreement by specialization status of the F2F physician. Studies were sorted into two groups, a) F2F diagnosis completed by a board-certified dermatologist; b) F2F diagnosis completed by a non-specialist (e.g., general practitioner). (A) Forest plot representing percentage agreement and 95% C.I. for overall concordance across 40 studies with a total of 72 unique number of comparisons, N of events and total included participants.

264x476mm (96 x 96 DPI)

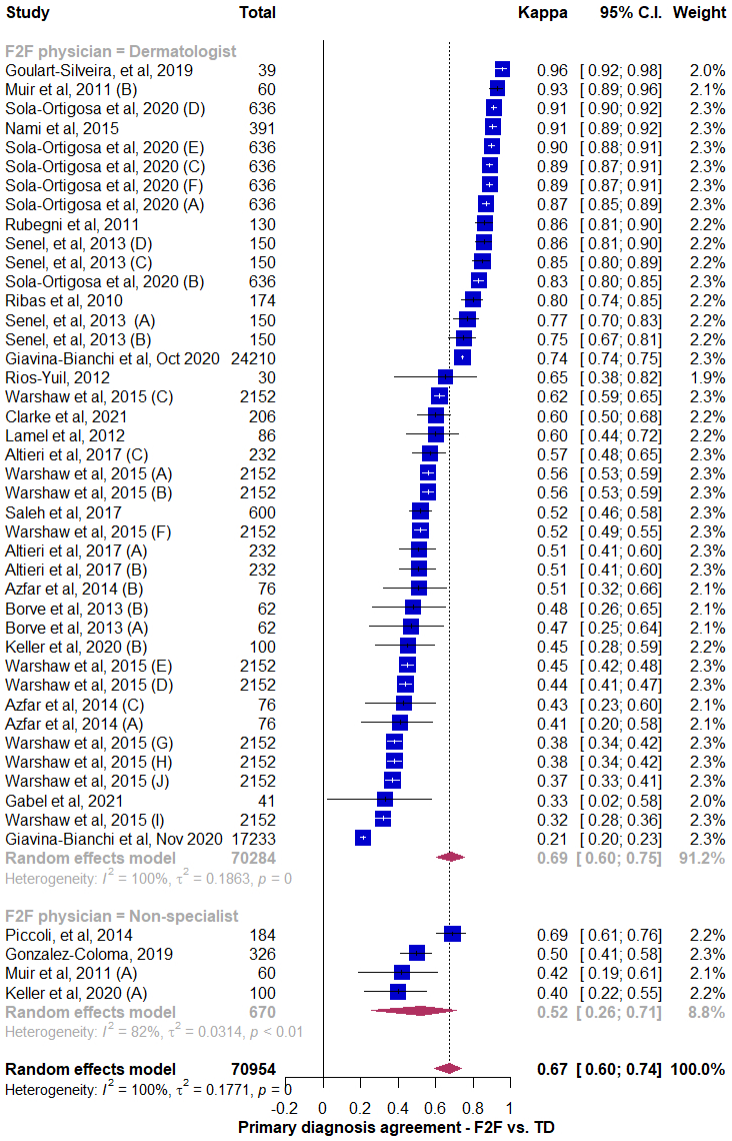


Figure 2. Forest plot representing F2F and TD primary diagnostic agreement by specialization status of the F2F physician. Studies were sorted into two groups, a) F2F diagnosis completed by a board-certified dermatologist; b) F2F diagnosis completed by a non-specialist (e.g., general practitioner). (B) Forest plot representing kappa concordance and 95% C.I. for overall concordance across 21 studies with a total of 45 unique number of comparisons, N of total included participants.

264x317mm (96 x 96 DPI)

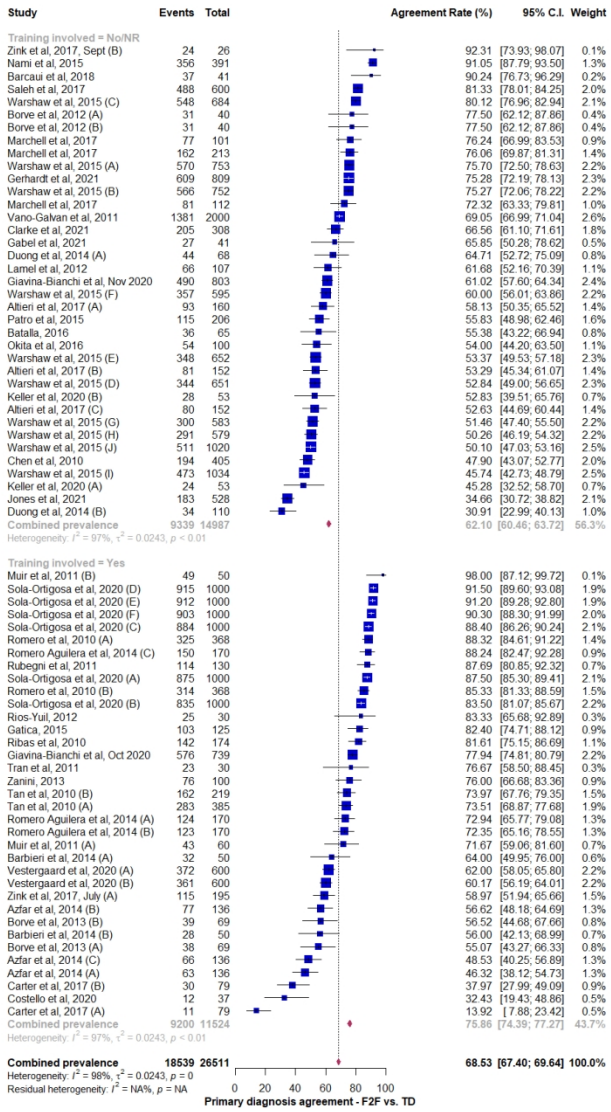


Figure 3. Forest plot representing F2F and TD primary diagnostic agreement by whether imaging acquisition training was indicated by the study.

Forest plot representing F2F and TD primary diagnostic agreement when image acquisition training is involved. Studies were sorted into two groups, a) Did not conduct or did not report training personnel on image acquisition; b) Stated that person in charge of image acquisition was trained. (A) Forest plot representing percentage agreement and 95% C.I. for overall concordance across 39 studies with a total of 71 unique number of comparisons, N of events and total included participants.

264x476mm (96 x 96 DPI)

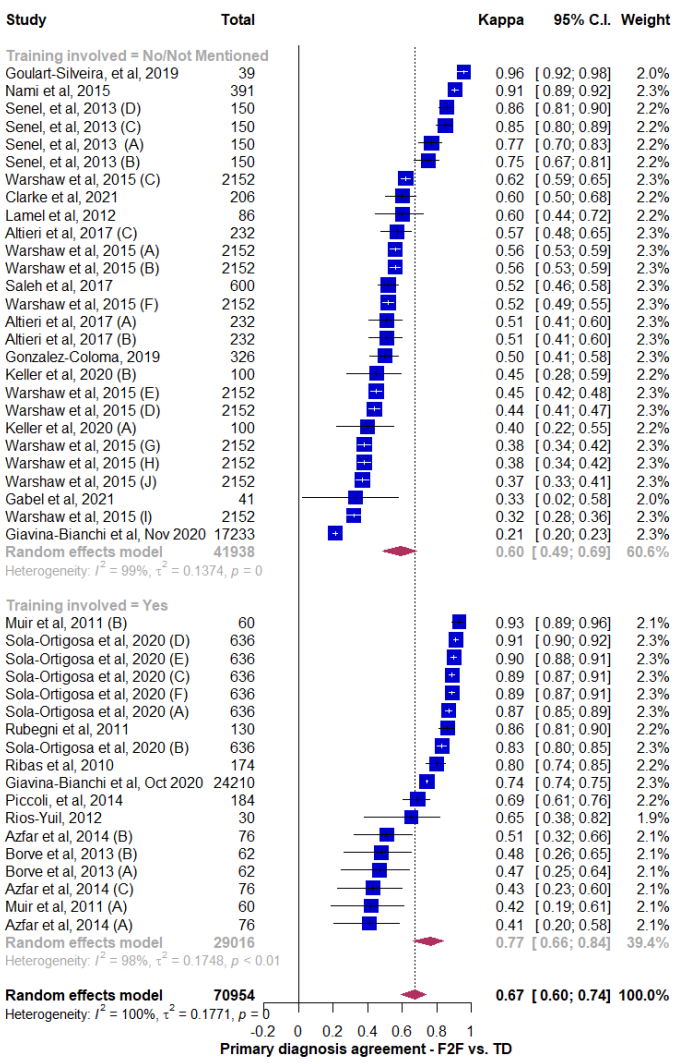


Figure 3. Forest plot representing F2F and TD primary diagnostic agreement by whether imaging acquisition training was indicated by the study.

Forest plot representing F2F and TD primary diagnostic agreement when image acquisition training is involved. Studies were sorted into two groups, a) Did not conduct or did not report training personnel on image acquisition; b) Stated that person in charge of image acquisition was trained. (B) Forest plot representing kappa concordance and 95% C.I. for overall concordance across 21 studies with a total of 45 unique number of comparisons, N of total included participants.

264x343mm (96 x 96 DPI)

Supplementary Online Content

Title: Diagnostic Reliability in Teledermatology: A Systematic Review and Meta-Analysis

Authors

Adrienn N. Bourkas*[1] (MSc), Natasha Barone*[2] (MSc), Matthew E.C. Bourkas[3] (PhD), Matthew Mannarino[5] (PhD), Robert D. J. Fraser[4,6] (RN, MN), Amy Lorincz[4] (MSc), Sheila C. Wang[4,7] (MD, PhD), Jose L. Ramirez-GarciaLuna[4,5] (MD, PhD)

* Authors contributed equally

Affiliations

[1]Faculty of Health Sciences, Queen's University School of Medicine, Kingston, Ontario, Canada

[2]Faculty of Medicine and Health Sciences, McGill University, Montreal, Quebec, Canada

[3]Temerty Faculty of Medicine, Department of Biochemistry, University of Toronto, Toronto, Ontario, Canada

[4]Swift Medical Inc., Toronto, Ontario, Canada

[5]Department of Surgery, McGill University, Montreal, Canada

[6]Arthur Labatt Family School of Nursing, Western University, London, Ontario Canada

[7]Department of Medicine, Division of Dermatology, McGill University Health Centre, Montreal, Quebec, Canada

Contents

Supplementary eMethods

Search Strategy

The search strategy was written for Ovid Medline and translated using each database's syntax, controlled vocabulary, and search fields. MeSH terms, Emtree terms, and free text words were used for TD and skin conditions such as melanoma and related synonyms. To identify additional articles not captured through the aforementioned search, a manual search was conducted via reference search of the included studies.

All database records were downloaded to EndNote X9 (Clarivate) and uploaded to web-based software for deduplication, screening, and full-text evaluation (Covidence; Veritas Health Innovation). We contacted three study authors to gain access to their published work.[1-3] The search strategy is available below.

Ovid MEDLINE Search

Ovid MEDLINE(R), Ovid MEDLINE(R) Daily and Epub Ahead of Print, In-Process & Other Non-Indexed Citations <1946 to 2022 May 02>

1. e consult*.mp. 2. econsult*.mp. 3. electronic consult*.mp. 4. e health.mp. 5. ehealth.mp. 6. e visit*.mp. 7. evisit*.mp. 8. home video visit*.mp. 9. internet/ or internet-based intervention/ 10. internet.mp. 11. offsite care.mp. 12. off site care.mp. 13. ontario telemedicine network.mp. 14. Remote Consultation/ 15. remote consultation*.mp. 16. remote visit*.mp. 17. tele care.mp. 18. telecare.mp. 19. tele consult*.mp. 20. teleconsult*.mp. 21. tele diagnos*.mp. 22. telehealth.mp. 23. tele health.mp. 24. telemedicine/ 25. telemedicine.mp. 26. tele medicine.mp. 27. telemonitor*.mp. 28. tele monitor*.mp. 29. Telepathology/ 30. telepatholog*.mp. 31. tele patholog*.mp. 32. telepractice*.mp. 33. tele practice*.mp. 34. Therapy, Computer-Assisted/ 35. video consult*.mp. 36. videoconsult*.mp. 37. virtual care.mp. 38. web based.mp. 39. Telepathology/ 40. or/1-39 41. Dermatology/ 42. dermatolog*.mp. 43. dermatopatholog*.mp. 44. exp Skin Diseases/di [Diagnosis] 45. exp Skin Neoplasms/ 46. skin.mp. 47. exp Skin Abnormalities/ 48. burns/ or burns, chemical/ or burns, electric/ or sunburn/ 49. burn*.mp. 50. wound healing/ or cicatrix/ 51. wound*.mp. 52. or/41-51, 53. 40 and 52, 54. teledermatolog*.mp. 55. tele dermatolog*.mp. 56. 54 or 55, 57. 53 or 56, 58. limit 57 to dt=20100101-20220402

Eligibility Criteria

Inclusion and exclusion criteria are summarized in **eTable 1**.

Data Selection and Extraction

Information extracted from full-text articles is summarized in **eTable 2**.

Data Analysis: Cohen's kappa Interpretations

Cohen's kappa values for diagnostic concordance between TD and F2F physicians were interpreted based on the following criteria.[4] Values between 0–.20 indicate no agreement, .21–.39 minimal agreement, .40–.59 weak agreement, .60–.79 moderate agreement, .80–.90 strong agreement, and above .90 almost perfect agreement.

Data Synthesis

Agreement rates and Cohen's kappa concordances for unique study groupings were treated as individual and independent values. A letter was assigned to each unique study grouping as explained in **eTable 3**. Confounding factors including technology type, year of publication, and training of study raters was controlled using meta-regression. Proportions meta-analysis looked at weighted averages and 95% confidence intervals were reported. A random-effects model as proposed by DerSimonian and Laird was chosen as the primary method to estimate all pooled estimates.[5] Heterogeneity was assessed by calculating I^2. Possible sources of heterogeneity were sought through sub-group analysis. This included different skin conditions, specialization of the F2F physician, whether staff were trained on image acquisition, the technology used for image acquisition, the use of teledermoscopy, studies poster pre-or post-pandemic, and risk of bias.

Supplementary eResults

Diagnostic reliability of TD when compared to F2F (specialist and non-specialists) evaluation

Of the 40 studies that reported diagnostic agreement rates there were 72 unique comparisons made between F2F and TD.[6-45] **eFigure 1A** shows that the mean percentage agreement of 68.9% (CI 64.4%-73.1%) ranged from 14% to 98%, where 35/72 had percentage agreement above 70% and 7 studies had over 90% agreement. The studies were heterogeneous (I^2=98%, p <0).

Of the 21 studies that reported concordance values, there were 45 unique comparisons made.[6, 7, 12, 15, 18, 21-26, 29, 30, 33-35, 46-50] **eFigure 1B** shows that the mean diagnostic concordance of 0.67 (CI 0.60 to 0.74) ranged from 0.213 (CI 0.20 to 0.23) to 0.96 (CI 0.92 to 0.98), with 21 studies (47%) having moderate agreement (k=0.6 and above), and 13 (29%) studies having strong agreement. The studies were heterogeneous (I^2=100%, p <0.001).

Diagnostic agreement between TD and TD, F2F and F2F, and TD and Histopathology

Of the ten studies that reported diagnostic agreement rates between TDs, there were 17 unique comparisons made between F2F and TD. **eFigure 2A** shows that the mean percentage agreement of 76.4% (CI 69% to 82.5%) ranged from 37% to 91.5%, with 10/17 having percentage agreement above 70% and two studies having over 90% agreement. The studies were heterogeneous (I^2=97%, p <0.001).

From four studies that reported diagnostic agreement rates between F2F dermatologists there were 6 unique comparisons. **eFigure 2B** shows that the mean percentage agreement 82.4% (CI 76.7%-87.0%) ranged from 75.5% to 91%. The studies were heterogeneous (I^2=68%, p <0.001).
Five studies compared TDs to histopathology data, and there were six unique comparisons. **eFigure 2C** shows that the mean percentage agreement of 55.7% (CI 53% to 58.4%) ranged from 53.8% to 65.4%. The mean agreement rate between histopathology and TD was 55.7% (CI 53.0 to 58.4). The studies were homogeneous (I^2=0%, p = 0.49).

Subgroup analyses

Diagnostic reliability of TD vs F2F by the inclusion of teledermoscopy in both TD and F2F assessments

Overall, twelve studies with 22 unique comparisons used teledermoscopy for diagnosing suspicious lesions.[9, 12, 16, 30, 33, 35, 39, 40, 43, 45] **eFigure 3A** shows that with teledermoscopy, the mean diagnostic agreement rates was 69.1% (CI 66.8% to 71.4%), and this percentage ranged between from 31.6% to 92.3%. Without the use of teledermsocopy, the mean agreement rate was 68.3% (CI 66.8% to 69.8%). The means were not significantly different between the two groups and the studies were heterogeneous (I^2=97%, p<0.001). **eFigure 3B** shows concordance values of seven studies that adapted teledermoscopy had a mean of 0.71 (CI 0.58 to 0.80).[12, 30, 33, 35, 40, 48, 49] Without teledermsocopy, the mean was 0.65 (CI 0.54 to 0.74). This difference was not statistically significant, and the studies were heterogeneous (I^2=100%, p<0.001).

Diagnostic reliability of TD vs F2F by the inclusion of lesion category
Twenty-six studies with 39 unique comparisons reporting percentage agreement rates that were inclusive to all lesion types as shown in e**Figure 4A.** [6-11, 16-20, 23, 25-27, 29-34, 37, 38, 41, 42, 44] The mean percentage agreement was 69.9% (CI 67.9% to 71.7%) and ranged from 30.9% to 98%, with the majority (26/39) having percentage agreement above 60% and 4 studies having over 90%. Eleven studies only looked at suspicious lesions [12, 13, 15, 21, 24, 35, 36, 39, 40, 43, 45], and the mean percentage agreement was 68.1% (CI 66.3% to 69.8%). Three studies excluded skin cancers [14, 22, 28] and the mean percentage agreement was 62.2% (CI 56.2% to 67.8%). No statistical significance could be identified between the three lesion groups and the studies were heterogeneous (I^2=98%, p<0.001).

Concordance values for studies inclusive to all lesions seen in **eFigure 4B** were reported in ten studies with a mean of 0.62 (CI 0.48 to 0.74).[6, 7, 18, 23, 25, 26, 29, 30, 33, 34] Six studies that looked at cancerous skin lesions only reported a mean of 0.70 (CI 0.59 to 0.78).[12, 15, 21, 24, 35, 40] Only one study that looked at all lesions except cancerous ones reported a concordance value.[22] No statistical significance could be identified between the three lesion groups and the studies were heterogeneous (I^2=100%, p<0.001).

Diagnostic reliability of TD vs F2F by type of technology used related to image acquisition

Approximately half of the studies with 41 unique comparisons that compared TDs with F2F physicians used digital cameras for image acquisition. Eighteen studies comparing F2F and TD agreement rates with 26 unique comparisons reported the use of smartphones and tablets for image acquisition. **eFigure 5A** shows that the mean percentage agreement rate was 71.7% (CI 70.3% to 73.1%) for digital cameras compared to 59.8% (CI 57.2% to 62.3%) for smartphones or tablets. The higher agreement rate with digital photography was statistically significant (p = 0.029, heterogeneity: I^2=98%).

Concordance values for digital photography were reported for twelve studies with a mean of 0.70 (CI 0.61 to 0.76) shown in **eFigure 5B**. Concordance values for smartphone or tablet technologies were reported for eight studies with a mean of 0.62 (CI 0.38 to 0.78). The higher concordance with digital photography was statistically significant (p = 0.003, heterogeneity: I^2=100%)

Diagnostic reliability of TD vs F2F by pre- and post-pandemic timelines.

When comparing TDs to all F2F physician, the average agreement rate was 65.5% (CI 64.0-66.9) for pre-pandemic studies, and 75.3% (CI 73.4% to 77.2%) for studies published after January 2020. When the percentage agreements were compared between the two groups, they were not statistically significant (p = 0.421) and also heterogeneous (I^2=98%, p<0.001). eTable not included.

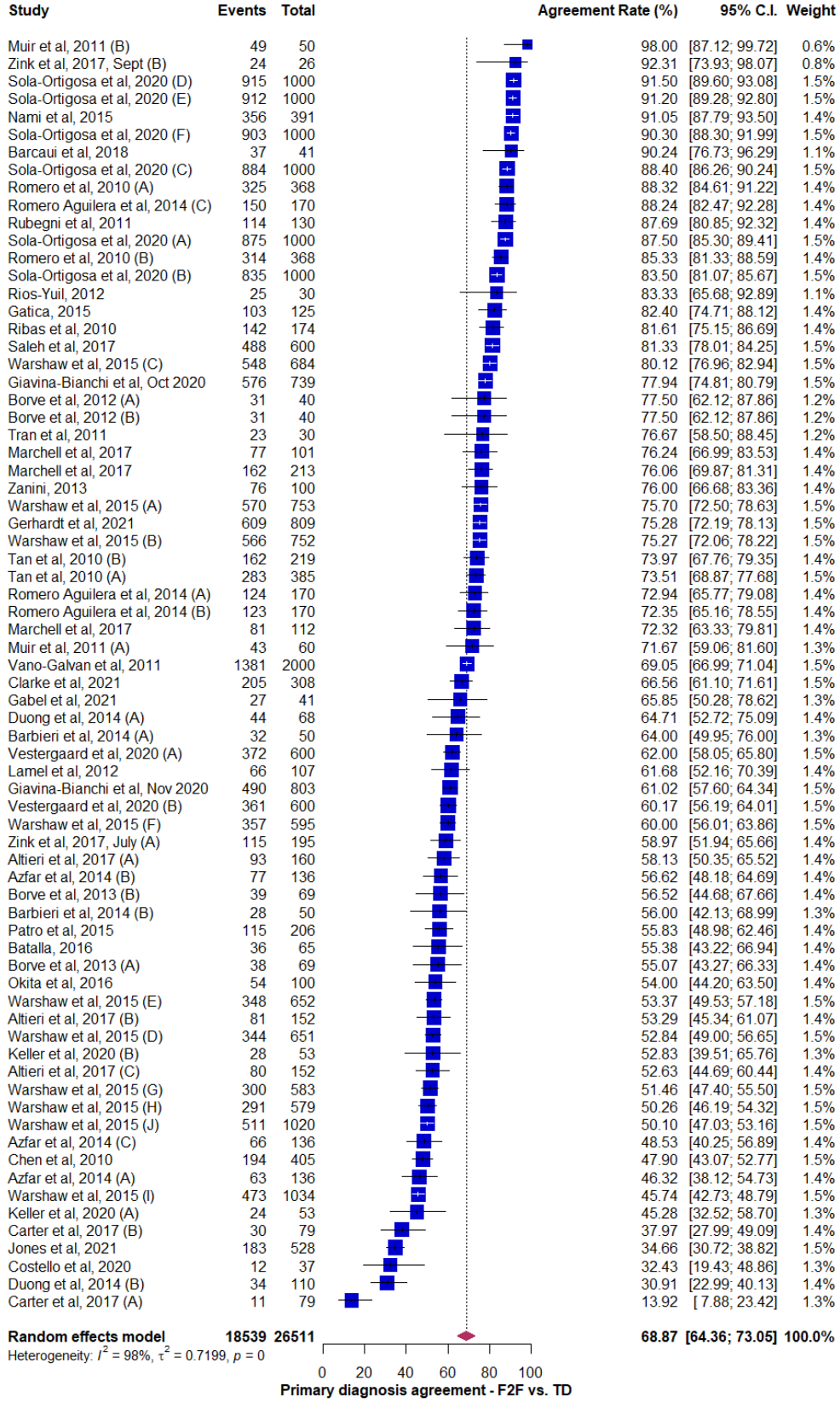
Risk of bias and quality assessment

The results of quality assessment for risk of bias and applicability in individual studies are displayed in**. eTable 4.** Five (11.4%) of the studies had low risk of bias, 11 (25%) had moderate risk, and 28 (63.6%) had high-risk of bias.

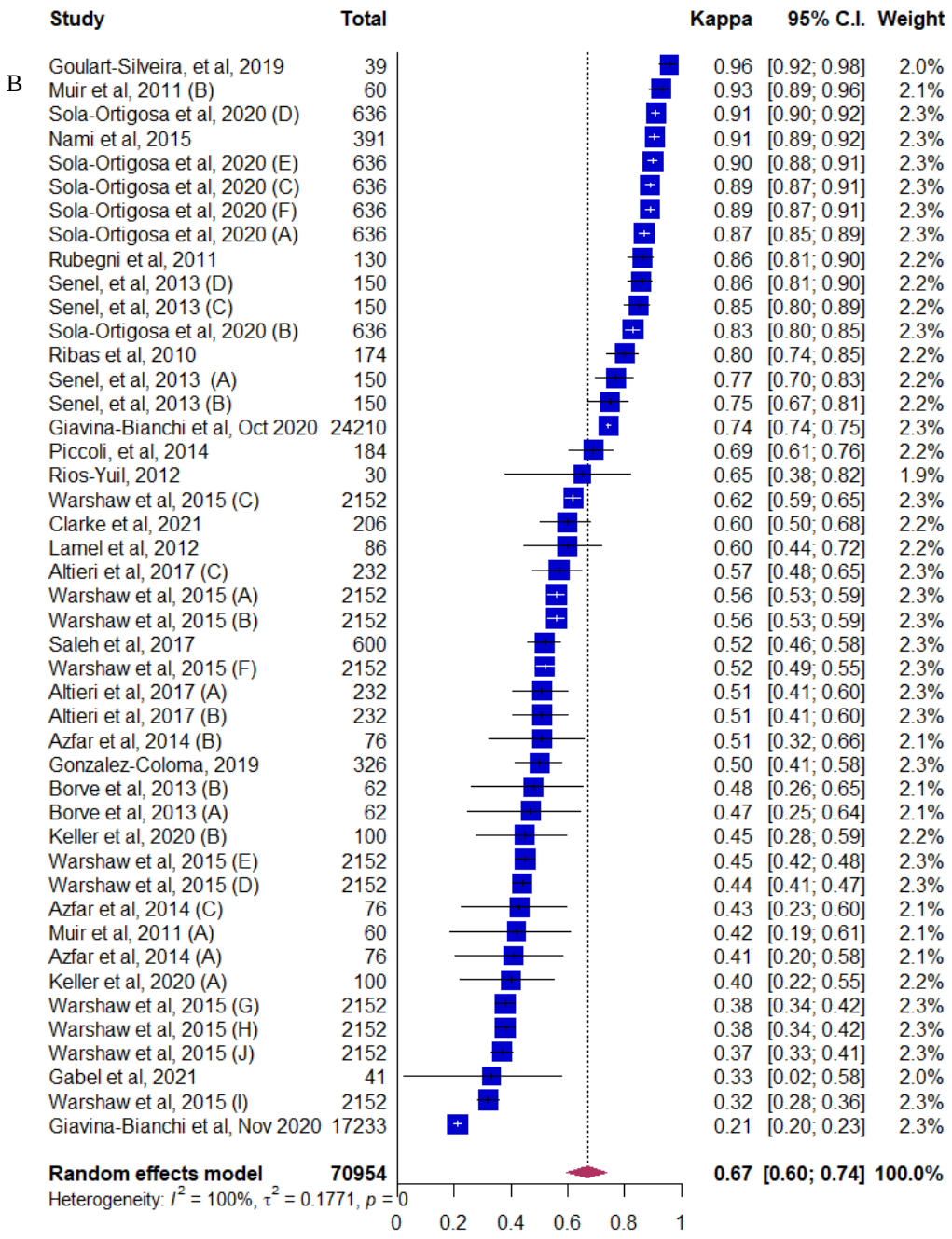
There were no systematic differences between the results of studies that attempted to reduce risk of bias, compared with those with higher risk of bias. The mean diagnostic agreement rate between F2F and TD was 66.4% (CI 62.4% to 70.1%) for low risk, and 69.1% (CI 67.6% to 70.6%) for high risk (p = 0.932). When the percentage agreements were compared between groups, they were heterogeneous (I^ 2=98%, p<0.001). eTable not included.

Supplementary eFigures and Legends

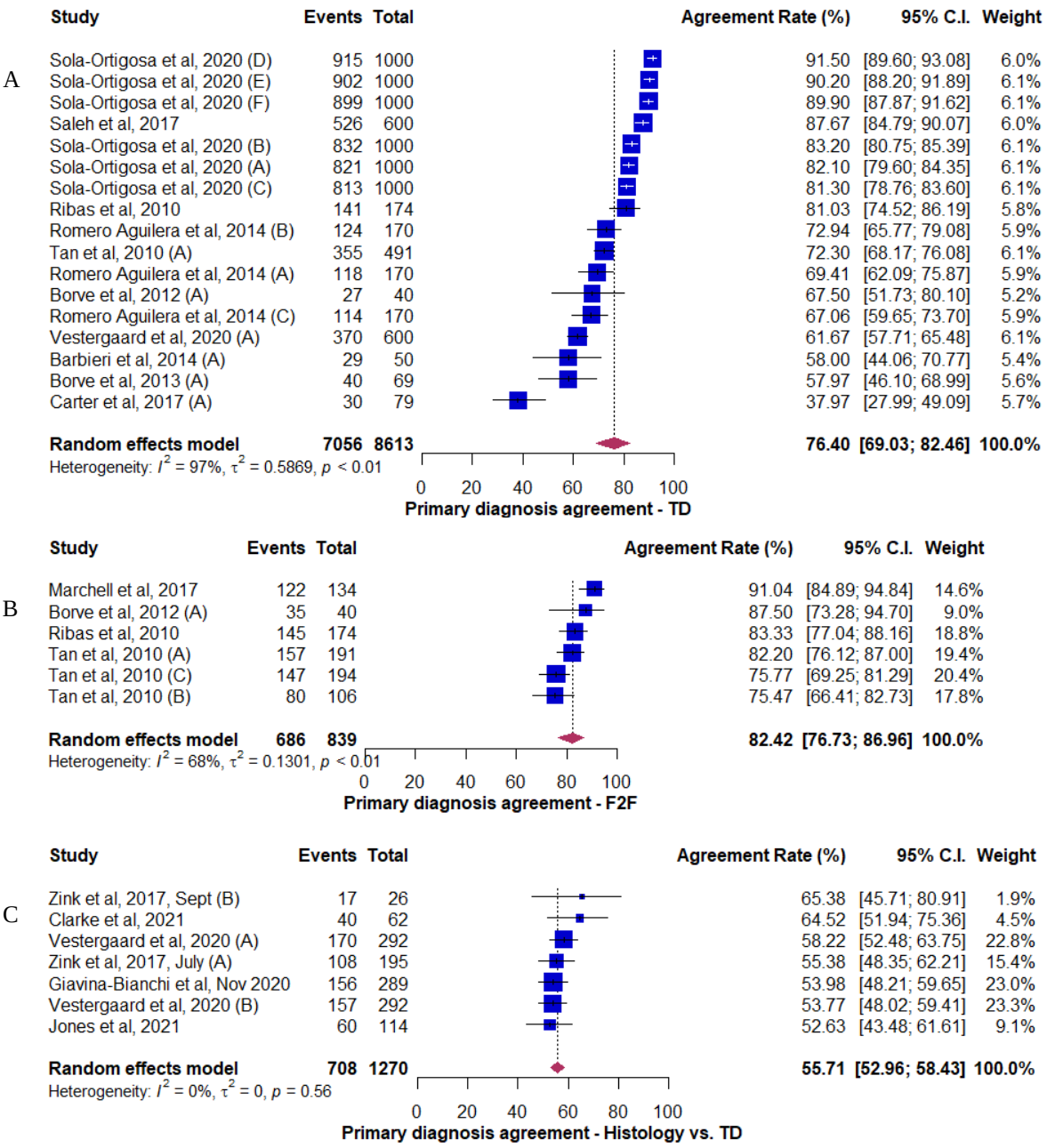
A



B

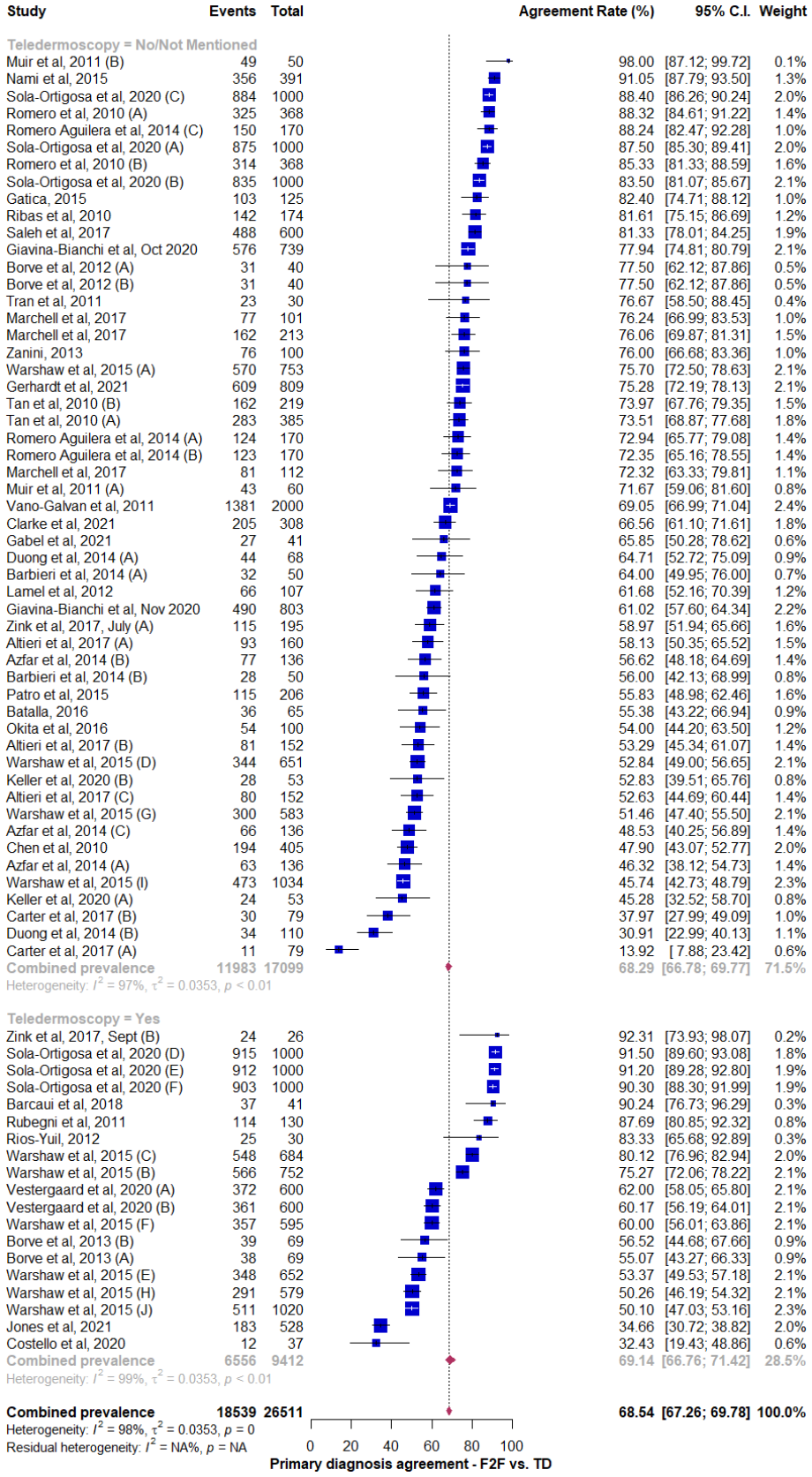


eFigure 1. Forest plot representing F2F and TD primary diagnostic agreement.
(A) Forest plot representing percentage agreement and 95% C.I. for overall concordance across 39 studies with a total of 71 unique number of comparisons, N of events and total included participants. **(B)** Forest plot representing kappa concordance and 95% C.I. for overall concordance across 21 studies with a total of 45 unique number of comparisons, N of total included participants.

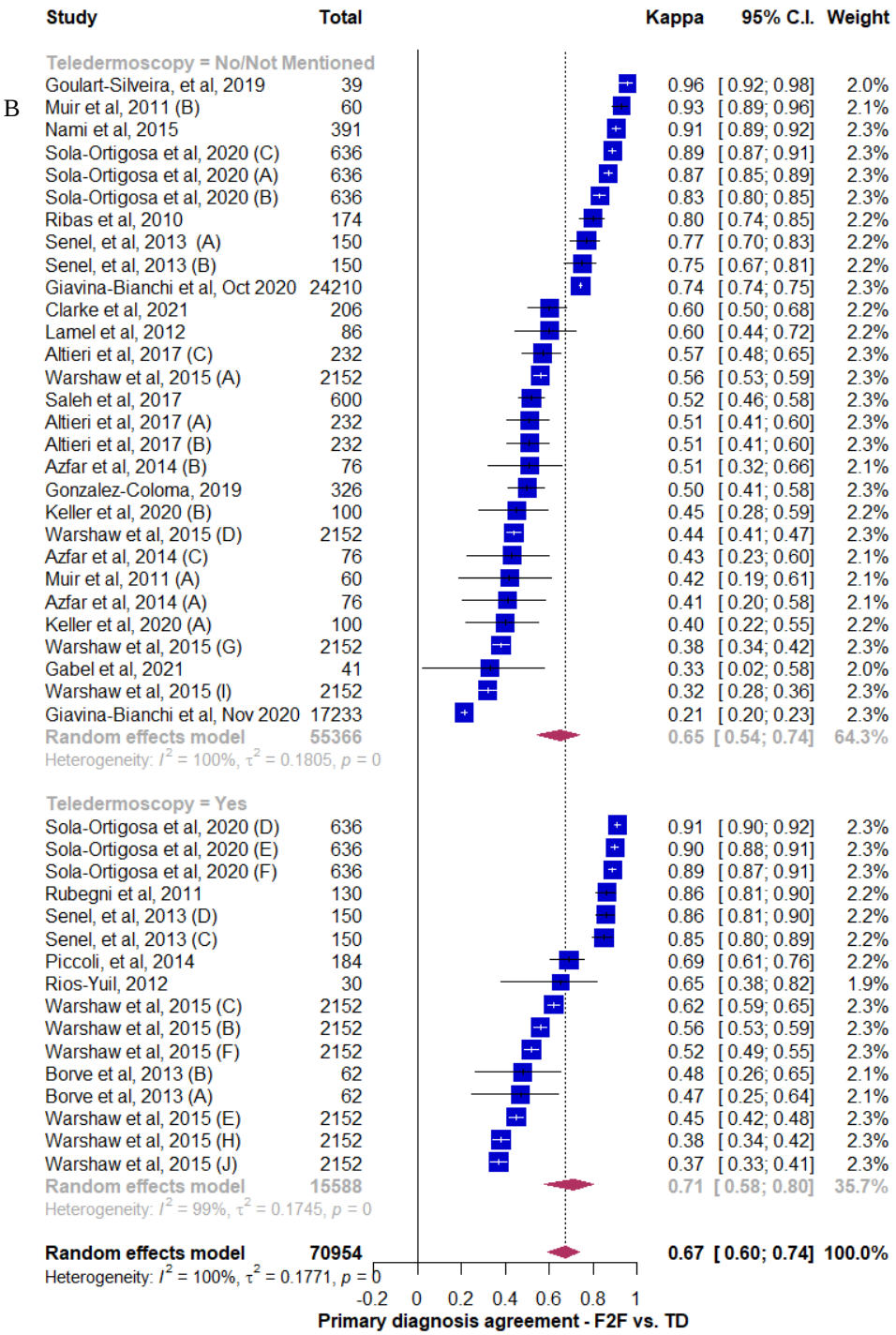


eFigure 2. Forest plot representing TD, F2F, and histopathology primary diagnostic agreements.
(A) Forest plot representing percentage agreement between TD and TD and 95% C.I. for overall concordance across 10 studies with a total of 17 unique number of comparisons, N of events and total included participants. **(B)** Forest plot representing kappa concordance and 95% C.I. for overall concordance between two F2F physician diagnoses across 4 studies with a total of 6 unique number of comparisons, N of total included participants. **(C)** Forest plot representing percentage agreement between TDs and histopathology with 95% C.I. for overall concordance across 6 studies, N of events and total included participants.

A


Study
Events
Total
Agreement Rate (%)
95% C.I.
Weight
Teledermoscopy = No/Not Mentioned
Muir et al, 2011 (B) 49 50 98.00 [87.12; 99.72] 0.1%
Nami et al, 2015 356 391 91.05 [87.79; 93.50] 1.3%
Sola-Ortigosa et al, 2020 (C) 884 1000 88.40 [86.26; 90.24] 2.0%
Romero et al, 2010 (A) 325 368 88.32 [84.61; 91.22] 1.4%
Romero Aguilera et al, 2014 (C) 150 170 88.24 [82.47; 92.28] 1.0%
Sola-Ortigosa et al, 2020 (A) 875 1000 87.50 [85.30; 89.41] 2.0%
Romero et al, 2010 (B) 314 368 85.33 [81.33; 88.59] 1.6%
Sola-Ortigosa et al, 2020 (B) 835 1000 83.50 [81.07; 85.67] 2.1%
Gatica, 2015 103 125 82.40 [74.71; 88.12] 1.0%
Ribas et al, 2010 142 174 81.61 [75.15; 86.69] 1.2%
Saleh et al, 2017 488 600 81.33 [78.01; 84.25] 1.9%
Giavina-Bianchi et al, Oct 2020 576 739 77.94 [74.81; 80.79] 2.1%
Borve et al, 2012 (A) 31 40 77.50 [62.12; 87.86] 0.5%
Borve et al, 2012 (B) 31 40 77.50 [62.12; 87.86] 0.5%
Tran et al, 2011 23 30 76.67 [58.50; 88.45] 0.4%
Marchell et al, 2017 77 101 76.24 [66.99; 83.53] 1.0%
Marchell et al, 2017 162 213 76.06 [69.87; 81.31] 1.5%
Zanini, 2013 76 100 76.00 [66.68; 83.36] 1.0%
Warshaw et al, 2015 (A) 570 753 75.70 [72.50; 78.63] 2.1%
Gerhardt et al, 2021 609 809 75.28 [72.19; 78.13] 2.1%
Tan et al, 2010 (B) 162 219 73.97 [67.76; 79.35] 1.5%
Tan et al, 2010 (A) 283 385 73.51 [68.87; 77.68] 1.8%
Romero Aguilera et al, 2014 (A) 124 170 72.94 [65.77; 79.08] 1.4%
Romero Aguilera et al, 2014 (B) 123 170 72.35 [65.16; 78.55] 1.4%
Marchell et al, 2017 81 112 72.32 [63.33; 79.81] 1.1%
Muir et al, 2011 (A) 43 60 71.67 [59.06; 81.60] 0.8%
Vano-Galvan et al, 2011 1381 2000 69.05 [66.99; 71.04] 2.4%
Clarke et al, 2021 205 308 66.56 [61.10; 71.61] 1.8%
Gabel et al, 2021 27 41 65.85 [50.28; 78.62] 0.6%
Duong et al, 2014 (A) 44 68 64.71 [52.72; 75.09] 0.9%
Barbieri et al, 2014 (A) 32 50 64.00 [49.95; 76.00] 0.7%
Lamel et al, 2012 66 107 61.68 [52.16; 70.39] 1.2%
Giavina-Bianchi et al, Nov 2020 490 803 61.02 [57.60; 64.34] 2.2%
Zink et al, 2017, July (A) 115 195 58.97 [51.94; 65.66] 1.6%
Altieri et al, 2017 (A) 93 160 58.13 [50.35; 65.52] 1.5%
Azfar et al, 2014 (B) 77 136 56.62 [48.18; 64.69] 1.4%
Barbieri et al, 2014 (B) 28 50 56.00 [42.13; 68.99] 0.8%
Patro et al, 2015 115 206 55.83 [48.98; 62.46] 1.6%
Batalla, 2016 36 65 55.38 [43.22; 66.94] 0.9%
Okita et al, 2016 54 100 54.00 [44.20; 63.50] 1.2%
Altieri et al, 2017 (B) 81 152 53.29 [45.34; 61.07] 1.4%
Warshaw et al, 2015 (D) 344 651 52.84 [49.00; 56.65] 2.1%
Keller et al, 2020 (B) 28 53 52.83 [39.51; 65.76] 0.8%
Altieri et al, 2017 (C) 80 152 52.63 [44.69; 60.44] 1.4%
Warshaw et al, 2015 (G) 300 583 51.46 [47.40; 55.50] 2.1%
Azfar et al, 2014 (C) 66 136 48.53 [40.25; 56.89] 1.4%
Chen et al, 2010 194 405 47.90 [43.07; 52.77] 2.0%
Azfar et al, 2014 (A) 63 136 46.32 [38.12; 54.73] 1.4%
Warshaw et al, 2015 (I) 473 1034 45.74 [42.73; 48.79] 2.3%
Keller et al, 2020 (A) 24 53 45.28 [32.52; 58.70] 0.8%
Carter et al, 2017 (B) 30 79 37.97 [27.99; 49.09] 1.0%
Duong et al, 2014 (B) 34 110 30.91 [22.99; 40.13] 1.1%
Carter et al, 2017 (A) 11 79 13.92 [7.88; 23.42] 0.6%
Combined prevalence 11983 17099 68.29 [66.78; 69.77] 71.5%
Heterogeneity: I^2 = 97%, τ^2 = 0.0353, p < 0.01
Teledermoscopy = Yes
Zink et al, 2017, Sept (B) 24 26 92.31 [73.93; 98.07] 0.2%
Sola-Ortigosa et al, 2020 (D) 915 1000 91.50 [89.60; 93.08] 1.8%
Sola-Ortigosa et al, 2020 (E) 912 1000 91.20 [89.28; 92.80] 1.9%
Sola-Ortigosa et al, 2020 (F) 903 1000 90.30 [88.30; 91.99] 1.9%
Barcaui et al, 2018 37 41 90.24 [76.73; 96.29] 0.3%
Rubegni et al, 2011 114 130 87.69 [80.85; 92.32] 0.8%
Rios-Yuil, 2012 25 30 83.33 [65.68; 92.89] 0.3%
Warshaw et al, 2015 (C) 548 684 80.12 [76.96; 82.94] 2.0%
Warshaw et al, 2015 (B) 566 752 75.27 [72.06; 78.22] 2.1%
Vestergaard et al, 2020 (A) 372 600 62.00 [58.05; 65.80] 2.1%
Vestergaard et al, 2020 (B) 361 600 60.17 [56.19; 64.01] 2.1%
Warshaw et al, 2015 (F) 357 595 60.00 [56.01; 63.86] 2.1%
Borve et al, 2013 (B) 39 69 56.52 [44.68; 67.66] 0.9%
Borve et al, 2013 (A) 38 69 55.07 [43.27; 66.33] 0.9%
Warshaw et al, 2015 (E) 348 652 53.37 [49.53; 57.18] 2.1%
Warshaw et al, 2015 (H) 291 579 50.26 [46.19; 54.32] 2.1%
Warshaw et al, 2015 (J) 511 1020 50.10 [47.03; 53.16] 2.3%
Jones et al, 2021 183 528 34.66 [30.72; 38.82] 2.0%
Costello et al, 2020 12 37 32.43 [19.43; 48.86] 0.6%
Combined prevalence 6556 9412 69.14 [66.76; 71.42] 28.5%
Heterogeneity: I^2 = 99%, τ^2 = 0.0353, p < 0.01
Combined prevalence 18539 26511 68.54 [67.26; 69.78] 100.0%
Heterogeneity: I^2 = 98%, τ^2 = 0.0353, p = 0
Residual heterogeneity: I^2 = NA%, p = NA
0
20
40
60
80
100
Primary diagnosis agreement - F2F vs. TD

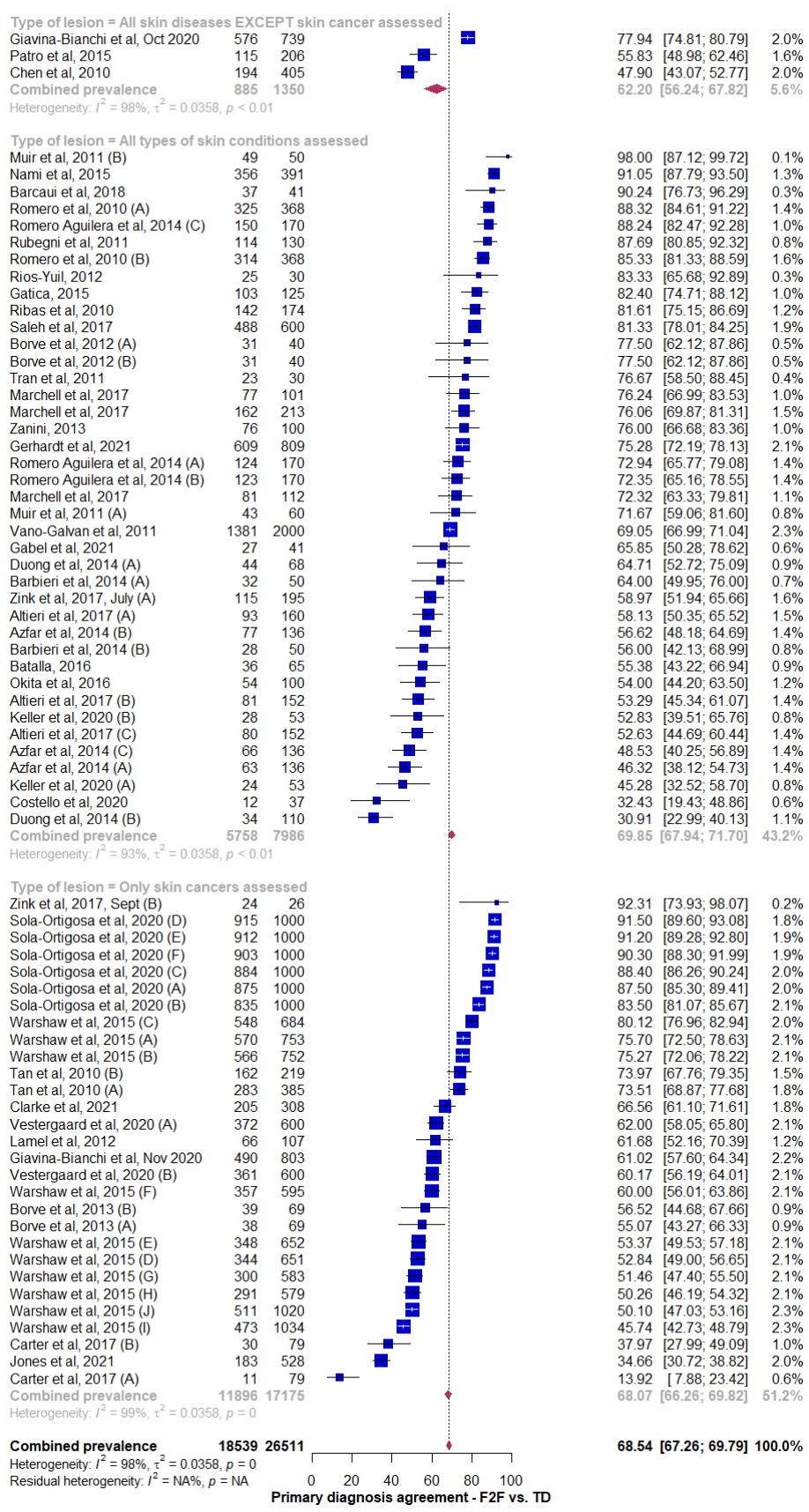
201



eFigure 3. Forest plot representing F2F and TD primary diagnostic agreement by utilization of teledermoscopy.

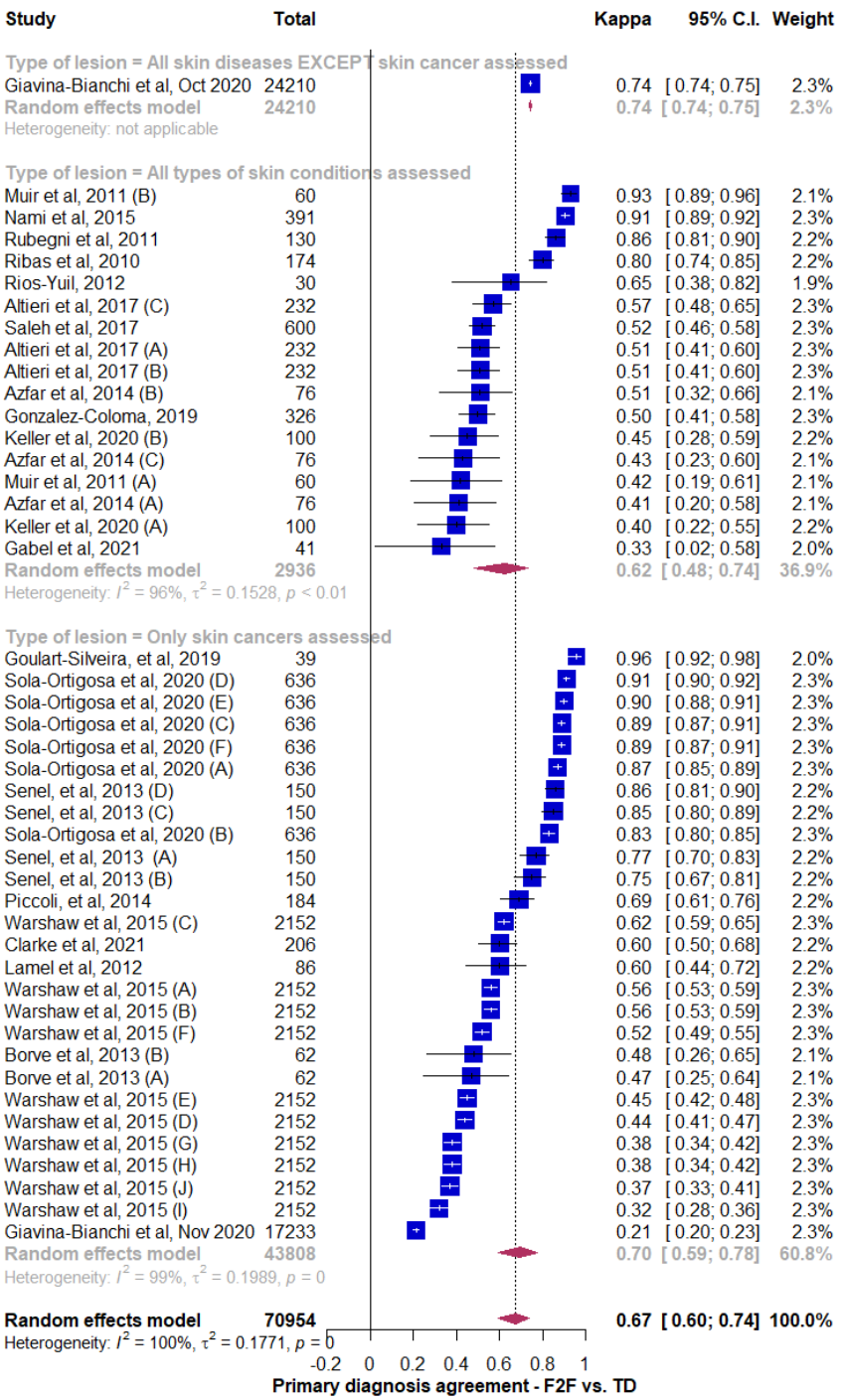
Studies were sorted into two groups, i) Did not use or did not report the use of teledermoscopy; ii) Used teledermoscopy. **(A)** Forest plot representing percentage agreement and 95% C.I. for overall concordance across 39 studies with a total of 71 unique number of comparisons, N of events and total included participants. **(B)** Forest plot representing kappa concordance and 95% C.I. for overall concordance across 21 studies with a total of 45 unique number of comparisons, N of total included participants.

A


Study Events Total Agreement Rate (%) 95% C.I. Weight
Type of lesion = All skin diseases EXCEPT skin cancer assessed
Giavina-Bianchi et al, Oct 2020 576 739 77.94 [74.81; 80.79] 2.0%
Patro et al, 2015 115 206 55.83 [48.98; 62.46] 1.6%
Chen et al, 2010 194 405 47.90 [43.07; 52.77] 2.0%
Combined prevalence 885 1350 62.20 [56.24; 67.82] 5.6%
Heterogeneity: I^2 = 98%, τ^2 = 0.0358, p < 0.01
Type of lesion = All types of skin conditions assessed
Muir et al, 2011 (B) 49 50 98.00 [87.12; 99.72] 0.1%
Nami et al, 2015 356 391 91.05 [87.79; 93.50] 1.3%
Barcaui et al, 2018 37 41 90.24 [76.73; 96.29] 0.3%
Romero et al, 2010 (A) 325 368 88.32 [84.61; 91.22] 1.4%
Romero Aguilera et al, 2014 (C) 150 170 88.24 [82.47; 92.28] 1.0%
Rubegni et al, 2011 114 130 87.69 [80.85; 92.32] 0.8%
Romero et al, 2010 (B) 314 368 85.33 [81.33; 88.59] 1.6%
Rios-Yuil, 2012 25 30 83.33 [65.68; 92.89] 0.3%
Gatica, 2015 103 125 82.40 [74.71; 88.12] 1.0%
Ribas et al, 2010 142 174 81.61 [75.15; 86.69] 1.2%
Saleh et al, 2017 488 600 81.33 [78.01; 84.25] 1.9%
Borve et al, 2012 (A) 31 40 77.50 [62.12; 87.86] 0.5%
Borve et al, 2012 (B) 31 40 77.50 [62.12; 87.86] 0.5%
Tran et al, 2011 23 30 76.67 [58.50; 88.45] 0.4%
Marchell et al, 2017 77 101 76.24 [66.99; 83.53] 1.0%
Marchell et al, 2017 162 213 76.06 [69.87; 81.31] 1.5%
Zanini, 2013 76 100 76.00 [66.68; 83.36] 1.0%
Gerhardt et al, 2021 609 809 75.28 [72.19; 78.13] 2.1%
Romero Aguilera et al, 2014 (A) 124 170 72.94 [65.77; 79.08] 1.4%
Romero Aguilera et al, 2014 (B) 123 170 72.35 [65.16; 78.55] 1.4%
Marchell et al, 2017 81 112 72.32 [63.33; 79.81] 1.1%
Muir et al, 2011 (A) 43 60 71.67 [59.06; 81.60] 0.8%
Vano-Galvan et al, 2011 1381 2000 69.05 [66.99; 71.04] 2.3%
Gabel et al, 2021 27 41 65.85 [50.28; 78.62] 0.6%
Duong et al, 2014 (A) 44 68 64.71 [52.72; 75.09] 0.9%
Barbieri et al, 2014 (A) 32 50 64.00 [49.95; 76.00] 0.7%
Zink et al, 2017, July (A) 115 195 58.97 [51.94; 65.66] 1.6%
Altieri et al, 2017 (A) 93 160 58.13 [50.35; 65.52] 1.5%
Azfar et al, 2014 (B) 77 136 56.62 [48.18; 64.69] 1.4%
Barbieri et al, 2014 (B) 28 50 56.00 [42.13; 68.99] 0.8%
Batalla, 2016 36 65 55.38 [43.22; 66.94] 0.9%
Okita et al, 2016 54 100 54.00 [44.20; 63.50] 1.2%
Altieri et al, 2017 (B) 81 152 53.29 [45.34; 61.07] 1.4%
Keller et al, 2020 (B) 28 53 52.83 [39.51; 65.76] 0.8%
Altieri et al, 2017 (C) 80 152 52.63 [44.69; 60.44] 1.4%
Azfar et al, 2014 (C) 66 136 48.53 [40.25; 56.89] 1.4%
Azfar et al, 2014 (A) 63 136 46.32 [38.12; 54.73] 1.4%
Keller et al, 2020 (A) 24 53 45.28 [32.52; 58.70] 0.8%
Costello et al, 2020 12 37 32.43 [19.43; 48.86] 0.6%
Duong et al, 2014 (B) 34 110 30.91 [22.99; 40.13] 1.1%
Combined prevalence 5758 7986 69.85 [67.94; 71.70] 43.2%
Heterogeneity: I^2 = 93%, τ^2 = 0.0358, p < 0.01
Type of lesion = Only skin cancers assessed
Zink et al, 2017, Sept (B) 24 26 92.31 [73.93; 98.07] 0.2%
Sola-Ortigosa et al, 2020 (D) 915 1000 91.50 [89.60; 93.08] 1.8%
Sola-Ortigosa et al, 2020 (E) 912 1000 91.20 [89.28; 92.80] 1.9%
Sola-Ortigosa et al, 2020 (F) 903 1000 90.30 [88.30; 91.99] 1.9%
Sola-Ortigosa et al, 2020 (C) 884 1000 88.40 [86.26; 90.24] 2.0%
Sola-Ortigosa et al, 2020 (A) 875 1000 87.50 [85.30; 89.41] 2.0%
Sola-Ortigosa et al, 2020 (B) 835 1000 83.50 [81.07; 85.67] 2.1%
Warshaw et al, 2015 (C) 548 684 80.12 [76.96; 82.94] 2.0%
Warshaw et al, 2015 (A) 570 753 75.70 [72.50; 78.63] 2.1%
Warshaw et al, 2015 (B) 566 752 75.27 [72.06; 78.22] 2.1%
Tan et al, 2010 (B) 162 219 73.97 [67.76; 79.35] 1.5%
Tan et al, 2010 (A) 283 385 73.51 [68.87; 77.68] 1.8%
Clarke et al, 2021 205 308 66.56 [61.10; 71.61] 1.8%
Vestergaard et al, 2020 (A) 372 600 62.00 [58.05; 65.80] 2.1%
Lamel et al, 2012 66 107 61.68 [52.16; 70.39] 1.2%
Giavina-Bianchi et al, Nov 2020 490 803 61.02 [57.60; 64.34] 2.2%
Vestergaard et al, 2020 (B) 361 600 60.17 [56.19; 64.01] 2.1%
Warshaw et al, 2015 (F) 357 595 60.00 [56.01; 63.86] 2.1%
Borve et al, 2013 (B) 39 69 56.52 [44.68; 67.66] 0.9%
Borve et al, 2013 (A) 38 69 55.07 [43.27; 66.33] 0.9%
Warshaw et al, 2015 (E) 348 652 53.37 [49.53; 57.18] 2.1%
Warshaw et al, 2015 (D) 344 651 52.84 [49.00; 56.65] 2.1%
Warshaw et al, 2015 (G) 300 583 51.46 [47.40; 55.50] 2.1%
Warshaw et al, 2015 (H) 291 579 50.26 [46.19; 54.32] 2.1%
Warshaw et al, 2015 (J) 511 1020 50.10 [47.03; 53.16] 2.3%
Warshaw et al, 2015 (I) 473 1034 45.74 [42.73; 48.79] 2.3%
Carter et al, 2017 (B) 30 79 37.97 [27.99; 49.09] 1.0%
Jones et al, 2021 183 528 34.66 [30.72; 38.82] 2.0%
Carter et al, 2017 (A) 11 79 13.92 [7.88; 23.42] 0.6%
Combined prevalence 11896 17175 68.07 [66.26; 69.82] 51.2%
Heterogeneity: I^2 = 99%, τ^2 = 0.0358, p = 0
Combined prevalence 18539 26511 68.54 [67.26; 69.79] 100.0%
Heterogeneity: I^2 = 98%, τ^2 = 0.0358, p = 0
Residual heterogeneity: I^2 = NA%, p = NA
0 20 40 60 80 100
Primary diagnosis agreement - F2F vs. TD

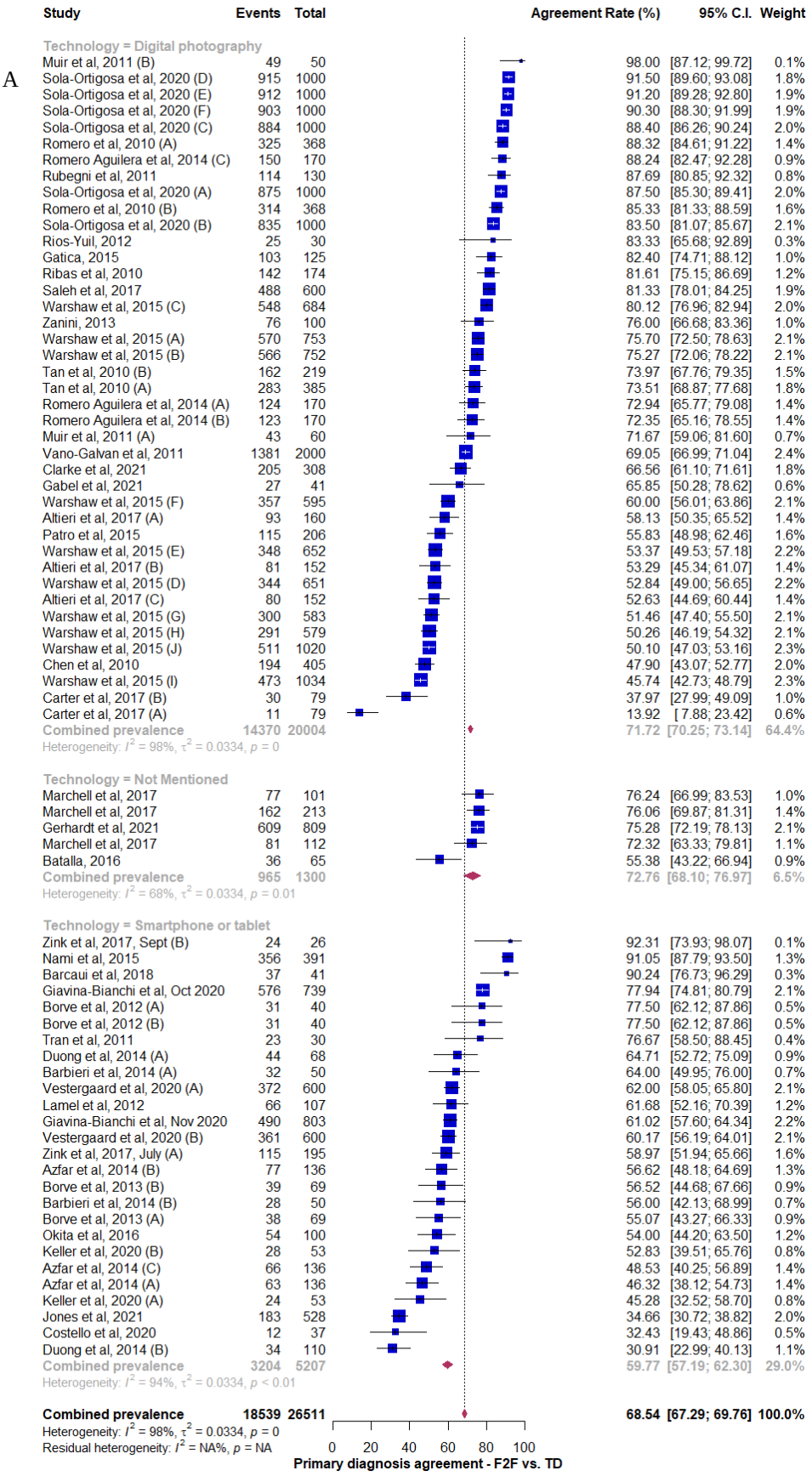
210

B

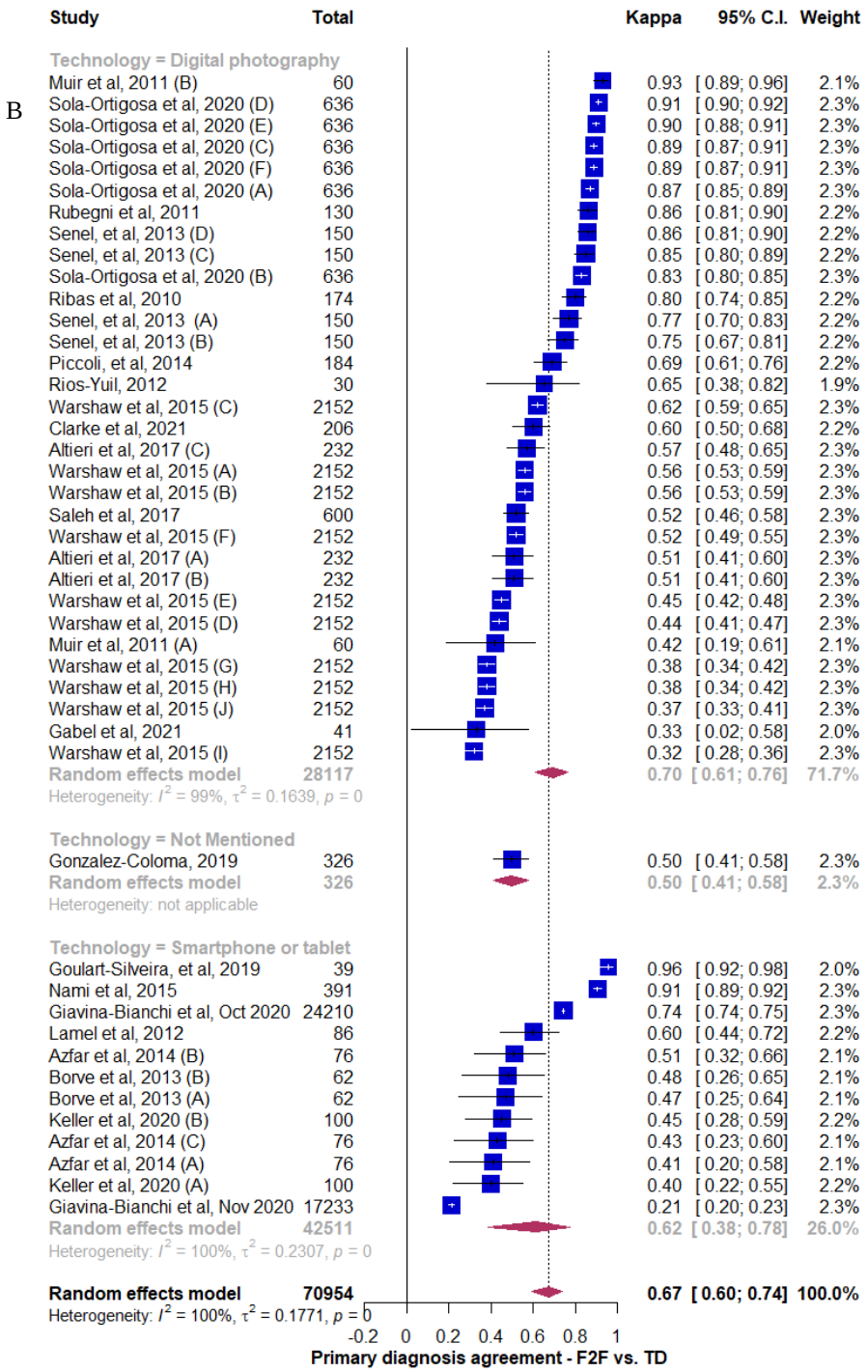


eFigure 4. Forest plot representing F2F and TD primary diagnostic agreement by skin lesion category. Studies were sorted into three groups according to the type of included lesions, i) All skin conditions except likely malignant lesion; ii) All skin conditions; iii) Likely malignant lesions only. **(A)** Forest plot representing percentage agreement and 95% C.I. for overall concordance across 39 studies with a total of 71 unique number of comparisons, N of events and total included participants. **(B)** Forest plot representing kappa concordance and 95% C.I. for overall concordance across 21 studies with a total of 45 unique number of comparisons, N of total included participants.

A


Study
Events
Total
Agreement Rate (%)
95% C.I.
Weight
Technology = Digital photography
Muir et al, 2011 (B) 49 50 98.00 [87.12; 99.72] 0.1%
Sola-Ortigosa et al, 2020 (D) 915 1000 91.50 [89.60; 93.08] 1.8%
Sola-Ortigosa et al, 2020 (E) 912 1000 91.20 [89.28; 92.80] 1.9%
Sola-Ortigosa et al, 2020 (F) 903 1000 90.30 [88.30; 91.99] 1.9%
Sola-Ortigosa et al, 2020 (C) 884 1000 88.40 [86.26; 90.24] 2.0%
Romero et al, 2010 (A) 325 368 88.32 [84.61; 91.22] 1.4%
Romero Aguilera et al, 2014 (C) 150 170 88.24 [82.47; 92.28] 0.9%
Rubegni et al, 2011 114 130 87.69 [80.85; 92.32] 0.8%
Sola-Ortigosa et al, 2020 (A) 875 1000 87.50 [85.30; 89.41] 2.0%
Romero et al, 2010 (B) 314 368 85.33 [81.33; 88.59] 1.6%
Sola-Ortigosa et al, 2020 (B) 835 1000 83.50 [81.07; 85.67] 2.1%
Rios-Yuil, 2012 25 30 83.33 [65.68; 92.89] 0.3%
Gatica, 2015 103 125 82.40 [74.71; 88.12] 1.0%
Ribas et al, 2010 142 174 81.61 [75.15; 86.69] 1.2%
Saleh et al, 2017 488 600 81.33 [78.01; 84.25] 1.9%
Warshaw et al, 2015 (C) 548 684 80.12 [76.96; 82.94] 2.0%
Zanini, 2013 76 100 76.00 [66.68; 83.36] 1.0%
Warshaw et al, 2015 (A) 570 753 75.70 [72.50; 78.63] 2.1%
Warshaw et al, 2015 (B) 566 752 75.27 [72.06; 78.22] 2.1%
Tan et al, 2010 (B) 162 219 73.97 [67.76; 79.35] 1.5%
Tan et al, 2010 (A) 283 385 73.51 [68.87; 77.68] 1.8%
Romero Aguilera et al, 2014 (A) 124 170 72.94 [65.77; 79.08] 1.4%
Romero Aguilera et al, 2014 (B) 123 170 72.35 [65.16; 78.55] 1.4%
Muir et al, 2011 (A) 43 60 71.67 [59.06; 81.60] 0.7%
Vano-Galvan et al, 2011 1381 2000 69.05 [66.99; 71.04] 2.4%
Clarke et al, 2021 205 308 66.56 [61.10; 71.61] 1.8%
Gabel et al, 2021 27 41 65.85 [50.28; 78.62] 0.6%
Warshaw et al, 2015 (F) 357 595 60.00 [56.01; 63.86] 2.1%
Altieri et al, 2017 (A) 93 160 58.13 [50.35; 65.52] 1.4%
Patro et al, 2015 115 206 55.83 [48.98; 62.46] 1.6%
Warshaw et al, 2015 (E) 348 652 53.37 [49.53; 57.18] 2.2%
Altieri et al, 2017 (B) 81 152 53.29 [45.34; 61.07] 1.4%
Warshaw et al, 2015 (D) 344 651 52.84 [49.00; 56.65] 2.2%
Altieri et al, 2017 (C) 80 152 52.63 [44.69; 60.44] 1.4%
Warshaw et al, 2015 (G) 300 583 51.46 [47.40; 55.50] 2.1%
Warshaw et al, 2015 (H) 291 579 50.26 [46.19; 54.32] 2.1%
Warshaw et al, 2015 (J) 511 1020 50.10 [47.03; 53.16] 2.3%
Chen et al, 2010 194 405 47.90 [43.07; 52.77] 2.0%
Warshaw et al, 2015 (I) 473 1034 45.74 [42.73; 48.79] 2.3%
Carter et al, 2017 (B) 30 79 37.97 [27.99; 49.09] 1.0%
Carter et al, 2017 (A) 11 79 13.92 [7.88; 23.42] 0.6%
Combined prevalence 14370 20004 71.72 [70.25; 73.14] 64.4%
Heterogeneity: I^2 = 98%, τ^2 = 0.0334, p = 0
Technology = Not Mentioned
Marchell et al, 2017 77 101 76.24 [66.99; 83.53] 1.0%
Marchell et al, 2017 162 213 76.06 [69.87; 81.31] 1.4%
Gerhardt et al, 2021 609 809 75.28 [72.19; 78.13] 2.1%
Marchell et al, 2017 81 112 72.32 [63.33; 79.81] 1.1%
Batalla, 2016 36 65 55.38 [43.22; 66.94] 0.9%
Combined prevalence 965 1300 72.76 [68.10; 76.97] 6.5%
Heterogeneity: I^2 = 68%, τ^2 = 0.0334, p = 0.01
Technology = Smartphone or tablet
Zink et al, 2017, Sept (B) 24 26 92.31 [73.93; 98.07] 0.1%
Nami et al, 2015 356 391 91.05 [87.79; 93.50] 1.3%
Barcaui et al, 2018 37 41 90.24 [76.73; 96.29] 0.3%
Giavina-Bianchi et al, Oct 2020 576 739 77.94 [74.81; 80.79] 2.1%
Borve et al, 2012 (A) 31 40 77.50 [62.12; 87.86] 0.5%
Borve et al, 2012 (B) 31 40 77.50 [62.12; 87.86] 0.5%
Tran et al, 2011 23 30 76.67 [58.50; 88.45] 0.4%
Duong et al, 2014 (A) 44 68 64.71 [52.72; 75.09] 0.9%
Barbieri et al, 2014 (A) 32 50 64.00 [49.95; 76.00] 0.7%
Vestergaard et al, 2020 (A) 372 600 62.00 [58.05; 65.80] 2.1%
Lamel et al, 2012 66 107 61.68 [52.16; 70.39] 1.2%
Giavina-Bianchi et al, Nov 2020 490 803 61.02 [57.60; 64.34] 2.2%
Vestergaard et al, 2020 (B) 361 600 60.17 [56.19; 64.01] 2.1%
Zink et al, 2017, July (A) 115 195 58.97 [51.94; 65.66] 1.6%
Azfar et al, 2014 (B) 77 136 56.62 [48.18; 64.69] 1.3%
Borve et al, 2013 (B) 39 69 56.52 [44.68; 67.66] 0.9%
Barbieri et al, 2014 (B) 28 50 56.00 [42.13; 68.99] 0.7%
Borve et al, 2013 (A) 38 69 55.07 [43.27; 66.33] 0.9%
Okita et al, 2016 54 100 54.00 [44.20; 63.50] 1.2%
Keller et al, 2020 (B) 28 53 52.83 [39.51; 65.76] 0.8%
Azfar et al, 2014 (C) 66 136 48.53 [40.25; 56.89] 1.4%
Azfar et al, 2014 (A) 63 136 46.32 [38.12; 54.73] 1.4%
Keller et al, 2020 (A) 24 53 45.28 [32.52; 58.70] 0.8%
Jones et al, 2021 183 528 34.66 [30.72; 38.82] 2.0%
Costello et al, 2020 12 37 32.43 [19.43; 48.86] 0.5%
Duong et al, 2014 (B) 34 110 30.91 [22.99; 40.13] 1.1%
Combined prevalence 3204 5207 59.77 [57.19; 62.30] 29.0%
Heterogeneity: I^2 = 94%, τ^2 = 0.0334, p < 0.01
Combined prevalence 18539 26511 68.54 [67.29; 69.76] 100.0%
Heterogeneity: I^2 = 98%, τ^2 = 0.0334, p = 0
Residual heterogeneity: I^2 = NA%, p = NA
0
20
40
60
80
100
Primary diagnosis agreement - F2F vs. TD

219



eFigure 5. Forest plot representing F2F and TD primary diagnostic agreement by device type used to capture clinical photographs.

Forest plot representing F2F and TD primary diagnostic agreement by imaging technology used. Studies were sorted into three groups, i) Digital photography ii) Imaging technology not mentioned iii) Smartphone or tablet. **(A)** Forest plot representing percentage agreement and 95% C.I. for overall concordance across 39 studies with a total of 71 unique number of comparisons, N of events and total included participants. **(B)** Forest plot representing kappa concordance and 95% C.I. for overall concordance across 21 studies with a total of 45 unique number of comparisons, N of total included participants.

Supplementary eTable Titles and Legends

Supplementary eTables

Inclusion criteria	Exclusion criteria
Primary articles assessing diagnostic agreement where store-and-forward technology or live video conference consults were compared with a control group who attend in-person visits.	Survey articles, feasibility studies, studies regarding other forms of telemedicine unrelated to dermatology, cost-effectiveness studies, editorials, and review articles.
Primarily comparing TD to F2F, sometimes using histopathology as the gold standard.	Studies that clearly stated they used TDs as the gold- or reference standard.
	Studies that only compared dermatoscopic images in the absence of clinical images.
	Studies where patients captured their own photographs.

eTable 1. Inclusion and exclusion criteria for screening of literature search results.
TD: TeleDermatology, TDs: TeleDermatologists, F2F: Face-to-Face.

Study characteristics Author, year, title, study type, objective, country of publication. Patient characteristics: total number of participants included declaration of funding source, number of participants per study, mean age +/- SD, age range, gender, mean BMI and range, race/ethnicity, type of lesions evaluated, type of patients evaluated.
Methodology - TD and F2F consults Method of correspondence, platform used for the TD consult, training on TD platform, length of TD and F2F consult, experience of the TD and F2F physician, location of TD, number of TDs and F2F physicians who made a diagnosis for each patient, total number of TDs and F2F physicians in study, order of visits, wait time between TD and F2F, whether same specialist conducted TD and F2F visit, specialization of the F2F physician, number of reviews; qualifications of the individual who acquired the clinical photographs and whether they received additional training on taking clinical photographs.
Metrics and results Technology used for image acquisition and for viewing images with, distance between camera and lesion, number of images taken, use of teledermoscopy & dermoscopy, brand of dermatoscope, use of histopathology, referral content provided to TD, primary and differential diagnoses agreement and concordance rates, diagnostic accuracy values (if available) such as sensitivity, specificity, PPV and NPV.

eTable 2. Data extraction form with details of domains record.
TD: TeleDermatology, F2F: Face-to-Face, PPV: Positive Predictive Value, NPV: Negative Predictive Value.

Author and Year	Unique Study Grouping	n_participants	n_lesions	%_primary diagnosis agreement_in_person	N_primary diagnosis agreement_in_person	n agreement	%_primary diagnosis agreement_TD	N_primary diagnosis agreement_TD	n agreement	%_primary diagnosis agreement (TD and F2F	N_primary diagnosis agreement (TD and F2F	n agreement	%_primary diagnosis agreement (TD & Histo)	N_primary diagnosis agreement (TD & Histo)	n agreement	**Inter_Kappa** (primary diagnosis, TD and F2F)	**N_Inter_Kappa** (primary diagnosis, TD and F2F)	**Inter_Kappa (**primary diagnosis, TD and Histo)
Altieri et al, 2017 (A)	F2F Derm vs TD1	232	232							58	160	93				0.51	160	
Altieri et al, 2017 (B)	F2F Derm vs TD2	232	232							53	152	81				0.51	152	
Altieri et al, 2017 (C)	F2F Derm vs TD3	232	232							53	152	80				0.57	152	
Azfar et al, 2014 (A)	F2F Derm vs TD1	76	159						40	47	136	63				0.41	136	
Azfar et al, 2014 (B)	F2F Derm vs TD2	76	159						63	57	136	77				0.51	136	
Azfar et al, 2014 (C)	F2F Derm vs TD3	76	159						59	49	136	66				0.43	136	
Barbieri et al, 2014 (A)	F2F Derm vs TD1	50	50				58	50	29	64	50	32						
Barbieri et al, 2014 (B)	F2F Derm vs TD2	50	50							56	50	28						
Barcaui et al, 2018	F2F Derm vs TD	31	41							90	41	37						
Batalla, 2016	F2F Derm vs TD	183	183							55	65	36						

Borve et al, 2012 (A)	F2F Derm vs TD1	40	40	88	40	35	68	40	27	78	40	31						
Borve et al, 2012 (B)	F2F Derm vs TD2	40	40							78	40	31						
Borve et al, 2013 (A)	F2F Derm vs TD1	62	69				58	69	40	55	69	38				0.47	69	.51
Borve et al, 2013 (B)	F2F Derm vs TD2	62	69							57	69	39				0.48	69	
Carter et al, 2017 (A)	F2F nonspecialist vs TD	79	79				38	79	30	14	79	11						
Carter et al, 2017 (B)	F2F Derm vs TD	79	79							38	79	30						
Chen et al, 2010	F2F nonspecialist vs TD	405	405							48	405	194						
Clarke et al, 2021	F2F Derm vs TD	206	308							67	308	205	65	62	40	0.6	308	
Costello et al, 2020	F2F nonspecialist vs TD	37	37							32	37	12						
Duong et al, 2014 (A)	F2F nonspecialist vs TD (Videoconference)	111	110							65	68	44						
Duong et al, 2014 (B)	F2F nonspecialist vs TD (SFTD)	111	110							31	110	34						
Gabel et al, 2021	F2F Derm vs TD	41	41							67	41	27				0.33	41	
Gatica, 2015	F2F Derm vs TD	125	125							82	125	103						
Gerhardt et al, 2021	F2F Derm vs TD	809	809							75	809	609						
Giavina-Bianchi et al, Nov 2020	F2F Derm vs TD	17233	17233							61	803	490	54	289	156	0.21	803	.09
Giavina-Bianchi et al, Oct 2020	F2F Derm vs TD	24210	27519							78	739	576				0.74	739	

Gonzalez-Coloma, 2019	F2F nonspecialist vs TD	326	326										0.5	326	
Goulart-Silveira, et al, 2019	F2F Derm vs TD	39	39										0.96	39	.56
Jones et al, 2021	F2F nonspecialist vs TD (Suspicious Skin Cancer pathway)	NA	528				35	528	183	53	114	60			
Keller et al, 2020 (A)	F2F nonspecialist vs TD	100	100				45	53	24				0.4	53	
Keller et al, 2020 (B)	F2F Derm vs TD	100	100				53	53	28				0.45	53	
Lamel et al, 2012	F2F Derm vs TD	86	107				62	107	66				0.6	107	
Marchell et al, 2017	F2F Derm vs TD (SFTD)	216	216	91	134	122	76	162	213						
Marchell et al, 2017	F2F Derm vs TD (Uncompressed video)	216	216				76	76.8	101						
Marchell et al, 2017	F2F Derm vs TD (Compressed video)	216	216				72	80.6	112						
Muir et al, 2011 (A)	F2F nonspecialist vs TD	60	60				72	60	43				0.42	60	
Muir et al, 2011 (B)	F2F Derm vs TD	60	60				98	50	49				0.93	50	
Nami et al, 2015	F2F Derm vs TD	391	391				91	391	356				0.91	391	
Okita et al, 2016	F2F Derm vs TD	100	100				54	100	54						
Patro et al, 2015	F2F nonspecialist vs TD	206	206				56	206	115						
Piccoli, et al, 2014	F2F nonspecialist vs TD	184	184										0.69	184	

Ribas et al, 2010	F2F Derm vs TD	174	174	83	174	145	81	174	141	82	174	142		0.8	174
Rios-Yuil, 2012	F2F Derm vs TD	30	30							83	30	25	67	0.65	30
Romero Aguilera et al, 2014 (A)	F2F Derm vs TD1	457	192				69	170	118	73	170	124			
Romero Aguilera et al, 2014 (B)	F2F Derm vs TD2	457	192				73	170	124	72	170	123			
Romero Aguilera et al, 2014 (C)	F2F Derm vs TD3	457	192				67	170	114	88	170	150			
Romero et al, 2010 (A)	F2F Derm vs TD (SFTD)	457	192							88	368	325			
Romero et al, 2010 (B)	F2F Derm vs TD (SFTD and videoconferencing)	457	176							85	368	314			
Rubegni et al, 2011	F2F Derm vs TD	130	130							88	130	114		0.86	130
Saleh et al, 2017	F2F Derm vs TD	600	600				88	600	526	81	600	488		0.46-0.52	600
Senel, et al, 2013	F2F Derm vs TD1 (no dermoscopy)	150	150											0.77	150
Senel, et al, 2013	F2F Derm vs TD2 (no dermoscopy)	150	150											0.75	150
Senel, et al, 2013	F2F Derm vs TD1 (dermoscopy)	150	150											0.85	150
Senel, et al, 2013	F2F Derm vs TD2 (dermoscopy)	150	150											0.86	150
Sola-Ortigosa et al, 2020 (A)	F2F Derm vs TD1 (no dermoscopy)	636	1000				82	1000	821	88	1000	875		0.87	1000
Sola-Ortigosa et al, 2020 (B)	F2F Derm vs TD2 (no dermoscopy)	636	1000				83	1000	832	84	1000	835		0.83	1000

Sola-Ortigosa et al, 2020 (C)	F2F Derm vs TD3 (no dermoscopy)	636	1000				81	1000	813	88	1000	884				0.89	1000
Sola-Ortigosa et al, 2020 (D)	F2F Derm vs TD1 (dermoscopy)	636	1000				92	1000	915	92	1000	915				0.91	1000
Sola-Ortigosa et al, 2020 (E)	F2F Derm vs TD2 (dermoscopy)	636	1000				90	1000	902	91	1000	912				0.9	1000
Sola-Ortigosa et al, 2020 (F)	F2F Derm vs TD3 (dermoscopy)	636	1000				90	1000	899	90	1000	903				0.89	1000
Tan et al, 2010 (A)	F2F Derm vs TD1, F2F Derm 1 vs F2F Derm 2	200	491	82	191	157	72	491	355	74	385	283					
Tan et al, 2010 (B)	F2F Derm vs TD2, F2F Derm 2 vs F2F Derm 3	200	491	76	106	80				74	219	162					
Tan et al, 2010 (C)	F2F Derm 1 vs F2F Derm 3	200	491	76	194	147											
Tran et al, 2011	F2F Derm vs TD	30	30							75	30	23					
Vano-Galvan et al, 2011	F2F Derm vs TD	100	100							69	2000	1381					
Vestergaard et al, 2020 (A)	A F2F Derm vs TD1	519	600				62	600	370	62	600	372	58	292	170		
Vestergaard et al, 2020 (B)	F2F Derm vs TD2	519	600							60	600	361	54	292	157		
Warshaw et al, 2015 (A)	F2F Derm vs TD (non biopsied pigmented lesions, Macro)	2152	3021							76	753	570				0.56	753
Warshaw et al, 2015 (B)	F2F Derm vs TD (non biopsied pigmented lesions, Macro+PLD)	2152	3021							75	752	566				0.56	752

Warshaw et al, 2015 (C)	F2F Derm vs TD (non biopsied pigmented lesions, Macro+PLD)	2152	3021	80	684	548				0.62	684
Warshaw et al, 2015 (D)	F2F Derm vs TD (biopsied pigmented lesions, Macro)	2152	3021	53	651	344				0.44	651
Warshaw et al, 2015 (E)	F2F Derm vs TD (biopsied pigmented lesions, Macro+PLD)	2152	3021	53	652	348				0.45	652
Warshaw et al, 2015 (F)	F2F Derm vs TD (biopsied pigmented lesions, Macro+PLD)	2152	3021	60	595	357				0.52	595
Warshaw et al, 2015 (G)	F2F Derm vs TD (NONbiopsied NONpigmented lesions, Macro)	2152	3021	52	583	300				0.38	583
Warshaw et al, 2015 (H)	F2F Derm vs TD (NONbiopsied NONpigmented lesions, Macro+PLD)	2152	3021	50	579	291				0.38	579
Warshaw et al, 2015 (I)	F2F Derm vs TD (biopsied NONpigmented lesions, Macro)	2152	3021	46	1034	473				0.32	1034
Warshaw et al, 2015 (J)	F2F Derm vs TD (biopsied NONpigmented lesions, Macro+PLD)	2152	3021	50	1020	511				0.37	1020
Zanini, 2013	F2F Derm vs TD	100	100	76	100	76					
Zink et al, 2017, July (A)	F2F Derm vs TD	195	195	59	195	115	56	195	108		

Zink et al, 2017, Sept (B)	F2F Derm vs TD	26	26	92	26	24	67	26	17				

eTable 3. Included unique study groupings and letter codes.

TD: TeleDermatology, TDs: TeleDermatologists, Derm: Dermatologist, F2F: Face-to-Face, SFTD: Store And Forward Technology, PLD: Polarized Light Dermoscopy, Macro: Macroscopic clinical images.

Study ID	Journal	Reason For Exclusion
NCT03034694, 2016	ClinicalTrials.gov	Wrong study design
Andersson et al, 2017	Lakartidningen	Wrong study design
Romero et al, 2018	Actas dermo-sifiliograficas	Wrong study design
Orruno et al, 2016	Health Technology Assessment Database	Wrong study design
Batalla et al, 2016	Piel	Wrong study design
Kroemer et al, 2011	British Journal of Dermatology	Wrong study design
Ernstberger et al, 2014	Zentralblatt fur Chirurgie	Wrong study design
Totty et al, 2018	Journal of wound care	Wrong study design
Wurm et al, 2013	Journal of Telemedicine and Telecare	Wrong study design
Wang et al, 2017	Telemedicine journal and e-health : the official journal of the American Telemedicine Association	Wrong study design
Singh et al, 2011	Australasian Journal of Dermatology	Wrong study design
Grey et al, 2017	Dermatitis	Wrong study design
Crompton et al, 2010	Journal of Visual Communication in Medicine	Wrong study design
Ali et al, 2021	JMIR formative research	Wrong study design
Boyce et al, 2011	Dermatology	Wrong study design
Berg et al, 2017	Sarcoidosis Vasculitis and Diffuse Lung Diseases	Wrong study design
Shin et al, 2014	Journal of telemedicine and telecare	Wrong study design
Gacto-Sanchez et al, 2020	Burns : journal of the International Society for Burn Injuries	Wrong study design
Tian et al, 2017	Journal of Cosmetic Dermatology	Wrong study design
Thind et al, 2011	Clinical and Experimental Dermatology	Wrong study design
Silveira et al, 2014	BMC Dermatology	Wrong study design
O'Connor et al, 2017	JAMA Dermatology	Wrong study design
Janda et al, 2020	The Lancet. Digital health	Wrong study design
Day et al, 2020	Military medicine	Wrong study design
Karlsson et al, 2015	Acta Dermato-Venereologica	Wrong study design
Seghers et al, 2015	Australasian Journal of Dermatology	Wrong study design
Hazenberg et al, 2010	Journal of Medical Engineering and Technology	Wrong study design
Borve et al, 2015	Acta Dermato-Venereologica	Wrong study design
Boissin et al, 2015	Burns	Wrong study design
Da Silva et al, 2018	Dermatology online journal	Wrong study design
Devrim et al, 2019	BMC pediatrics	Wrong study design
Danielsson et al, 2016	Health Technology Assessment Database	Wrong study design

Berglund et al, 2020	Journal of the European Academy of Dermatology and Venereology : JEADV	Wrong study design
Forsblom et al, 2013	Clinical Infectious Diseases	Wrong study design
G Bianchi et al, 2020	Journal of medical Internet research	Wrong study design
Congalton et al, 2015	Journal of the European Academy of Dermatology and Venereology	Wrong study design
Ferrandiz et al, 2012	Archives of Dermatology	Wrong study design
Ismail et al, 2018	International Journal of Women's Dermatology	Wrong study design
Gamus et al, 2019	International journal of medical informatics	Wrong study design
Paudel et al, 2020	Case reports in dermatological medicine	Wrong study design
Georgesen et al, 2020	Telemedicine journal and e-health : the official journal of the American Telemedicine Association	Wrong study design
Gagnon et al, 2015	Dermatology Times	Wrong study design
Philp et al, 2013	Pediatric Dermatology	Wrong study design
Mooney et al, 2011	Skin Research and Technology	Wrong study design
Do Khac et al, 2021	JMIR mHealth and uHealth	Wrong study design
Chambers et al, 2012	Journal of the American Academy of Dermatology	Wrong study design
Garcia-Romero et al, 2011	Telemedicine journal and e-health : the official journal of the American Telemedicine Association	Wrong study design
Ahmed et al, 2020	Annals of internal medicine	Wrong study design
Marwaha et al, 2019	Journal of the American Academy of Dermatology	Wrong study design
NCT02122432, 2014	ClinicalTrials.gov	Wrong study design
Lowe et al, 2021	Clinical and experimental dermatology	Wrong study design
Bowling et al, 2011	Wound Repair and Regeneration	Wrong study design
Marin-Gomez et al, 2020	Journal of primary care & community health	Wrong study design
Veronese et al, 2021	Diagnostics (Basel, Switzerland)	Wrong study design
Ismail et al, 2018	International journal of dermatology	Wrong study design
NCT02905851, 2016	ClinicalTrials.gov	Wrong study design
Trinidad et al, 2020	Journal of the American Academy of Dermatology	Wrong study design
Tensen et al, 2019	Studies in health technology and informatics	Wrong study design
Karavan et al, 2014	Journal of telemedicine and telecare	Wrong study design
Viola et al, 2011	Archives of Dermatology	Wrong study design
van Netten et al, 2017	Scientific reports	Wrong study design

Cai et al, 2016	Burns : journal of the International Society for Burn Injuries	Wrong study design
Hazenberg et al, 2010	Diabetes Technology and Therapeutics	Wrong study design
Jacoby et al, 2021	Journal of drugs in dermatology : JDD	Wrong study design
Pak et al, 2018	Wound repair and regeneration : official publication of the Wound Healing Society [and] the European Tissue Repair Society	Wrong study design
Kummerow Broman et al, 2019	JAMA surgery	Wrong study design
Munoz-Lopez et al, 2021	Journal of the European Academy of Dermatology and Venereology : JEADV	Wrong study design
Markun et al, 2017	Medicine	Wrong study design
Piette et al, 2017	Journal of telemedicine and telecare	Wrong study design
Tan et al, 2010	British Journal of Dermatology	Wrong study design
Watson et al, 2010	Archives of Dermatology	Wrong study design
Wiseman et al, 2016	Journal of vascular surgery. Venous and lymphatic disorders	Wrong study design
Wolf et al, 2013	JAMA dermatology	Wrong study design
Laggis et al, 2020	The American Journal of dermatopathology	Wrong study design
Kazi et al, 2021	Telemedicine journal and e-health : the official journal of the American Telemedicine Association	Wrong study design
Kanthraj et al, 2013	Indian Journal of Dermatology, Venereology and Leprology	Wrong study design
Shah et al, 2016	Journal of the American Academy of Dermatology	Wrong study design
Kim et al, 2018	Skin research and technology	Wrong study design
Nguyen et al, 2017	Journal of Clinical and Aesthetic Dermatology	Wrong study design
Rizvi et al, 2020	PloS one	Wrong study design
Mehrtens et al, 2019	Clinical and experimental dermatology	Wrong study design
Knudsen et al, 2012	Lakartidningen	Research letter or letter to the editor
Korman et al, 2020	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Mercer et al, 2014	Journal of Cutaneous Medicine and Surgery	Research letter or letter to the editor
Grunig et al, 2015	JAMA Dermatology	Research letter or letter to the editor
Cartron et al, 2020	Dermatologic therapy	Research letter or letter to the editor

McAfee et al, 2020	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Wong et al, 2021	JAMA dermatology	Research letter or letter to the editor
Baranowski et al, 2020	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Micheletti et al, 2014	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Osei-Tutu et al, 2013	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Nair et al, 2015	International Journal of Dermatology	Research letter or letter to the editor
Miller et al, 2021	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Keleshian et al, 2017	Journal of the American Academy of Dermatology	Research letter or letter to the editor
HAYES; Inc et al, 2016	Health Technology Assessment Database	Research letter or letter to the editor
Jacob et al, 2017	Journal of telemedicine and telecare	Research letter or letter to the editor
Perkins et al, 2020	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Halpern et al, 2010	British Journal of Dermatology	Research letter or letter to the editor
Newman et al, 2020	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Hunt et al, 2020	Clinical and experimental dermatology	Research letter or letter to the editor
2018	Nursing	Research letter or letter to the editor
Taneja et al, 2021	Indian journal of dermatology, venereology and leprology	Research letter or letter to the editor
Echeverria-Garcia et al, 2019	Actas dermo-sifiliograficas	Research letter or letter to the editor
Henning et al, 2010	Archives of Dermatology	Research letter or letter to the editor
Demo et al, 2019	Clinical and experimental dermatology	Research letter or letter to the editor
Byamba et al, 2015	British Journal of Dermatology	Research letter or letter to the editor
Gupta et al, 2020	Journal of the American Academy of Dermatology	Research letter or letter to the editor
De Giorgi et al, 2017	Journal of the European Academy of Dermatology and Venereology	Research letter or letter to the editor
Duong et al, 2016	Annales de Dermatologie et de Venereologie	Research letter or letter to the editor

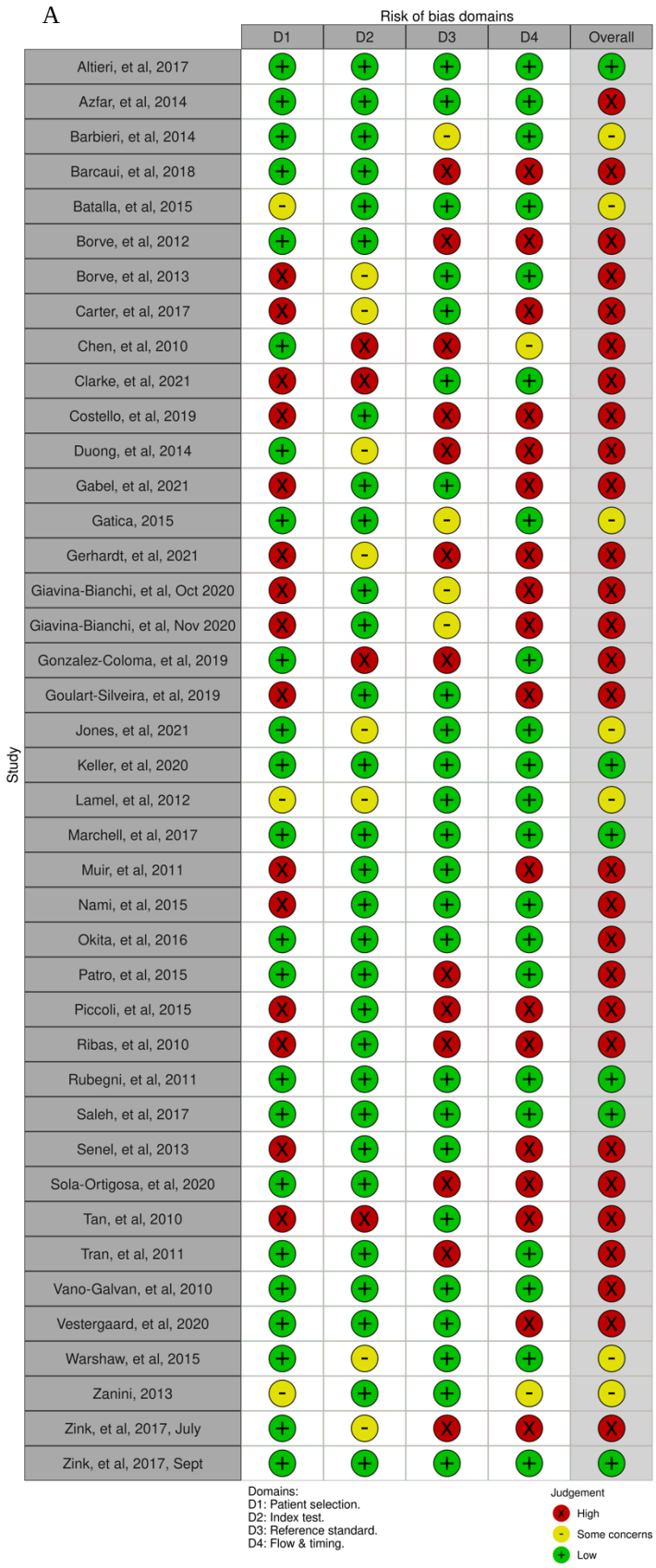
Mortimer et al, 2021	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Gravely et al, 2010	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Choi et al, 2021	International journal of dermatology	Research letter or letter to the editor
Motley et al, 2012	BMJ: British Medical Journal (Clinical Research Edition)	Research letter or letter to the editor
Leavitt et al, 2016	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Cheng et al, 2020	Dermatitis : contact, atopic, occupational, drug	Research letter or letter to the editor
Clark et al, 2021	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Fuesl et al, 2010	MMW-Fortschritte der Medizin	Research letter or letter to the editor
English III et al, 2013	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Cotes et al, 2021	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Abi Rafeh et al, 2021	Journal of cutaneous medicine and surgery	Research letter or letter to the editor
Okeke et al, 2020	The Journal of dermatological treatment	Research letter or letter to the editor
Splete et al, 2014	Emergency Medicine (00136654)	Research letter or letter to the editor
Khosravi et al, 2021	Clinical and experimental dermatology	Research letter or letter to the editor
Sivesind et al, 2021	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Stoecker et al, 2013	JAMA dermatology	Research letter or letter to the editor
Skayem et al, 2020	Journal of the European Academy of Dermatology and Venereology : JEADV	Research letter or letter to the editor
Su et al, 2020	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Massone et al, 2021	Anais brasileiros de dermatologia	Research letter or letter to the editor
Li et al, 2021	The Journal of infection	Research letter or letter to the editor
Afanasiev et al, 2021	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Varma et al, 2011	British Journal of Dermatology	Research letter or letter to the editor
Van Der Heijden et al, 2010	Journal of the European Academy of Dermatology and Venereology	Research letter or letter to the editor

Motley et al, 2012	BMJ (Online)	Research letter or letter to the editor
Villani et al, 2020	Dermatologic therapy	Research letter or letter to the editor
Portnoy et al, 2018	The journal of allergy and clinical immunology. In practice	Research letter or letter to the editor
Tschandl et al, 2018	British Journal of Dermatology	Research letter or letter to the editor
Poolworaluk et al, 2020	Future healthcare journal	Research letter or letter to the editor
Anonymous et al, 2020	Journal of drugs in dermatology : JDD	Research letter or letter to the editor
Tan et al, 2021	Annals of the Academy of Medicine, Singapore	Research letter or letter to the editor
Silva et al, 2021	Anais brasileiros de dermatologia	Research letter or letter to the editor
de Giorgi et al, 2016	International Journal of Dermatology	Wrong outcomes
Senel et al, 2014	Journal of telemedicine and telecare	Wrong outcomes
Goodier et al, 2021	Contact dermatitis	Wrong outcomes
Foolad et al, 2017	International Journal of Dermatology	Wrong outcomes
Wells et al, 2020	The Journal of clinical and aesthetic dermatology	Wrong outcomes
Arzberger et al, 2016	Acta Dermato-Venereologica	Wrong outcomes
Creighton-Smith et al, 2017	International Journal of Dermatology	Wrong outcomes
Marwaha et al, 2019	Journal of the American Academy of Dermatology	Wrong outcomes
Pasquali et al, 2021	Actas dermo-sifiliograficas	Wrong outcomes
Vestergaard et al, 2020	Family practice	Wrong outcomes
Kravets et al, 2018	Acta dermatovenerologica Alpina, Pannonica, et Adriatica	Wrong outcomes
Speiser et al, 2014	American Journal of Dermatopathology	Wrong outcomes
N/A	Journal of the American Academy of Dermatology	Wrong outcomes
Whited et al, 2013	Journal of Telemedicine and Telecare	Wrong outcomes
Abhishek et al, 2021	medRxiv	Wrong outcomes
Villa et al, 2020	Internal and emergency medicine	Wrong outcomes
Lubeek et al, 2016	Tijdschrift voor gerontologie en geriatrie	review
Ndegwa et al, 2016	Health Technology Assessment Database	review
Moreno-Ramirez et al, 2017	Acta dermato-venereologica	review
Moreno-Ramirez et al, 2017	Acta Dermato-Venereologica	review

Van Der Heijden et al, 2010	Huisarts en Wetenschap	review
Walocko et al, 2017	Dermatologic Clinics	review
Roman et al, 2014	Journal of the Dermatology Nurses' Association	review
Hart et al, 2011	Telemedicine journal and e-health : the official journal of the American Telemedicine Association	review
Elsner et al, 2020	Journal der Deutschen Dermatologischen Gesellschaft = Journal of the German Society of Dermatology : JDDG	review
Kaliyadan et al, 2020	Indian journal of dermatology	review
Burch et al,		review
Evans et al, 2017	Pharmazeutische Zeitung	Editorial
Anonymous. et al, 2016	Journal of AHIMA / American Health Information Management Association	Editorial
Luk et al, 2018	Hong Kong Journal of Dermatology and Venereology	Editorial
Queen et al, 2018	International wound journal	Editorial
Anguita et al, 2014	Nurse Prescribing	Editorial
Haworth et al, 2020	Clinical and experimental dermatology	Editorial
Romero-Aguilera et al, 2019	Actas dermo-sifiliograficas	Editorial
Barrio Garde et al, 2016	Piel	Editorial
Morand et al, 2010	Annales de dermatologie et de venereologie	Editorial
N/A	Journal of the American Academy of Dermatology	Abstract
N/A	Journal of the American Academy of Dermatology	Abstract
Bianchi et al, 2020	Journal of the American Academy of Dermatology	Abstract
Creadore et al, 2020	Journal of the American Academy of Dermatology	Abstract
N/A	Journal of the American Academy of Dermatology	Abstract
Tognetti L et al, 2020		Abstract
SPLETE et al, 2014	Emergency Medicine (00136654)	Abstract
N/A	Journal of the American Academy of Dermatology	Abstract
Dahlen Gyllencreutz et al, 2017	Journal of the European Academy of Dermatology and Venereology	Wrong intervention
Tandjung et al, 2015	Journal of Evaluation in Clinical Practice	Wrong intervention

Paradela-De-La-Morena et al, 2015	European Journal of Dermatology	Wrong intervention
Horsham et al, 2015	British Journal of Dermatology	Wrong intervention
Saenz et al, 2018	International Journal of Telemedicine and Applications	Wrong intervention
Kochmann et al, 2016	Telemedicine journal and e-health : the official journal of the American Telemedicine Association	Wrong comparator
Markun et al, 2017	Medicine (United States)	Wrong comparator
Feigenbaum et al, 2017	Pediatric Dermatology	Wrong comparator
Massone et al, 2014	Journal of the European Academy of Dermatology and Venereology	Wrong comparator
MacLellan et al, 2021	Journal of the American Academy of Dermatology	Wrong comparator
Koysombat et al, 2021	Journal of plastic, reconstructive & aesthetic surgery : JPRAS	Corrrespondence
Jakhar et al, 2020	Clinical and experimental dermatology	Corrrespondence
Alkmim et al, 2013	Journal of Telemedicine and Telecare	Corrrespondence
NCT02836665, 2016	ClinicalTrials.gov	Clinical trial - no associated manuscript
JPRN-UMIN000020873 et al, 2016		Clinical trial - no associated manuscript
Fogel et al, 2016	Journal of the American Academy of Dermatology	Commentary
Hoyer et al, 2020	Cutis	Commentary
Pasadyn et al, 2020	Journal of the American Academy of Dermatology	Duplicate
Moreno-Ramirez et al, 2017	American Journal of Clinical Dermatology	Erratum
Trovato et al, 2011	Eplasty	Wrong patient population
Bowns et al, 2016	Health Technology Assessment Database	Wrong publication date
Gemelas et al, 2019	Telemedicine journal and e-health : the official journal of the American Telemedicine Association	Wrong setting

242 **eTable 4. List of studies excluded at the full-text screening stage.**



243

eTable 5. Risk of Bias (ROB) results.
(A,B) QUADAS-2 RoB analysis of 41 observational studies. **(C,D)** ROB-2 analysis of three randomized controlled trials.

eReferences.

1. Hoyer P, Ahatov R, Ross L. Utilization of telehealth services during the COVID-19 pandemic. *Cutis*. 2020;106(2):70-71. doi:https://dx.doi.org/10.12788/cutis.0034
2. Gomez Arias PJ, Arias Blanco MC, Redondo Sanchez J, Escribano Villanueva F, Velez Garcia-Nieto AJ. [Usefulness and efficiency of teledermoscopy in skin cancer management in primary care]. *Semergen*. 2020;46(8):553-559. doi:https://dx.doi.org/10.1016/j.semerg.2020.06.026
3. Jacoby T, Woolard A, Chamoun S, Moy R. Asynchronous Teledermatology Assessment of Young Adult Acne Likely Concordant With In-Person Evaluation. *Journal of drugs in dermatology : JDD*. 2021;20(4):432-435. doi:https://dx.doi.org/10.36849/JDD.2021.5688
4. McHugh ML. Interrater reliability: the kappa statistic. *Biochem Med (Zagreb)*. 2012;22(3):276-82.
5. DerSimonian R, Laird N. Meta-analysis in clinical trials. *Control Clin Trials*. Sep 1986;7(3):177-88. doi:10.1016/0197-2456(86)90046-2
6. Altieri L, Hu J, Nguyen A, et al. Interobserver reliability of teledermatology across all Fitzpatrick skin types. *Journal of telemedicine and telecare*. 2017;23(1):68-73. doi:http://dx.doi.org/10.1177/1357633X15621226
7. Castelo-Soccio L, Kovarik CL, Azfar RS, et al. Reliability and validity of mobile teledermatology in human immunodeficiency virus-positive patients in botswana a pilot study. *JAMA Dermatology*. 2014;150(6):601-607. doi:http://dx.doi.org/10.1001/jamadermatol.2013.7321
8. Barbieri JS, Nelson CA, James WD, et al. The reliability of teledermatology to triage inpatient dermatology consultations. *JAMA Dermatology*. 2014;150(4):419-424. doi:http://dx.doi.org/10.1001/jamadermatol.2013.9517
9. Barcaui CB, Lima PMO. Application of teledermoscopy in the diagnosis of pigmented lesions. *International Journal of Telemedicine and Applications*. 2018;2018((Barcaui) Adjunct Professor of Dermatology, Faculty of Medical Sciences, State University of Rio de Janeiro, PhD in Medicine (Dermatology), University of Sao Paulo, Dermatology Department, Pedro Ernesto University Hospital, Rio de Janeiro State University):1624073. doi:http://dx.doi.org/10.1155/2018/1624073
10. Batalla A, Suh-Oh HJ, Abalde T, Salgado-Boquete L, de la Torre C. Teledermatology in Paediatrics. Observations in daily clinical practice. *Anales de pediatria (Barcelona, Spain : 2003)*. 2016;84(6):324-330. doi:http://dx.doi.org/10.1016/j.anpedi.2015.07.005
11. Borve A, Holst A, Gente-Lidholm A, Molina-Martinez R, Paoli J. Use of the mobile phone multimedia messaging service for teledermatology. *Journal of Telemedicine and Telecare*. 2012;18(5):292-296. doi:http://dx.doi.org/10.1258/jtt.2012.120206
12. Borve A, Terstappen K, Sandberg C, Paoli J. Mobile teledermoscopy-there's an app for that! *Dermatology practical & conceptual*. 2013;3(2):41-8. doi:https://dx.doi.org/10.5826/dpc.0302a05
13. Carter ZA, Li X, Goldman S, et al. Creation of an internal teledermatology store-and-forward system in an existing electronic health record: A pilot study in a safety-net public health and hospital system. *JAMA Dermatology*. 2017;153(7):644-650. doi:http://dx.doi.org/10.1001/jamadermatol.2017.0204
14. Chen TS, Goldyne ME, Mathes EFD, Frieden IJ, Gilliam AE. Pediatric teledermatology: Observations based on 429 consults. *Journal of the American Academy of Dermatology*. 2010;62(1):61-66. doi:http://dx.doi.org/10.1016/j.jaad.2009.05.039
15. Clarke EL, Reichenberg JS, Ahmed AM, et al. The utility of teledermatology in the evaluation of skin lesions. *Journal of telemedicine and telecare*. 2021;(9506702, cpj):1357633X20987423. doi:https://dx.doi.org/10.1177/1357633X20987423
16. Costello CM, Cumsky HJL, Maly CJ, et al. Improving Access to Care Through the Establishment of a Local, Teledermatology Network. *Telemedicine journal and e-health : the official journal of the American Telemedicine Association*. 2020;26(7):935-940. doi:https://dx.doi.org/10.1089/tmj.2019.0051
17. Duong TA, Cordoliani F, Julliard C, et al. Emergency department diagnosis and management of skin diseases with real-time teledermatologic expertise. *JAMA Dermatology*. 2014;150(7):743-747. doi:http://dx.doi.org/10.1001/jamadermatol.2013.7792
18. Gabel CK, Nguyen E, Karmouta R, et al. Use of teledermatology by dermatology hospitalists is effective in the diagnosis and management of inpatient disease. *Journal of the American Academy of Dermatology*. 2021;84(6):1547-1553. doi:https://dx.doi.org/10.1016/j.jaad.2020.04.171
19. Gatica JL, Bertolo S, Morales E, Espinoza M, Contreras C. Store-and-forward teledermatogy in Chile: A contribution to primary health care. *Piel*. 2015;30(3):148-154. doi:http://dx.doi.org/10.1016/j.piel.2014.07.007
20. Gerhardt CA, Foels R, Grewe S, Baldwin BT. Assessing the Diagnostic Accuracy of Teledermatology Consultations at a Local Veterans Affairs Dermatology Clinic. *Cureus*. 2021;13(6):e15406. doi:https://dx.doi.org/10.7759/cureus.15406

21. Giavina-Bianchi M, Azevedo MFD, Sousa RM, Cordioli E. Part II: Accuracy of Teledermatology in Skin Neoplasms. *Frontiers in medicine*. 2020;7(101648047):598903. doi:https://dx.doi.org/10.3389/fmed.2020.598903
22. Giavina-Bianchi M, Sousa R, Cordioli E. Part I: Accuracy of Teledermatology in Inflammatory Dermatoses. *Frontiers in medicine*. 2020;7(101648047):585792. doi:https://dx.doi.org/10.3389/fmed.2020.585792
23. Keller JJ, Johnson JP, Latour E. Inpatient teledermatology: Diagnostic and therapeutic concordance among a hospitalist, dermatologist, and teledermatologist using store-and-forward teledermatology. *Journal of the American Academy of Dermatology*. 2020;82(5):1262-1267. doi:https://dx.doi.org/10.1016/j.jaad.2020.01.030
24. Lamel SA, Haldeman KM, Ely H, Armstrong AW, Kovarik CL, Pak H. Application of mobile teledermatology for skin cancer screening. *Journal of the American Academy of Dermatology*. 2012;67(4):576-581. doi:http://dx.doi.org/10.1016/j.jaad.2011.11.957
25. Muir J, Xu C, Singh P, et al. Incorporating teledermatology into emergency medicine. *EMA - Emergency Medicine Australasia*. 2011;23(5):562-568. doi:http://dx.doi.org/10.1111/j.1742-6723.2011.01443.x
26. Nami N, Rubegni P, Fimiani M, Massone C, Hofmann-Wellenhof R, Cevenini G. Concordance and Time Estimation of Store-and-Forward Mobile Teledermatology Compared to Classical Face-to-Face Consultation. *Acta Dermato-Venereologica*. 2015;95(1):35-39. doi:http://dx.doi.org/10.2340/00015555-1876
27. Okita AL, Molina Tinoco LJ, Criado PR, et al. Use of Smartphones in Telemedicine: Comparative Study Between Standard and Teledermatological Evaluation of High-Complex Care Hospital Inpatients. *Telemedicine journal and e-health : the official journal of the American Telemedicine Association*. 2016;22(9):755-760. doi:http://dx.doi.org/10.1089/tmj.2015.0086
28. Patro BK, Tripathy JP, De D, Sinha S, Singh A, Kanwar AJ. Diagnostic agreement between a primary care physician and a teledermatologist for common dermatological conditions in North India. *Indian dermatology online journal*. 2015;6(1):21-6. doi:https://dx.doi.org/10.4103/2229-5178.148927
29. Ribas J, Schettini APM, Ribas CBDR, Cunha MDGS. Agreement between dermatological diagnoses made by live examination compared to analysis of digital images. *Anais Brasileiros de Dermatologia*. 2010;85(4):441-447. doi:http://dx.doi.org/10.1590/s0365-05962010000400004
30. Rios-Yuil JM. [Correlation between face-to-face assessment and telemedicine for the diagnosis of skin disease in case conferences]. *Actas dermo-sifiliograficas*. 2012;103(2):138-43. doi:https://dx.doi.org/10.1016/j.ad.2011.05.011
31. Romero Aguilera G, Cortina De La Calle P, Vera Iglesias E, Sanchez Caminero P, Garcia Arpa M, Garrido Martin JA. Interobserver reliability of store-and-forward teledermatology in a clinical practice setting. *Actas Dermo-Sifiliograficas*. 2014;105(6):605-613. doi:http://dx.doi.org/10.1016/j.adengl.2014.05.018
32. Romero G, Sanchez P, Garcia M, Cortina P, Vera E, Garrido JA. Randomized controlled trial comparing store-and-forward teledermatology alone and in combination with web-camera videoconferencing. *Clinical and Experimental Dermatology*. 2010;35(3):311-317. doi:http://dx.doi.org/10.1111/j.1365-2230.2009.03503.x
33. Rubegni P, Nami N, Poggiali S, et al. Geriatric teledermatology: Store-and-forward vs. face-to-face examination. *Journal of the European Academy of Dermatology and Venereology*. 2011;25(11):1334-1339. doi:http://dx.doi.org/10.1111/j.1468-3083.2011.03986.x
34. Saleh N, Abdel Hay R, Hegazy R, Hussein M, Gomaa D. Can teledermatology be a useful diagnostic tool in dermatology practice in remote areas? An Egyptian experience with 600 patients. *Journal of telemedicine and telecare*. 2017;23(2):233-238. doi:http://dx.doi.org/10.1177/1357633X16633944
35. Sola-Ortigosa J, Munoz-Santos C, Masat-Tico T, Isidro-Ortega J, Guilabert A, Grup d'Estudi de Teledermatologia del Valles O. The Role of Teledermatology and Teledermoscopy in the Diagnosis of Actinic Keratosis and Field Cancerization. *The Journal of investigative dermatology*. 2020;140(10):1976-1984.e4. doi:https://dx.doi.org/10.1016/j.jid.2020.02.013
36. Tan E, Yung A, Oakley A, Rademaker M, Jameson M. Successful triage of patients referred to a skin lesion clinic using teledermoscopy (IMAGE IT trial). *British Journal of Dermatology*. 2010;162(4):803-811. doi:http://dx.doi.org/10.1111/j.1365-2133.2010.09673.x
37. Tran K, Ayad M, Monir S, et al. Mobile teledermatology in the developing world: Implications of a feasibility study on 30 Egyptian patients with common skin diseases. *Journal of the American Academy of Dermatology*. 2011;64(2):302-309. doi:http://dx.doi.org/10.1016/j.jaad.2010.01.010
38. Vano-Galvan S, Aguayo-Leiva I, Rios-Buceta L, et al. Store-and-forward teledermatology: Assessment of validity in a series of 2000 observations. *Actas Dermo-Sifiliograficas*. 2011;102(4):277-283. doi:http://dx.doi.org/10.1016/S1578-2190(11)70803-4
39. Vestergaard T, Prasad SC, Schuster A, Laurinaviciene R, Andersen MK, Bygum A. Diagnostic accuracy and interobserver concordance: teledermoscopy of 600 suspicious skin lesions in Southern Denmark. *Journal of the*

European Academy of Dermatology and Venereology : JEADV. 2020;34(7):1601-1608. doi:https://dx.doi.org/10.1111/jdv.16275

40. Gravely AA, Warshaw EM, Nelson DB. Reliability of store and forward teledermatology for skin neoplasms. *Journal of the American Academy of Dermatology*. 2015;72(3):426-435. doi:http://dx.doi.org/10.1016/j.jaad.2014.11.001

41. Zanini M. Analyze of diagnostic concordance between face-to-face and teledermatology diagnosis. *Medicina Cutanea Ibero-Latino-Americana*. 2013;41(2):60-62. doi:http://dx.doi.org/10.4464/MC.2013.41.2.5058

42. Zink A, Kolbinger A, Leibl M, et al. The value of teledermatology using a mobile app compared to conventional dermatology. *European Journal of Dermatology*. 2017;27(4):429-431. doi:http://dx.doi.org/10.1684/ejd.2017.3044

43. Zink A, Kolbinger A, Leibl M, et al. Teledermoscopy by mobile phones: Reliable help in the diagnosis of skin lesions? *Hautarzt*. 2017;68(11):890-895. doi:http://dx.doi.org/10.1007/s00105-017-4042-0

44. Marchell R, Locatis C, Liu W-L, Ackerman M, Burges G, Maisiak R. Comparing High Definition Live Interactive and Store-and-Forward Consultations to In-Person Examinations. *Telemedicine journal and e-health : the official journal of the American Telemedicine Association*. 2017;23(3):213-218. doi:http://dx.doi.org/10.1089/tmj.2016.0093

45. Jones L, Jameson M, Oakley A. Remote Skin Cancer Diagnosis: Adding Images to Electronic Referrals Is More Efficient Than Wait-Listing for a Nurse-Led Imaging Clinic. *Cancers (Basel)*. Nov 20 2021;13(22)doi:10.3390/cancers13225828

46. Gonzalez Coloma F, Sandoval Garces M, Gedda Quiroga V, Bley Banda C. Teledermatology in Remote Parts of Chile: Experience in 4 Isolated Rural Areas. *Actas dermo-sifiliograficas*. 2019;110(8):653-658. doi:https://dx.doi.org/10.1016/j.ad.2019.01.009

47. Goulart Silveira CE, Carcano C, Mauad EC, Faleiros H, Longatto-Filho A. Call phone usefulness to improve the skin cancer screening: preliminary results and critical analysis of mobile app development. *Rural & Remote Health*. 2019;19(1):1-7. doi:10.22605/RRH4895

48. Piccoli MF, Amorim BDB, Wagner HM, Nunes DH. Teledermatology protocol for screening of Skin cancer. *Anais Brasileiros de Dermatologia*. 2015;90(2):202-210. doi:http://dx.doi.org/10.1590/abd1806-4841.20153163

49. Senel E, Baba M, Durdu M. The contribution of teledermatoscopy to the diagnosis and management of non-melanocytic skin tumours. *Journal of Telemedicine and Telecare*. 2013;19(1):60-63. doi:http://dx.doi.org/10.1177/1357633X12474961

50. Gravely AA, Nelson DB, Warshaw EM. Accuracy of teledermatology/teledermoscopy and clinic-based dermatology for specific categories of skin neoplasms. *Journal of the American Academy of Dermatology*. 2010;63(2):348-352. doi:http://dx.doi.org/10.1016/j.jaad.2009.10.037

This supplementary material has been provided by the authors to give readers additional information about their work.

MOOSE Checklist for Meta-analyses of Observational Studies

Item No	Recommendation	Reported on Page No
Reporting of background should include		
1	Problem definition	4
2	Hypothesis statement	4
3	Description of study outcome(s)	4-5
4	Type of exposure or intervention used	6-8
5	Type of study designs used	6-8
6	Study population	6-8
Reporting of search strategy should include		
7	Qualifications of searchers (eg, librarians and investigators)	6
8	Search strategy, including time period included in the synthesis and key words	6-8
9	Effort to include all available studies, including contact with authors	6-8
10	Databases and registries searched	6-8
11	Search software used, name and version, including special features used (eg, explosion)	6-8
12	Use of hand searching (eg, reference lists of obtained articles)	6-8
13	List of citations located and those excluded, including justification	Supplement
14	Method of addressing articles published in languages other than English	6-8
15	Method of handling abstracts and unpublished studies	6-8, Supplement
16	Description of any contact with authors	6-8, Supplement
Reporting of methods should include		
17	Description of relevance or appropriateness of studies assembled for assessing the hypothesis to be tested	9-12
18	Rationale for the selection and coding of data (eg, sound clinical principles or convenience)	9-12
19	Documentation of how data were classified and coded (eg, multiple raters, blinding and interrater reliability)	9-12
20	Assessment of confounding (eg, comparability of cases and controls in studies where appropriate)	9-12
21	Assessment of study quality, including blinding of quality assessors, stratification or regression on possible predictors of study results	9-12
22	Assessment of heterogeneity	9-12
23	Description of statistical methods (eg, complete description of fixed or random effects models, justification of whether the chosen models account for predictors of study results, dose-response models, or cumulative meta-analysis) in sufficient detail to be replicated	9-12
24	Provision of appropriate tables and graphics	9-12, Supplement
Reporting of results should include		
25	Graphic summarizing individual study estimates and overall estimate	Fig 1-3, Supplement
26	Table giving descriptive information for each study included	Tables 1, 2, Supplement
27	Results of sensitivity testing (eg, subgroup analysis)	9-12
28	Indication of statistical uncertainty of findings	9-12

Item No	Recommendation	Reported on Page No
Reporting of discussion should include		
29	Quantitative assessment of bias (eg, publication bias)	9-12
30	Justification for exclusion (eg, exclusion of non-English language citations)	9-12
31	Assessment of quality of included studies	9-12
Reporting of conclusions should include		
32	Consideration of alternative explanations for observed results	13-17
33	Generalization of the conclusions (ie, appropriate for the data presented and within the domain of the literature review)	13-17
34	Guidelines for future research	13-17
35	Disclosure of funding source	18

From: Stroup DF, Berlin JA, Morton SC, et al, for the Meta-analysis Of Observational Studies in Epidemiology (MOOSE) Group. Meta-analysis of Observational Studies in Epidemiology. A Proposal for Reporting. *JAMA*. 2000;283(15):2008-2012. doi: 10.1001/jama.283.15.2008.

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	p1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	p3-4
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	p5-6
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	p5-6
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	p8, Supplementary p15
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	p7
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Supplementary p2
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	p8
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	p8
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Supplementary p15
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	p8 and Supplementary p15
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	p9
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	p8-9
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	p8-9
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	p 8-9 Supplementary p2
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	p 8-9 Supplementary p2
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	p 8-9 Supplementary p2
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	p 8-9 Supplementary p2
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	NA
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	p9
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	NA

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Figure 1, p10
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Supplementary p23-3
Study characteristics	17	Cite each included study and present its characteristics.	p10-11, Table 1, 2
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	p15, Supplementary eTable 5
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	p15, Supplementary eTable 5
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Figure 2, 3, Supplementary eFigure 1-5
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	p 11-13 Supplementary p3
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	p 11-13 Supplementary p3
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	NA
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Supplementary eTable 5
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	p 11-13 Supplementary p3
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	p14
	23b	Discuss any limitations of the evidence included in the review.	p15-16
	23c	Discuss any limitations of the review processes used.	p16
	23d	Discuss implications of the results for practice, policy, and future research.	p17
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	p7
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	p7
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	NA
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	p18
Competing interests	26	Declare any competing interests of review authors.	p18
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

BMJ Open

Diagnostic Reliability in Teledermatology: A Systematic Review and a Meta-Analysis

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2022-068207.R1
Article Type:	Original research
Date Submitted by the Author:	28-Jun-2023
Complete List of Authors:	Bourkas, Adrienn; Queen's University School of Medicine Barone, Natasha; McGill University Montreal, Faculty of Medicine and Health Sciences Bourkas, Matthew; University of Toronto, Department of Biochemistry Mannarino, Matthew; McGill University, Department of Surgery Fraser, Robert; Western University Arthur Labatt Family School of Nursing, Nursing; Swift Medical Lorincz, Amy; Independent researcher Wang, Sheila; McGill University Department of Medicine, Dermatology; Swift Medical Ramirez-GarciaLuna, Jose; McGill University, Department of Surgery
Primary Subject Heading:	Dermatology
Secondary Subject Heading:	Health informatics, General practice / Family practice
Keywords:	Telemedicine < BIOTECHNOLOGY & BIOINFORMATICS, DERMATOLOGY, PRIMARY CARE, Information technology < BIOTECHNOLOGY & BIOINFORMATICS, STATISTICS & RESEARCH METHODS

I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our licence.

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which Creative Commons licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

Title: Diagnostic Reliability in Teledermatology: A Systematic Review and a Meta-Analysis

Authors

Adrienn N. Bourkas*[1] (MSc), Natasha Barone*[2] (MD, MSc), Matthew E.C. Bourkas[3] (PhD), Matthew Mannarino[4] (PhD), Robert D. J. Fraser[5,6] (RN, MN), Amy Lorincz (MSc), Sheila C. Wang[5,7] (MD, PhD), Jose L. Ramirez-GarciaLuna[4] (MD, PhD)

* Authors contributed equally

Affiliations

[1]Faculty of Health Sciences, Queen's University School of Medicine, Kingston, Ontario, Canada

[2]Faculty of Medicine and Health Sciences, McGill University, Montreal, Quebec, Canada

[3]Temerty Faculty of Medicine, Department of Biochemistry, University of Toronto, Toronto, Ontario, Canada

[4]Department of Surgery, McGill University, Montreal, Quebec, Canada

[5]Swift Medical Inc., Toronto, Ontario, Canada

[6]Arthur Labatt Family School of Nursing, Western University, London, Ontario, Canada

[7]Department of Medicine, Division of Dermatology, McGill University Health Centre, Montreal, Quebec, Canada

Corresponding author

Jose L. Ramirez-GarciaLuna, MD, PhD

Research Institute-McGill University Health Centre

Montreal General Hospital 1650 Cedar Ave, Montreal, Quebec, Canada H3G 1A4

Tel: 514-934-1934 ext 44522

Email: ramirezgl@gmail.com

Abstract

Objectives: To compare teledermatology and face-to-face (F2F) agreement in primary diagnoses of dermatological conditions.

Design: Systematic Review and Meta-Analysis

Methods: MEDLINE, Embase, Cochrane Library (Wiley), CINAHL, and medRxiv were searched between January 2010 and May 2022. Observational studies and randomized clinical trials that reported percentage agreement or kappa concordance for primary diagnoses between teledermatology and F2F physicians were included. Titles, abstracts, and full-text articles were screened in duplicate. From 7,173 citations, 44 articles were included. A random-effects meta-analysis was conducted to estimate pooled estimates. Primary outcome measures were mean percentage and kappa concordance for assessing diagnostic matches between teledermatology and F2F physicians. Secondary outcome measures included the agreement between teledermatologists, F2F dermatologists, and teledermatology and histopathology results.

Results: 44 studies were extracted and reviewed. The pooled agreement rate was 68.9%, and kappa concordance was 0.67. When dermatologists conducted F2F and teledermatology consults, the overall diagnostic agreement was significantly higher at 71%, compared to 44% for non-specialists. Kappa concordance was 0.69 for teledermatologist vs specialist and 0.52 for non-specialists. Higher diagnostic agreements were also noted with image acquisition training and digital photography. The agreement rate was 76.4% between teledermatologsists, 82.4% between F2F physicians, and 55.7% between teledermatology and histopathology.

Conclusions and Relevance: Teledermatology can be an attractive option particularly in resource-poor settings. Future efforts should be placed on incorporating image acquisition training and access to high-quality imaging technologies.

Registration number: 10.17605/OSF.IO/FJDVG

Keywords: teledermatology, dermatology consultations, store-and-forward, telemedicine, remote consultation, dermatology hospitalists

Article Summary:

Strengths and limitations of this study:

- This is the most comprehensive systematic review and meta-analysis of the topic to date without language restrictions applied.
- Inclusion criteria were broad, including all types of dermatological diseases, imaging technologies, in-person physician specializations (GPs, hospitalists, and dermatologists), and the presence or absence of image acquisition training.
- The article search was limited to 2010 and later due to the recent incorporation of smartphones in teledermatology practices.
- Due to considerable heterogeneity between studies, meta-analysis and synthesis of predictors for accurate diagnoses remotely were limited even after subgrouping.

Introduction

With the emergence of COVID-19, the introduction of virtual consults in healthcare settings, especially dermatology, has been expanded to allow many patients the opportunity for equitable access to care when in-person appointments pose a challenge and risk to patients. [1] Different modalities were introduced to support teledermatology. This involves remote sharing of patient data, including synchronous video-streaming teledermatology and asynchronous sharing of still images via emails, or text messages, or store-and-forward teledermatology (SFTD).

Although both synchronous and asynchronous approaches have been shown to be cost-effective, SFTD is particularly popular as it requires fewer resources and less coordination than synchronous teledermatology. [2 3] With the advent of higher resolution smartphone cameras, relatively minimal training is required to capture data for remote dermatologists correctly; multiple SFTD studies opted to provide no training in image capture and still found value in teledermatology. [4 5]

There is valid concern over the reliability of teledermatology given the significant variability in diagnostic accuracy predicted across pre-pandemic research. [6] This is expected given the lack of standardization across studies and the potential for confounders across teledermatology methodologies and applications, e.g., level of training or skin lesion type. This variability in approach may benefit from an increased demand, which could provide greater impetus to optimize and standardize teledermatology.

To our knowledge, this is the first and most inclusive meta-analysis (MA) that compares teledermatology consults to face-to-face (F2F) that looked at all relevant studies without overly

exclusive inclusion criteria. The primary objective of this study was to compare the reliability of teledermatology diagnoses to F2F consults, as determined by Cohen's kappa interrater agreement and total agreement rates. Teledermatology can assume important roles as a routine complement to primary care and an alternate route to the typical in-person referrals. Consequently, we wanted to determine agreement for teledermatology and all F2F consults, teledermatology and F2F primary care consults, and finally teledermatology and F2F dermatologist consults, which would arguably best capture the limitations introduced by the change in medium from F2F to teledermatology.

Additional subset analyses were performed to control for potential confounders (e.g., inflammatory vs. malignant, staff training for image acquisition, teledermoscopy, and smartphone vs digital cameras) introduced by the heterogenous methodology. The secondary objectives sought to determine the agreement rate within teledermatology diagnoses and F2F consults to provide an idea of each medium's consistency, and provide the best estimate of accuracy for the agreement rate between teledermatology and histopathology.

Methods

This study was performed in accordance with the Preferred Reported Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

Protocol Registration

Prior to the conduct of this review, a protocol which adhered to the PRISMA-protocols (i.e., PRISMA-P) guidelines was developed and then registered on Open Science Framework (OSF). Access: https://osf.io/fjdvg. [7]

Search Strategy

A comprehensive search of major bibliographic databases, MEDLINE, Embase, Cochrane Library (Wiley), CINAHL, and medRxiv was performed in August 2021. MEDLINE was searched again between August 2021 and May 2022 to screen any new articles published after our protocol was registered. The search strategy was developed by a medical librarian at Queen's University (Kingston, ON). Please see the supplementary appendix for additional information on the search strategy.

No restrictions were placed on the language or status of the publications. Search results were limited to studies published between January 2010 and May 2022 due to the novelty of incorporating smartphones in teledermatology remote consultations. [8] The International Prospective Register of Systematic Reviews (PROSPERO) and OSF were searched up to May 2022 for relevant ongoing systematic reviews using the terms 'telemedicine,' 'teledermatology,'

'dermatology,' 'diagnostic accuracy,' and 'diagnostic concordance.' Reference lists of included studies were screened to identify additional studies not captured in the search.

Eligibility Criteria

Studies evaluating the diagnostic reliability of teledermatology that reported on patients with dermatological conditions assessed by a clinician using asynchronous or synchronous telemedicine systems were included. All articles were required to compare tele- to F2F diagnoses conducted by a physician. Exclusion criteria encompassed survey articles, feasibility studies, non-dermatological telemedicine studies, cost-effectiveness studies, editorials, review articles, studies using teledermatology as the reference standard, studies comparing only dermatoscopic images without clinical images, and studies where patients captured their own photographs. The latter was excluded to ensure consistent image quality, enabling a more accurate comparison of diagnostic reliability between tele- and F2F methods. Included articles are summarized in **eTable 1** in the supplementary appendix. Inclusion and exclusion criteria are summarized in **eTable 2**, available in the supplementary appendix.

Data Selection & Extraction

Following the removal of duplicated citations, the titles and abstracts were screened. Following this step, a full-text assessment was conducted. At both stages, two reviewers performed screening independently [AB and NB]. Any disagreements were resolved through consensus by the two reviewers and when necessary, through discussion with a third reviewer [JLRG].

A data collection form was created on the *Covidence* website and piloted by two reviewers [AB, NB]. Three additional reviewers assisted with data extraction [JLRG, MB, MM]. Two reviewers were assigned to each paper. One reviewer extracted all characteristics of the included literature, and the second reviewer validated the characteristics for accuracy. Any disagreements were resolved by consensus. In the supplementary appendix, **eTable 3** summarizes the information extracted from full-text articles.

Data Synthesis

This meta-analysis assessed the effectiveness of SFTD technologies and live video conferencing in diagnosing skin conditions. Outcomes regarding complete diagnostic percentage agreement rates and Cohen's kappa concordance were evaluated separately, with some studies being part of both analyses if they reported both variables. The patient, intervention type, lesion, and geographic characteristics were summarized qualitatively. Please see the supplementary appendix and **eTable 4** for more details on data synthesis and nomenclature for each study grouping.

Risk of Bias

Three reviewers [AB, NB, MB] completed the risk of bias assessment; all studies were independently reviewed. Version 2 of the Cochrane risk-of-bias tool for randomized trials (RoB 2) was used to assess the risk of bias in three randomized trials. [9-11] RoB 2 is structured into a fixed set of domains of bias, focusing on different aspects of trial design, conduct, and reporting. [12] The Quality Assessment of Diagnostic Assessment of Diagnostic Accuracy (2nd Edition, QUADAS-2) was used to assess the risk of bias. Uncertain risk of bias was assigned to studies with insufficient

information except for studies that were likely to be biased due to missing data. In the latter case, a high risk of bias was assigned.

Synthesis of Results

Statistical analysis was performed using the dmetar package in R v.4.0.1 (R Foundation for Statistical Computing, 2022). Agreement rates and Cohen's kappa concordances for unique study groupings were treated as individual and independent values. For the percentage of agreement, meta-analyses were conducted using the aggregated data, and proportions were calculated with the corresponding 95 percent confidence intervals (CI). Point-biserial correlations were utilized to calculate pooled kappa values. Statistical heterogeneity was investigated using the I^2 index and the τ^2 statistic, leading to the use of a random-effects model for overall complications with a logit transformation due to the high degree of heterogeneity. Possible sources of heterogeneity were explored through sub-group analysis, and confounding factors were controlled using meta-regression. A random-effects model, as proposed by DerSimonian and Laird, was chosen as the primary method to estimate all pooled estimates. Further details on the statistical analysis can be found in the supplementary appendix.

Patient and Public Involvement

Patients or the public were not involved in our research's design, conduct, reporting, or dissemination plans.

Results

A total of 7,173 studies were screened for eligibility of which 44 were included in this study. Of these, 40 studies reported diagnostic agreement rates [4 5 9-11 13-47] and 21 studies reported kappa concordance. [5 9 13 14 19 22 25 28-33 35-37 48-52] Further details are provided in the PRISMA diagram in **Figure 1**. The complete list of excluded studies can be found in the supplementary appendix, **eTable 5**.

Study and patient characteristics

eTable 1 summarizes the study and participant characteristics for the 44 included papers. Forty of the included studies were observational, of which 31 were prospective, nine were retrospective. One study was ambispective. Three studies were randomized controlled trials and one study was a quasi-randomized trial. Studies selected for the review included a total of 52,075 patients (Range: 26 to 24,210 patients). Some patients had multiple lesions and the total number of lesions included in the study was 57,222 (Range: 26 to 27,519 lesions).

The mean age reported in 27 (61%) studies was 54.78 ± 15.69 years (Range: 0 to 100 years old). Thirty-four (77%) studies reported participant gender, with a mean of 57% females (Range: 3.2% to 74%). Only 13 (29%) studies reported information on Fitzpatrick skin types, ethnicity, or race. Twenty-eight studies (64%) included in this analysis were inclusive of all types of dermatoses, 13 (29%) studies looked specifically at suspicious lesions, and three (7%) studies excluded skin cancers completely.

Diagnostic reliability of teledermatology when compared to F2F (specialist and non-specialist) evaluation

We assessed the diagnostic reliability of teledermatology compared to F2F evaluations by analyzing diagnostic agreement rates and concordance. The overall diagnostic agreement rate ranged from 13.9% to 98.0% (mean 68.9%, CI 64.4% to 73.1%), with a concordance that ranged from 0.21 to 0.96 (mean 0.67, CI 0.60 to 0.74). See **eFigure 1** and the supplementary appendix for further details.

Sub-group analyses

Diagnostic agreement between teledermatologist and teledermatologist, F2F and F2F physicians, and teledermatology and histopathology

See supplementary appendix and **eFigure 2** for further details.

Diagnostic reliability of teledermatologist vs F2F specialist and non-specialist

See supplementary appendix and **eFigure 3** for further details.

Diagnostic reliability of teledermatology vs F2F by training provided for image acquisition

Twenty studies with 37 unique comparisons explicitly provided training to those in charge of image acquisition shown in **Figure 2**.[9-11 14-16 19 20 23 26 29 32 35-41 43 44] The mean agreement rate between teledermatology and F2F physicians in these studies was 75.9% (CI 74.4% to 77.27%), significantly higher than the 62.1% (CI 60.5% to 63.7%) observed when no training was provided

(p = 0.033, heterogeneity: I^2 = 98%). Concordance values were also higher when training was provided (mean 0.77, CI 0.66-0.84) compared to when no training was provided (mean 0.60, CI 0.49-0.69) (p = 0.01, I^2=98%).

Diagnostic reliability of teledermatology vs F2F by type of technology used for image acquisition

Approximately half of the studies with 41 unique comparisons that compared Teledermatologists with F2F physicians used digital cameras for image acquisition. Eighteen studies comparing F2F and teledermatology agreement rates with 26 unique comparisons reported the use of smartphones and tablets for image acquisition. **Figure 3** shows that the mean percentage agreement rate for digital cameras was 71.7% (CI 70.3% to 73.1% compared to 59.8% (CI 57.2% to 62.3%) for smartphones or tablets. The higher agreement rate with digital photography was statistically significant (p = 0.029, heterogeneity: I^2=98%). The concordance values for digital photography were reported for twelve studies with a mean of 0.70 (CI 0.61 to 0.76). Concordance values for smartphone or tablet technologies were reported for eight studies with a mean of 0.62 (CI 0.38 to 0.78). The higher concordance with digital photography was statistically significant (p = 0.003, heterogeneity: I^2=100%).

Other sub-group analyses

No statistically significant patterns could be identified with the inclusion of teledermoscopy in addition to clinical images (**eFigure 4**), lesion type (**eFigure 5**), grouping studies as pre- or post-pandemic (figure not shown), or risk of bias (figure not shown). Please see the supplementary appendix for further details.

Quality assessment

The quality assessment results for risk of bias and applicability in individual studies are displayed in the supplementary appendix and **eTable 6**.

Discussion:

To our knowledge, this study constitutes the most extensive systematic review and meta-analysis on teledermatology, including 44 studies across four languages.

Our sub-group analyses revealed that agreement rates between teledermatology consultations and F2F physicians were significantly higher when dermatologists conducted in-person assessments compared to non-specialists. This finding suggests that teledermatology may be more beneficial in supplementing primary care than specialist care, as lower concordance with non-specialists indicates reduced reference test accuracy. Although we did not directly assess the impact of consulting teledermatologists on non-specialist accuracy, the included studies report high levels of non-specialist satisfaction with the teleconsultation process. In fact, 96% of non-specialists agreed that they learned about the dermatologic diagnosis, and 100% agreed that it helped patient care.[23] These results are consistent with prior research attributing high provider satisfaction to streamlined workflows, effective communication, and fast turnaround times in teledermatology.[2 53]

The study emphasizes the importance of standardized training on image acquisition in improving agreement rates between in-person and remote care. Additionally, digital photography was linked to increased agreement rates, potentially due to enhanced image resolution and experienced staff

conducting virtual consultations using standardized procedures. This suggests a crucial need for comprehensive training in image acquisition, highlighting the importance of equipping primary care providers supporting telehealth delivery with high-quality cameras and the latest smartphone models.[24 54 55]

Assessing agreement on the management plan is crucial in teledermatology as it serves as a triage tool for distinguishing mild/benign cases from severe/malignant/uncertain cases. Ensuring concordance in the management plan between telemedicine and face-to-face consultations is vital for optimizing patient care. Future research should explore the consistency of treatment recommendations and interventions between telemedicine and in-person consultations to further enhance the evaluation of telemedicine's effectiveness in guiding appropriate patient management.

Pathological assessment of skin lesions is the cornerstone of skin cancer diagnosis. This meta-analysis found a 55.7% (CI 53.0% to 58.4%) agreement rate between teledermatology and histopathology. This low agreement rate reflects all skin biopsies and specific diagnostic accuracy rates could not be calculated by lesion type due to the small number of studies that reported this value. Through sub-group analyses, we were able to compare cancerous and non-cancerous lesions; slightly higher concordance was seen with skin cancers compared to studies that also included non-suspicious lesions like dermatitis and psoriasis. However, the data was too heterogeneous for any significant conclusions. We also looked at the use of teledermoscopy, another technique that could help improve the diagnostic accuracy of teledermatology for suspicious lesions, but no significant trends could be identified. These findings reflected the results of a 2016 systematic review on teledermatology.[6]

Many teledermoscopy studies grouped statistics from lesions analyzed with and without dermoscopy, preventing the assessment of the dermatoscope's incremental contributions without the influence of potentially less accurate, dermatoscope-free analysis. Supporting this explanation, the three teledermoscopy studies focused on cancer lesions demonstrated greater concordance rates than the teledermoscopy studies targeting broader lesions. One study identified agreement rates between teledermatology and F2F dermatology of 92.3% (24/26) and between teledermatology and histopathology of 66.7% (17/26), both above our identified median.[45] Another study found an agreement rate of 90% (37/41) when targeting pigmented lesions, although the rate may have been inflated due to recall bias introduced by having the same dermatologist perform teledermatology and F2F consults.[16] Finally, one study diagnosed keratotic lesions in sun-exposed areas, finding a high agreement rate of 92% (915/1000).[37] However, this study also risked bias from its experimental design, which excluded lesions with poor image quality. This fails to recapitulate the complexities of practical teledermatology, which must contend with potentially difficult image acquisition.

The 68.9% (CI 64.4% to 73.05%) combined agreement rate between teledermatology and F2F is lower than the agreement rates outlined in a recent review.[56] This suggests our greater sample size introduces more studies with poor agreement, which may better reflect the reality of adopting teledermatology at a larger scale and signal risk from a lack of standardization.[55] Our date cut-off of 2010 means our dataset has little overlap with existing reviews, and more heavily features new relevant technologies like smartphone apps for image acquisition.[6 57] The most recent MA[57] on

teledermatology limited its dataset to studies with multiple teledermatology and F2F consults and variably choosing to filter low-frequency diagnoses from certain studies.[46]

We acknowledge several potential limitations. The heterogeneity of the data, though at first glance might limit generalizability, enhances the adaptability and applicability of teledermatology across diverse real-world contexts. Challenges exist due to the absence of stratification by study design and a limited number of randomized controlled trials. Nevertheless, our findings emphasize the critical importance of standardized processes for effective teledermatology, such as training in image acquisition, reporting guidelines, and addressing privacy concerns. Our study reveals a greater degree of heterogeneity compared to previous meta-analyses, reflecting real-world application and clinical practice, bolstering the robustness of our conclusions. We advocate for a nuanced interpretation when generalizing these findings across all settings, recognizing the demographic and technological diversity in our sample as an asset. While our attempts to filter biased studies didn't yield significant improvements to our meta-analysis model, we are mindful of the potential risk of publication bias in our review.

Furthermore, our study only included a limited number of live video conferencing studies,[11 24 46] and our ability to draw meaningful conclusions regarding the differences between live video conferencing and SFTD methods is therefore limited. A recent study by Duong et al. demonstrated that live video conferencing can significantly contribute to diagnosis in teledermatology by improving the quality of collected information and accuracy of the patient's status evaluation.[24] The study found that videoconferencing significantly improved the diagnostic performance in

68.7% of cases. While these results are promising, further research is needed to explore the potential differences between clinical images and live video conferencing.

In addition, our search was limited to published literature and may have missed relevant studies in the grey literature and reports from low- and middle-income countries. Nonetheless, the variability across providers and settings underlines the need for a standardized framework to employ and assess teledermatologists. Future research is needed to explore the differences between these methods and other potential factors that may impact the efficacy of teledermatology, particularly in low- and middle-income countries. We acknowledge these limitations and encourage further research to address these gaps in the literature.

Current trends suggest that teledermatology will continue to expand, there have been many recent studies examining its accuracy without the design considerations necessary to allow comparisons beyond siloed investigations.[1] The implementation of evidence-informed processes is critical to the success of teledermatology services, and the accurate assessment of teledermatology will be required to assess which contexts it should be employed in, e.g., suspected malignancy vs. erythema.

While acknowledging the significant potential of artificial intelligence (AI) in enhancing teledermatology, particularly in areas like image recognition and diagnosis, it is crucial to note that our current study does not incorporate these aspects. The impact of AI on teledermatology, while promising, introduces an additional layer of complexity, necessitating a dedicated, separate investigation beyond the scope of our current study.

The factors targeted by our sub-analysis are undoubtedly important to standardize with best practices requiring the inclusion of primary care provider training in image acquisition, explicitly outlined conditions where dermatoscope attachments are required, and standardized reporting with a lesion's anatomical site, size, distribution, morphology, and colour. Additional guidelines for data reporting could be designed with a mind to future research goals, e.g., the inclusion of Fitzpatrick grading to identify gaps in medical care. Finally, both clinical and research guidelines must address privacy concerns, as integrating EMR and sharing of patient images or videos presents potential vulnerabilities.

Conclusion:

This meta-analysis indicates that diagnostic agreement between remote and in-person dermatologists is acceptable in select conditions (i.e., when training for image acquisition is provided and technologies for high-quality images are used). Telemedicine adoption rates are accelerating globally, and teledermatology must be considered for enhanced accessibility, flexibility, reduced costs, and safer environments it can provide patients.

The results of this meta-analysis represent significant evidence to indicate the suitability of teledermatology for remote care, particularly as a complement to primary care, where it can serve as an intermediate step before F2F specialist consultations. Furthermore, the categorization of diagnostic concordance highlights important factors to further improve diagnostic accuracy. Additionally, it highlights the lack of standardization in teledermatology studies, calling for greater structure in clinical practice and conducting primary research.

Acknowledgements:

The authors would like to acknowledge Heba Tallah Mohammed affiliated with Swift Medical for reviewing the manuscript and adding their valuable insight. The search strategies were developed with Abdul Kareem Pullattayil (AKP), a health science librarian at Bracken Health Sciences Library Botterell Hall at Queen's University.

Author Contributions:

JLRG is the guarantor of the review and supervised study design. JLRG also contributed to data analysis and provided statistical expertise. AB and NB oversaw study design, data collection, data analysis, and original draft preparation. AB designed the search strategy with the guidance

of the medical librarian, AKP. AB, NB, MB, and MM participated in the abstract and full-text screen, data extraction, and risk of bias assessment. RDJF, AL, and SCW contributed to the draft review and editing. All authors read, provided feedback and approved the final manuscript.

Funding:

This work was supported by the Digital Technology Supercluster as part of the Telewound Care Canada project. The funder was not involved in the design or analysis of this study.

Competing interests:

RDJF is an employee, and SCW is a co-founder, chief medical officer, and shareholder of Swift Medical. JRGL and AL were formerly employees of Swift. No funding bodies have any role in study design, data collection and analysis, decision to publish, or preparation of the manuscript. All other authors declare no conflict of interest.

Data availability statement:

Data are available in a public, open access repository. All data relevant to the study are included in the article, uploaded as supplementary information, or deposited on Open Science Framework: https://osf.io/fjdvg. Data are available under the terms of the Creative Commons Zero "No rights reserved" data waiver (CC0 1.0 Public domain dedication). Our systematic review produced a large amount of information, and the arising database is available for future collaboration on additional analyses. Please contact the corresponding author with any inquiries.

Patient consent for publication:

Not required.

Ethics and dissemination

Ethics approval is not applicable for this study since no original data will be collected.

Abstract word count: 230 words; **Manuscript word count:** 3409 words

References

1. Mohammed HT, Hyseni L, Bui V, et al. Exploring the use and challenges of implementing virtual visits during COVID-19 in primary care and lessons for sustained use. *PLoS One* 2021;16(6):e0253665. doi: 10.1371/journal.pone.0253665 [published Online First: 2021/06/25]
2. Armstrong AW, Chambers CJ, Maverakis E, et al. Effectiveness of Online vs In-Person Care for Adults With Psoriasis: A Randomized Clinical Trial. *JAMA Network Open* 2018;1(6):e183062-e62. doi: 10.1001/jamanetworkopen.2018.3062
3. Wang RH, Barbieri JS, Nguyen HP, et al. Clinical effectiveness and cost-effectiveness of teledermatology: Where are we now, and what are the barriers to adoption? *Journal of the American Academy of Dermatology* 2020;83(1):299-307. doi: 10.1016/j.jaad.2020.01.065 [published Online First: 2020/02/05]
4. Okita AL, Molina Tinoco LJ, Criado PR, et al. Use of Smartphones in Telemedicine: Comparative Study Between Standard and Teledermatological Evaluation of High-Complex Care Hospital Inpatients. *Telemedicine journal and e-health : the official journal of the American Telemedicine Association* 2016;22(9):755-60. doi: http://dx.doi.org/10.1089/tmj.2015.0086
5. Saleh N, Abdel Hay R, Hegazy R, et al. Can teledermatology be a useful diagnostic tool in dermatology practice in remote areas? An Egyptian experience with 600 patients. *Journal of telemedicine and telecare* 2017;23(2):233-38. doi: http://dx.doi.org/10.1177/1357633X16633944
6. Finnane A, Dallest K, Janda M, et al. Teledermatology for the Diagnosis and Management of Skin Cancer: A Systematic Review. *JAMA Dermatol* 2017;153(3):319-27. doi: 10.1001/jamadermatol.2016.4361 [published Online First: 2016/12/08]
7. Moher D, Shamseer L, Clarke M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Syst Rev* 2015;4(1):1. doi: 10.1186/2046-4053-4-1 [published Online First: 2015/01/03]
8. Brewer AC, Endly DC, Henley J, et al. Mobile applications in dermatology. *JAMA Dermatol* 2013;149(11):1300-4. doi: 10.1001/jamadermatol.2013.5517 [published Online First: 2013/09/27]
9. Rios-Yuil JM. [Correlation between face-to-face assessment and telemedicine for the diagnosis of skin disease in case conferences]. *Actas dermo-sifiliograficas* 2012;103(2):138-43. doi: https://dx.doi.org/10.1016/j.ad.2011.05.011
10. Romero Aguilera G, Cortina De La Calle P, Vera Iglesias E, et al. Interobserver reliability of store-and-forward teledermatology in a clinical practice setting. *Actas Dermo-Sifiliograficas* 2014;105(6):605-13. doi: http://dx.doi.org/10.1016/j.adengl.2014.05.018
11. Romero G, Sanchez P, Garcia M, et al. Randomized controlled trial comparing store-and-forward teledermatology alone and in combination with web-camera videoconferencing. *Clinical and Experimental Dermatology* 2010;35(3):311-17. doi: http://dx.doi.org/10.1111/j.1365-2230.2009.03503.x
12. Sterne JAC, Savović J, Page MJ, et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. *BMJ* 2019;366:l4898. doi: 10.1136/bmj.l4898
13. Altieri L, Hu J, Nguyen A, et al. Interobserver reliability of teledermatology across all Fitzpatrick skin types. *Journal of telemedicine and telecare* 2017;23(1):68-73. doi: http://dx.doi.org/10.1177/1357633X15621226

14. Castelo-Soccio L, Kovarik CL, Azfar RS, et al. Reliability and validity of mobile teledermatology in human immunodeficiency virus-positive patients in botswana a pilot study. *JAMA Dermatology* 2014;150(6):601-07. doi: http://dx.doi.org/10.1001/jamadermatol.2013.7321
15. Barbieri JS, Nelson CA, James WD, et al. The reliability of teledermatology to triage inpatient dermatology consultations. *JAMA Dermatology* 2014;150(4):419-24. doi: http://dx.doi.org/10.1001/jamadermatol.2013.9517
16. Barcaui CB, Lima PMO. Application of teledermoscopy in the diagnosis of pigmented lesions. *International Journal of Telemedicine and Applications* 2018;2018((Barcaui) Adjunct Professor of Dermatology, Faculty of Medical Sciences, State University of Rio de Janeiro, PhD in Medicine (Dermatology), University of Sao Paulo, Dermatology Department, Pedro Ernesto University Hospital, Rio de Janeiro State University):1624073. doi: http://dx.doi.org/10.1155/2018/1624073
17. Batalla A, Suh-Oh HJ, Abalde T, et al. Teledermatology in Paediatrics. Observations in daily clinical practice. *Anales de pediatria (Barcelona, Spain : 2003)* 2016;84(6):324-30. doi: http://dx.doi.org/10.1016/j.anpedi.2015.07.005
18. Borve A, Holst A, Gente-Lidholm A, et al. Use of the mobile phone multimedia messaging service for teledermatology. *Journal of Telemedicine and Telecare* 2012;18(5):292-96. doi: http://dx.doi.org/10.1258/jtt.2012.120206
19. Borve A, Terstappen K, Sandberg C, et al. Mobile teledermoscopy-there's an app for that! *Dermatology practical & conceptual* 2013;3(2):41-8. doi: https://dx.doi.org/10.5826/dpc.0302a05
20. Carter ZA, Li X, Goldman S, et al. Creation of an internal teledermatology store-and-forward system in an existing electronic health record: A pilot study in a safety-net public health and hospital system. *JAMA Dermatology* 2017;153(7):644-50. doi: http://dx.doi.org/10.1001/jamadermatol.2017.0204
21. Chen TS, Goldyne ME, Mathes EFD, et al. Pediatric teledermatology: Observations based on 429 consults. *Journal of the American Academy of Dermatology* 2010;62(1):61-66. doi: http://dx.doi.org/10.1016/j.jaad.2009.05.039
22. Clarke EL, Reichenberg JS, Ahmed AM, et al. The utility of teledermatology in the evaluation of skin lesions. *Journal of telemedicine and telecare* 2021(9506702, cpj):1357633X20987423. doi: https://dx.doi.org/10.1177/1357633X20987423
23. Costello CM, Cumsky HJL, Maly CJ, et al. Improving Access to Care Through the Establishment of a Local, Teledermatology Network. *Telemedicine journal and e-health : the official journal of the American Telemedicine Association* 2020;26(7):935-40. doi: https://dx.doi.org/10.1089/tmj.2019.0051
24. Duong TA, Cordoliani F, Julliard C, et al. Emergency department diagnosis and management of skin diseases with real-time teledermatologic expertise. *JAMA Dermatology* 2014;150(7):743-47. doi: http://dx.doi.org/10.1001/jamadermatol.2013.7792
25. Gabel CK, Nguyen E, Karmouta R, et al. Use of teledermatology by dermatology hospitalists is effective in the diagnosis and management of inpatient disease. *Journal of the American Academy of Dermatology* 2021;84(6):1547-53. doi: https://dx.doi.org/10.1016/j.jaad.2020.04.171
26. Gatica JL, Bertolo S, Morales E, et al. Store-and-forward teledermatogy in Chile: A contribution to primary health care. *Piel* 2015;30(3):148-54. doi: http://dx.doi.org/10.1016/j.piel.2014.07.007

27. Gerhardt CA, Foels R, Grewe S, et al. Assessing the Diagnostic Accuracy of Teledermatology Consultations at a Local Veterans Affairs Dermatology Clinic. *Cureus* 2021;13(6):e15406. doi: https://dx.doi.org/10.7759/cureus.15406
28. Giavina-Bianchi M, Azevedo MFD, Sousa RM, et al. Part II: Accuracy of Teledermatology in Skin Neoplasms. *Frontiers in medicine* 2020;7(101648047):598903. doi: https://dx.doi.org/10.3389/fmed.2020.598903
29. Giavina-Bianchi M, Sousa R, Cordioli E. Part I: Accuracy of Teledermatology in Inflammatory Dermatoses. *Frontiers in medicine* 2020;7(101648047):585792. doi: https://dx.doi.org/10.3389/fmed.2020.585792
30. Keller JJ, Johnson JP, Latour E. Inpatient teledermatology: Diagnostic and therapeutic concordance among a hospitalist, dermatologist, and teledermatologist using store-and-forward teledermatology. *Journal of the American Academy of Dermatology* 2020;82(5):1262-67. doi: https://dx.doi.org/10.1016/j.jaad.2020.01.030
31. Lamel SA, Haldeman KM, Ely H, et al. Application of mobile teledermatology for skin cancer screening. *Journal of the American Academy of Dermatology* 2012;67(4):576-81. doi: http://dx.doi.org/10.1016/j.jaad.2011.11.957
32. Muir J, Xu C, Singh P, et al. Incorporating teledermatology into emergency medicine. *EMA - Emergency Medicine Australasia* 2011;23(5):562-68. doi: http://dx.doi.org/10.1111/j.1742-6723.2011.01443.x
33. Nami N, Rubegni P, Fimiani M, et al. Concordance and Time Estimation of Store-and-Forward Mobile Teledermatology Compared to Classical Face-to-Face Consultation. *Acta Dermato-Venereologica* 2015;95(1):35-39. doi: http://dx.doi.org/10.2340/00015555-1876
34. Patro BK, Tripathy JP, De D, et al. Diagnostic agreement between a primary care physician and a teledermatologist for common dermatological conditions in North India. *Indian dermatology online journal* 2015;6(1):21-6. doi: https://dx.doi.org/10.4103/2229-5178.148927
35. Ribas J, Schettini APM, Ribas CBDR, et al. Agreement between dermatological diagnoses made by live examination compared to analysis of digital images. *Anais Brasileiros de Dermatologia* 2010;85(4):441-47. doi: http://dx.doi.org/10.1590/s0365-05962010000400004
36. Rubegni P, Nami N, Poggiali S, et al. Geriatric teledermatology: Store-and-forward vs. face-to-face examination. *Journal of the European Academy of Dermatology and Venereology* 2011;25(11):1334-39. doi: http://dx.doi.org/10.1111/j.1468-3083.2011.03986.x
37. Sola-Ortigosa J, Munoz-Santos C, Masat-Tico T, et al. The Role of Teledermatology and Teledermoscopy in the Diagnosis of Actinic Keratosis and Field Cancerization. *The Journal of investigative dermatology* 2020;140(10):1976-84.e4. doi: https://dx.doi.org/10.1016/j.jid.2020.02.013
38. Tan E, Yung A, Oakley A, et al. Successful triage of patients referred to a skin lesion clinic using teledermoscopy (IMAGE IT trial). *British Journal of Dermatology* 2010;162(4):803-11. doi: http://dx.doi.org/10.1111/j.1365-2133.2010.09673.x
39. Tran K, Ayad M, Monir S, et al. Mobile teledermatology in the developing world: Implications of a feasibility study on 30 Egyptian patients with common skin diseases. *Journal of the American Academy of Dermatology* 2011;64(2):302-09. doi: http://dx.doi.org/10.1016/j.jaad.2010.01.010

40. Vano-Galvan S, Aguayo-Leiva I, Rios-Buceta L, et al. Store-and-forward teledermatology: Assessment of validity in a series of 2000 observations. *Actas Dermo-Sifiliograficas* 2011;102(4):277-83. doi: http://dx.doi.org/10.1016/S1578-2190(11)70803-4
41. Vestergaard T, Prasad SC, Schuster A, et al. Diagnostic accuracy and interobserver concordance: teledermoscopy of 600 suspicious skin lesions in Southern Denmark. *Journal of the European Academy of Dermatology and Venereology : JEADV* 2020;34(7):1601-08. doi: https://dx.doi.org/10.1111/jdv.16275
42. Gravely AA, Warshaw EM, Nelson DB. Reliability of store and forward teledermatology for skin neoplasms. *Journal of the American Academy of Dermatology* 2015;72(3):426-35. doi: http://dx.doi.org/10.1016/j.jaad.2014.11.001
43. Zanini M. Analyze of diagnostic concordance between face-to-face and teledermatology diagnosis. *Medicina Cutanea Ibero-Latino-Americana* 2013;41(2):60-62. doi: http://dx.doi.org/10.4464/MC.2013.41.2.5058
44. Zink A, Kolbinger A, Leibl M, et al. The value of teledermatology using a mobile app compared to conventional dermatology. *European Journal of Dermatology* 2017;27(4):429-31. doi: http://dx.doi.org/10.1684/ejd.2017.3044
45. Zink A, Kolbinger A, Leibl M, et al. Teledermoscopy by mobile phones: Reliable help in the diagnosis of skin lesions? *Hautarzt* 2017;68(11):890-95. doi: http://dx.doi.org/10.1007/s00105-017-4042-0
46. Marchell R, Locatis C, Liu W-L, et al. Comparing High Definition Live Interactive and Store-and-Forward Consultations to In-Person Examinations. *Telemedicine journal and e-health : the official journal of the American Telemedicine Association* 2017;23(3):213-18. doi: http://dx.doi.org/10.1089/tmj.2016.0093
47. Jones L, Jameson M, Oakley A. Remote Skin Cancer Diagnosis: Adding Images to Electronic Referrals Is More Efficient Than Wait-Listing for a Nurse-Led Imaging Clinic. *Cancers (Basel)* 2021;13(22) doi: 10.3390/cancers13225828 [published Online First: 2021/11/28]
48. Gonzalez Coloma F, Sandoval Garces M, Gedda Quiroga V, et al. Teledermatology in Remote Parts of Chile: Experience in 4 Isolated Rural Areas. *Actas dermo-sifiliograficas* 2019;110(8):653-58. doi: https://dx.doi.org/10.1016/j.ad.2019.01.009
49. Goulart Silveira CE, Carcano C, Mauad EC, et al. Call phone usefulness to improve the skin cancer screening: preliminary results and critical analysis of mobile app development. *Rural & Remote Health* 2019;19(1):1-7. doi: 10.22605/RRH4895
50. Piccoli MF, Amorim BDB, Wagner HM, et al. Teledermatology protocol for screening of Skin cancer. *Anais Brasileiros de Dermatologia* 2015;90(2):202-10. doi: http://dx.doi.org/10.1590/abd1806-4841.20153163
51. Senel E, Baba M, Durdu M. The contribution of teledermatoscopy to the diagnosis and management of non-melanocytic skin tumours. *Journal of Telemedicine and Telecare* 2013;19(1):60-63. doi: http://dx.doi.org/10.1177/1357633X12474961
52. Gravely AA, Nelson DB, Warshaw EM. Accuracy of teledermatology/teledermoscopy and clinic-based dermatology for specific categories of skin neoplasms. *Journal of the American Academy of Dermatology* 2010;63(2):348-52. doi: http://dx.doi.org/10.1016/j.jaad.2009.10.037
53. McFarland LV, Raugi GJ, Reiber GE. Primary care provider and imaging technician satisfaction with a teledermatology project in rural Veterans Health Administration

clinics. *Telemed J E Health* 2013;19(11):815-25. doi: 10.1089/tmj.2012.0327 [published Online First: 20130921]
54. Massone C, Javor S, Amato I, et al. Training of primary care physicians enhances performance of mobile teledermatology. *Anais brasileiros de dermatologia* 2021;96(4):514-16. doi: https://dx.doi.org/10.1016/j.abd.2020.07.017
55. Finnane A, Curiel-Lewandrowski C, Wimberley G, et al. Proposed Technical Guidelines for the Acquisition of Clinical Images of Skin-Related Conditions. *JAMA Dermatol* 2017;153(5):453-57. doi: 10.1001/jamadermatol.2016.6214 [published Online First: 2017/02/28]
56. Lee JJ, English JC, 3rd. Teledermatology: A Review and Update. *Am J Clin Dermatol* 2018;19(2):253-60. doi: 10.1007/s40257-017-0317-6 [published Online First: 2017/09/06]
57. Bastola M, Locatis C, Fontelo P. Diagnostic Reliability of In-Person Versus Remote Dermatology: A Meta-Analysis. *Telemed J E Health* 2021;27(3):247-50. doi: 10.1089/tmj.2020.0043 [published Online First: 2020/07/09]

Figure Legends

Figure 1. **PRISMA Flow diagram of study selection.**

Figure 2. Forest plot representing F2F and teledermatology primary diagnostic agreement by whether imaging acquisition training was indicated by the study.
Forest plot representing F2F and teledermatology primary diagnostic agreement when image acquisition training is involved. Studies were sorted into two groups, a) Did not conduct or did not report training personnel on image acquisition; b) Stated that person in charge of image acquisition was trained. **(Left)** Forest plot representing percentage agreement and 95% C.I. for overall concordance across 40 studies with a total of 72 unique number of comparisons, N of events and total included participants. **(Right)** Forest plot representing kappa concordance and 95% C.I. for overall concordance across 21 studies with a total of 45 unique number of comparisons, N of total included participants. Abbreviations: F2F (Face-to-Face), PCP (Primary Care Provider), TD (Teledermatology or Teledermatologist).

Figure 3. Forest plot representing F2F and teledermatology primary diagnostic agreement by device type used to capture clinical photographs.
Forest plot representing F2F and teledermatology primary diagnostic agreement by imaging technology used. Studies were sorted into three groups, i) Digital photography ii) Imaging technology not mentioned iii) Smartphone or tablet. **(Left)** Forest plot representing percentage agreement and 95% C.I. for overall concordance across 40 studies with a total of 72 unique number of comparisons, N of events and total included participants. **(Right)** Forest plot representing kappa concordance and 95% C.I. for overall concordance across 21 studies with a total of 45 unique number of comparisons, N of total included participants. Abbreviations: F2F (Face-to-Face), PCP (Primary Care Provider), TD (Teledermatology or Teledermatologist)

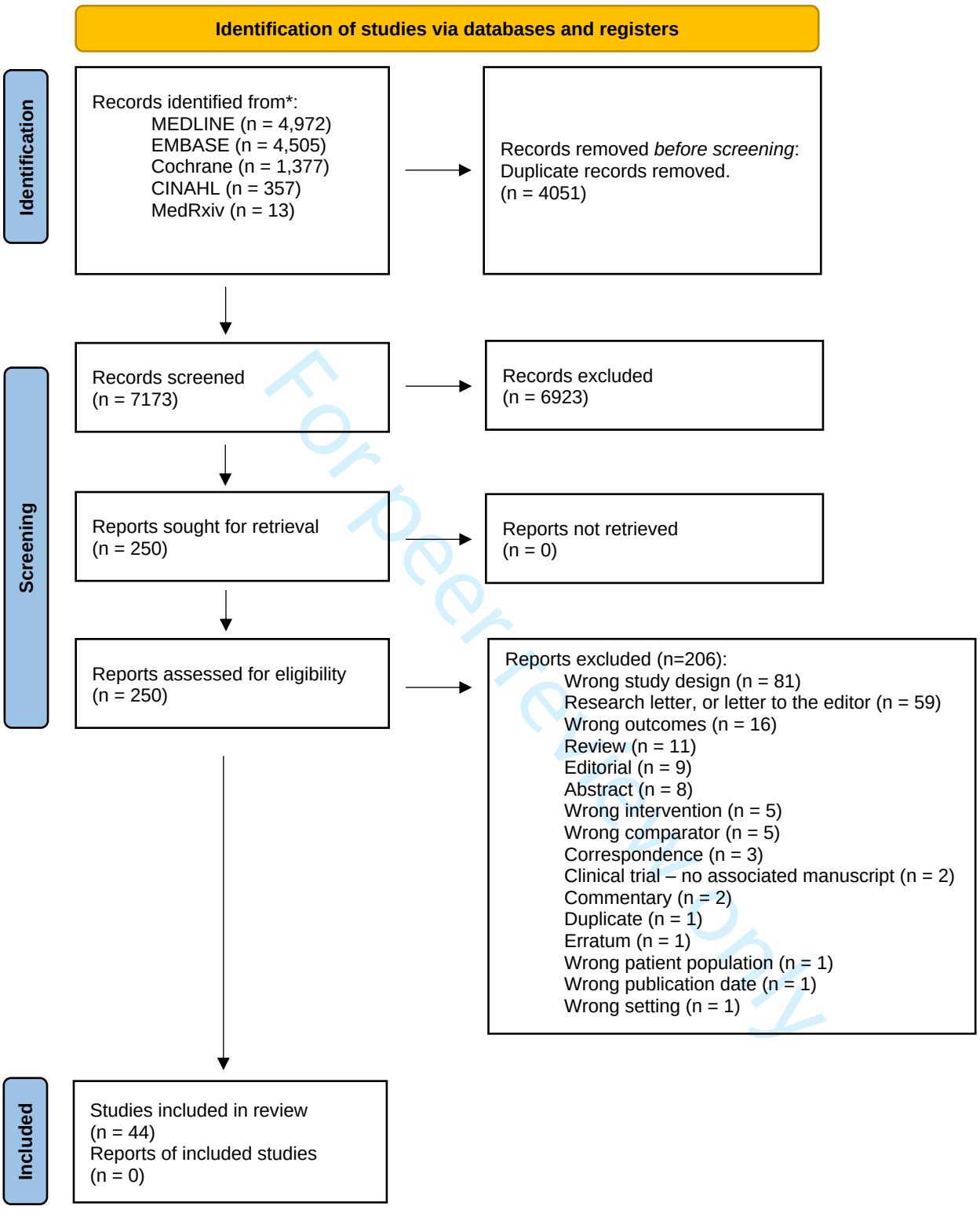
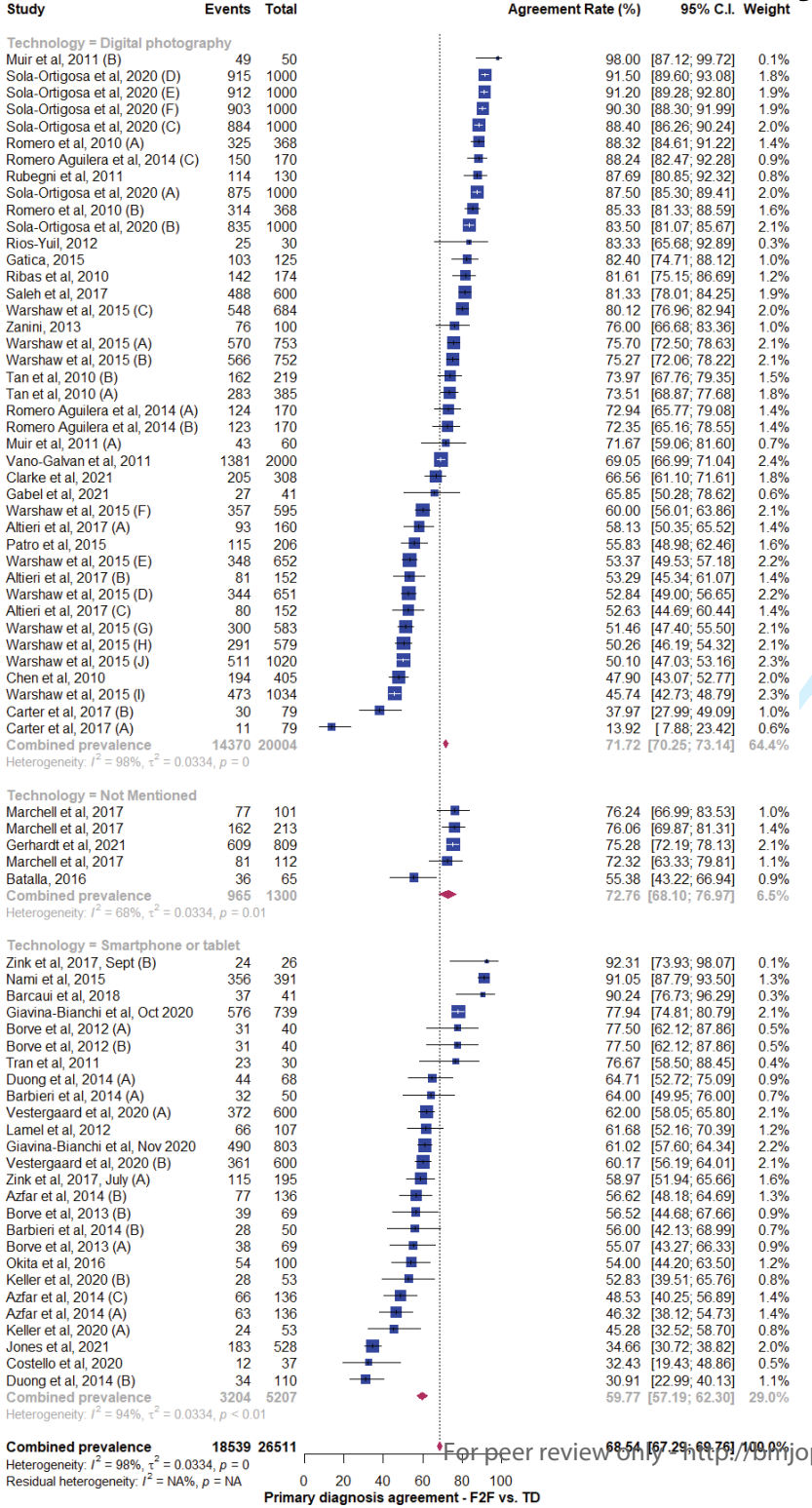
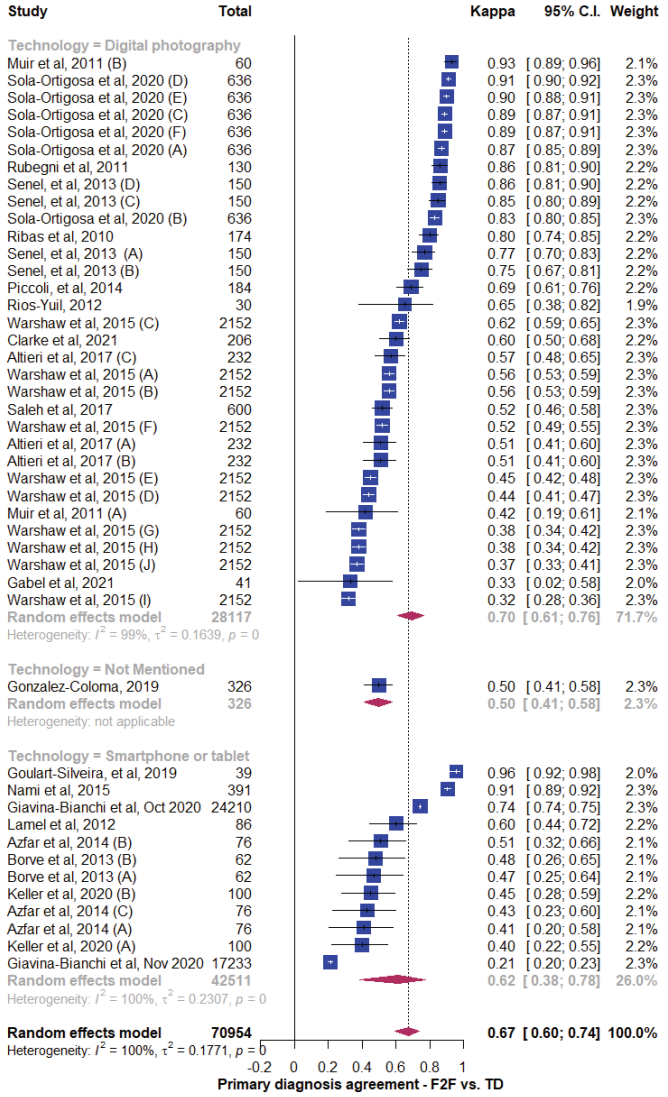
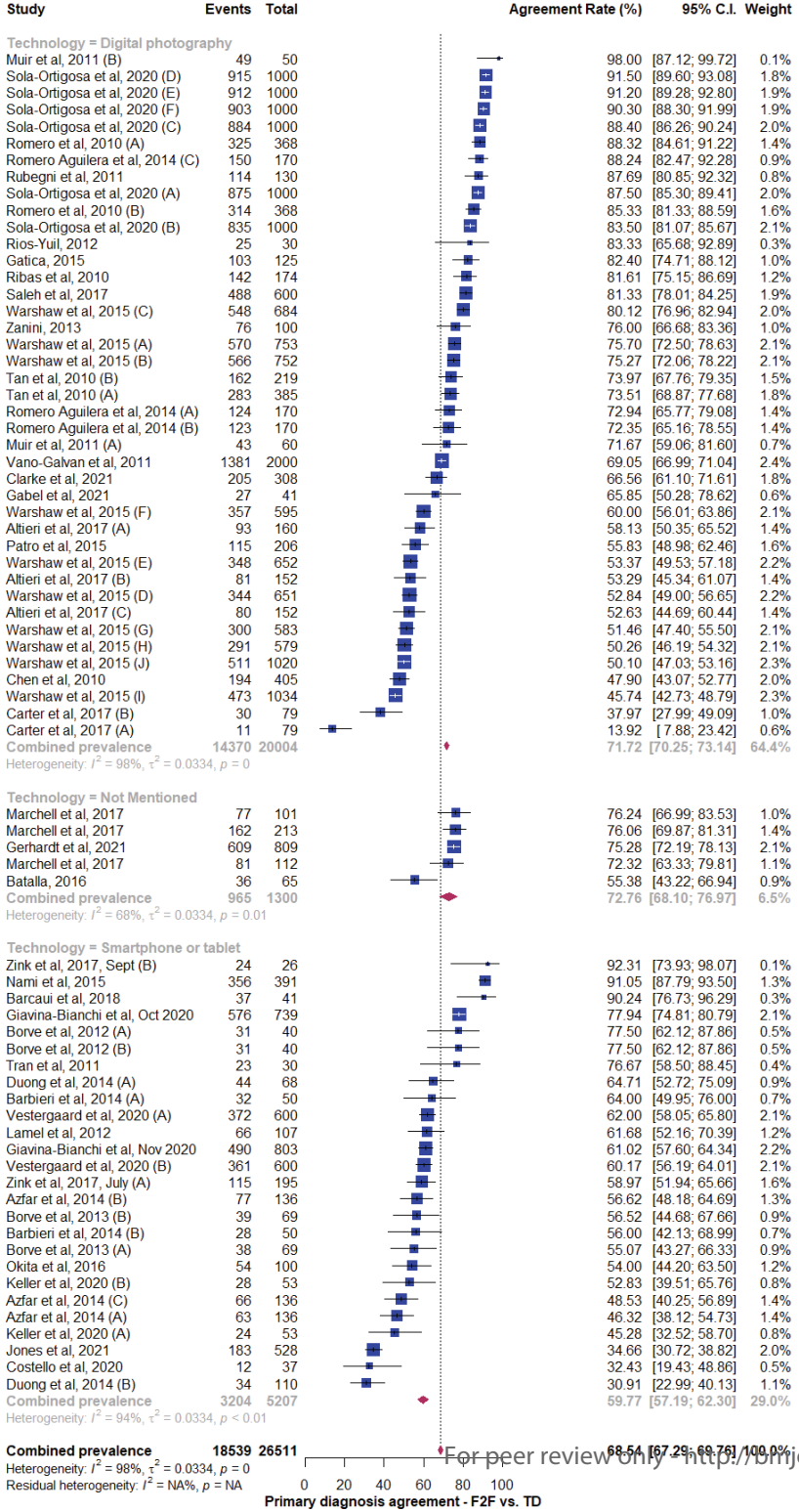
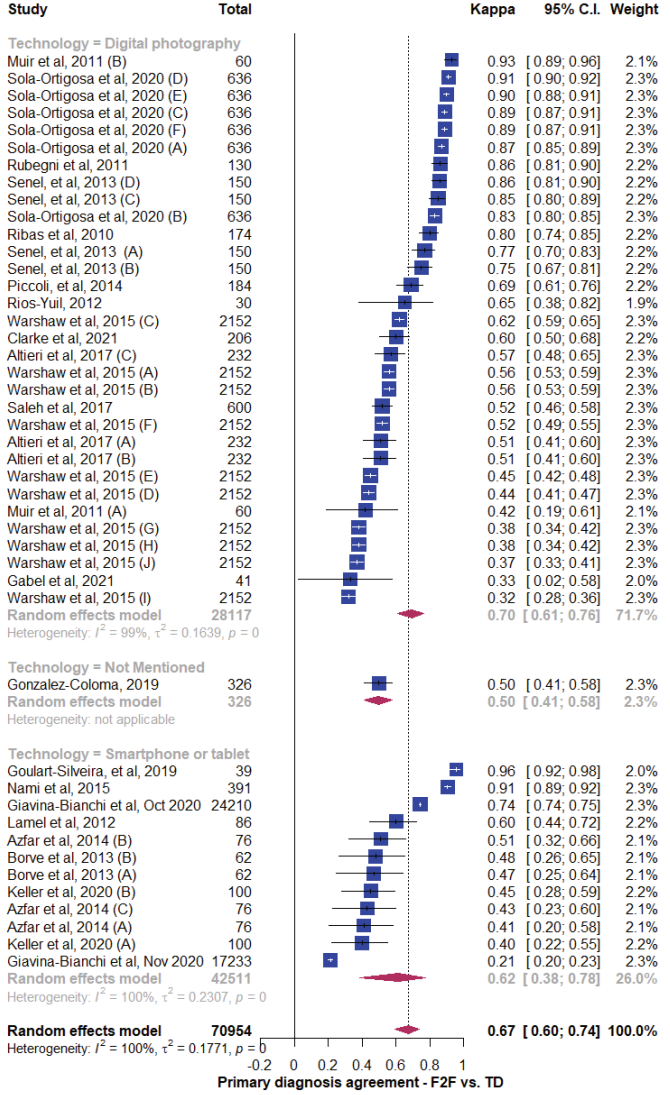


Figure 1. PRISMA Flow diagram of study selection.









Supplementary Online Content

Title: Diagnostic Reliability in Teledermatology: A Systematic Review and Meta-Analysis

Authors
Adrienn N. Bourkas*[1] (MSc), Natasha Barone*[2] (MD, MSc), Matthew E.C. Bourkas[3] (PhD), Matthew Mannarino[4] (PhD), Robert D. J. Fraser[5,6] (RN, MN), Amy Lorincz (MSc), Sheila C. Wang[5,7] (MD, PhD), Jose L. Ramirez-GarciaLuna[4] (MD, PhD)
* Authors contributed equally

Affiliations
[1]Faculty of Health Sciences, Queen's University School of Medicine, Kingston, Ontario, Canada
[2]Faculty of Medicine and Health Sciences, McGill University, Montreal, Quebec, Canada
[3]Temerty Faculty of Medicine, Department of Biochemistry, University of Toronto, Toronto, Ontario, Canada
[4]Department of Surgery, McGill University, Montreal, Quebec, Canada
[5]Swift Medical Inc., Toronto, Ontario, Canada
[6]Arthur Labatt Family School of Nursing, Western University, London, Ontario Canada
[7]Department of Medicine, Division of Dermatology, McGill University Health Centre, Montreal, Quebec, Canada

Supplementary eMethods

Search Strategy

The search strategy was written for Ovid Medline and translated using each database's syntax, controlled vocabulary, and search fields. MeSH terms, Emtree terms, and free text words were used for teledermatology and skin conditions such as melanoma and related synonyms. To identify additional articles not captured through the aforementioned search, a manual search was conducted via reference search of the included studies.

All database records were downloaded to EndNote X9 (Clarivate) and uploaded to web-based software for deduplication, screening, and full-text evaluation (Covidence; Veritas Health Innovation). We contacted three study authors to gain access to their published work.[1-3] The search strategy is available below.

Ovid MEDLINE Search

Ovid MEDLINE(R) and Epub Ahead of Print, In-Process, In-Data-Review & Other Non-Indexed Citations and Daily <1946 to 2022 May 02>

1	e consult*.mp.	322
2	econsult*.mp.	218
3	electronic consult*.mp.	366
4	e health.mp.	4095
5	ehealth.mp.	6823
6	e visit*.mp.	88
7	evisit*.mp.	26
8	home video visit*.mp.	4
9	internet/ or internet-based intervention/	82046
10	internet.mp.	128675
11	offsite care.mp.	4
12	off site care.mp.	9
13	ontario telemedicine network.mp.	19
14	Remote Consultation/	5689
15	remote consultation*.mp.	6406
16	remote visit*.mp.	95
17	tele care.mp.	40
18	telecare.mp.	945
19	tele consult*.mp.	208
20	teleconsult*.mp.	2208
21	tele diagnos*.mp.	46
22	telehealth.mp.	13222
23	tele health.mp.	287
24	telemedicine/	36763
25	telemedicine.mp.	47751
26	tele medicine.mp.	197
27	telemonitor*.mp.	2380
28	tele monitor*.mp.	209
29	Telepathology/	918
30	telepatholog*.mp.	1223
31	tele patholog*.mp.	25
32	telepractice*.mp.	276
33	tele practice*.mp.	16
34	Therapy, Computer-Assisted/	6969
35	video consult*.mp.	827
36	videoconsult*.mp.	41
37	virtual care.mp.	1177
38	web based.mp.	42402
39	Telepathology/	918

40	or/1-39	216985	
41	Dermatology/	21077	
42	dermatolog*.mp.	110593	
43	dermatopatholog*.mp.	2990	
44	exp Skin Diseases/di [Diagnosis]	196739	
45	exp Skin Neoplasms/	142454	
46	skin.mp.	880457	
47	exp Skin Abnormalities/	34228	
48	burns/ or burns, chemical/ or burns, electric/ or sunburn/	59533	
49	burn*.mp.	141877	
50	wound healing/ or cicatrix/	127484	
51	wound*.mp.	446154	
52	or/41-51	1580012	
53	40 and 52	7160	
54	teledermatolog*.mp.	1273	
55	tele dermatolog*.mp.	35	
56	54 or 55	1298	
57	53 or 56	7448	
58	limit 57 to dt=20100101-20220501 [January 1st, 2010 to May 1st, 2022]	4972	

Embase Search

Embase Classic+Embase <1947 to 2021 July 15>

1	computer assisted therapy/	4772
2	e consult*.mp.	411
3	econsult*.mp.	283
4	electronic consult*.mp.	461
5	e health.mp.	4440
6	ehealth.mp.	5099
7	e visit*.mp.	83
8	evisit*.mp.	30
9	home video visit*.mp.	10
10	internet/ or web-based intervention/	114861
11	internet.mp.	143810
12	offsite care.mp.	5
13	off site care.mp.	12
14	ontario telemedicine network.mp.	36
15	remote consultation*.mp.	808
16	remote visit*.mp.	79
17	tele care.mp.	55
18	telecare.mp.	983
19	teleconsultation/	11686
20	tele consult*.mp.	243
21	teleconsult*.mp.	12352
22	tele diagnos*.mp.	53
23	telehealth.mp.	15276
24	tele health.mp.	389
25	telemedicine/	31867
26	telemedicine.mp.	38951
27	tele medicine.mp.	333
28	telemonitor*.mp.	4838
29	tele monitor*.mp.	344
30	Telepathology/	869
31	telepatholog*.mp.	1265
32	tele patholog*.mp.	41
33	telepractice*.mp.	162

34 tele practice*.mp. 9
35 video consult*.mp. 751
36 videoconsult*.mp. 54
37 virtual care.mp. 496
38 web based.mp. 49157
39 or/1-38 240118
40 dermatology/ or cosmetic dermatology/ or pediatric dermatology/ or psychodermatology/ 51419
41 dermatolog*.mp. 161210
42 dermatopatholog*.mp. 3737
43 burn/ or burn contracture/ or electric burn/ or face burn/ or hand burn/ or ionizing radiation burn/ or scald/ or sunburn/ 74890
44 burn*.mp. 189010
45 exp skin disease/di [Diagnosis] 209136
46 exp skin tumor/ 213775
47 skin*.mp. 1294867
48 or/40-47 1665263
49 39 and 48 7063
50 teledermatology/ 1295
51 tele dermatolog*.mp. 42
52 teledermatolog*.mp. 1798
53 50 or 51 or 52 1812
54 49 or 53 8004
55 limit 54 to (books or chapter or conference abstract or conference paper or "conference review") 1828
56 54 not 55 6176
57 limit 56 to yr="2010 -Current" 4505

Cochrane Search

EBM Reviews - Cochrane Database of Systematic Reviews <2005 to July 14, 2021> EBM Reviews - ACP Journal Club <1991 to June 2021> EBM Reviews - Database of Abstracts of Reviews of Effects <1st Quarter 2016> EBM Reviews - Cochrane Clinical Answers <June 2021> EBM Reviews - Cochrane Central Register of Controlled Trials <June 2021> EBM Reviews - Cochrane Methodology Register <3rd Quarter 2012> EBM Reviews - Health Technology Assessment <4th Quarter 2016> EBM Reviews - NHS Economic Evaluation Database <1st Quarter 2016>

1 e consult*.mp. 44
2 econsult*.mp. 22
3 electronic consult*.mp. 29
4 e health.mp. 617
5 ehealth.mp. 766
6 e visit*.mp. 14
7 evisit*.mp. 1
8 home video visit*.mp. 3
9 internet/ or internet-based intervention/ 4,275
10 internet.mp. 15,059
11 offsite care.mp. 2
12 off site care.mp. 2
13 ontario telemedicine network.mp. 7
14 Remote Consultation/ 460
15 remote consultation*.mp. 551
16 remote visit*.mp. 17
17 tele care.mp. 34
18 telecare.mp. 249
19 tele consult*.mp. 59
20 teleconsult*.mp. 822
21 tele diagnos*.mp. 4
22 telehealth.mp. 2,308
23 tele health.mp. 128

24	telemedicine/	2,617
25	telemedicine.mp.	4,819
26	tele medicine.mp.	57
27	telemonitor*.mp.	1,236
28	tele monitor*.mp.	115
29	Telepathology/	8
30	telepatholog*.mp.	22
31	tele patholog*.mp.	2
32	telepractice*.mp.	37
33	tele practice*.mp.	0
34	Therapy, Computer-Assisted/	1,391
35	video consult*.mp.	117
36	videoconsult*.mp.	8
37	virtual care.mp.	31
38	web based.mp.	9,110
39	Telepathology/	8
40	or/1-39	29,268
41	Dermatology/	124
42	dermatolog*.mp.	10,838
43	dermatopatholog*.mp.	80
44	exp Skin Diseases/di [Diagnosis]	630
45	exp Skin Neoplasms/	1,738
46	skin.mp.	67,534
47	exp Skin Abnormalities/	269
48	burns/ or burns, chemical/ or burns, electric/ or sunburn/	1,779
49	burn*.mp.	12,780
50	wound healing/ or cicatrix/	5,677
51	wound*.mp.	35,982
52	or/41-51	110,390
53	40 and 52	1,622
54	teledermatolog*.mp.	149
55	tele dermatolog*.mp.	20
56	54 or 55	151
57	53 or 56	1,684
58	limit 57 to yr="2010 -Current"	1,377

CINAHL Search

Searched keyword teledermatology and set limit to yr="2010-Current" 357

MedRxiv Search

Searched keyword teledermatology and set limit to yr="2010-Current" 13

Eligibility Criteria

Inclusion and exclusion criteria are summarized in **eTable 2**.

Data Selection and Extraction

Information extracted from full-text articles is summarized in **eTable 3**.

Data Analysis and Synthesis

In this study, a letter was assigned to each unique study grouping as explained in **eTable 4**. For both the percentage of agreement and kappa values, forest plots, the I^2 index, and the τ^2 statistic were used in combination to investigate statistical heterogeneity.

Cohen's kappa values for diagnostic concordance between teledermatology and F2F physicians were interpreted based on the following criteria.[4] Values between 0–.20 indicate no agreement, .21–.39 minimal agreement, .40–.59 weak agreement, .60–.79 moderate agreement, .80–.90 strong agreement, and above .90 almost perfect agreement.

Sub-group analysis included different skin conditions, specialization of the F2F physician, whether staff were trained on image acquisition, the technology used for image acquisition, the use of teledermoscopy, studies conducted pre- or post-pandemic, and the risk of bias. Confounding factors, such as technology type, year of publication, and training of study raters, were controlled using meta-regression.

Proportions meta-analysis looked at weighted averages, and 95% confidence intervals were reported. Publication bias was not statistically pursued due to the substantial heterogeneity observed, in addition to the authors' decision to pursue a meta-analysis of proportions.

Supplementary eResults

Our analysis incorporated forty-four relevant studies. Key study and participant details are summarized in **eTable 1**, with a concise overview provided in the main text. Articles excluded based on our criteria are listed in **eTable 5**.

Diagnostic reliability of teledermatology when compared to F2F (specialist and non-specialists) evaluation

Of the 40 studies that reported diagnostic agreement rates there were 72 unique comparisons made between F2F and teledermatology.[5-44] **eFigure 1A** shows that the mean percentage agreement of 68.9% (CI 64.4%-73.1%) ranged from 14% to 98%, where 35/72 had percentage agreement above 70% and 7 studies had over 90% agreement. The studies were heterogeneous (I^2=98%, p <0).

Of the 21 studies that reported concordance values, there were 45 unique comparisons made.[5 6 11 14 17 20-25 28 29 32-34 45-49] **eFigure 1B** shows that the mean diagnostic concordance of 0.67 (CI 0.60 to 0.74) ranged from 0.213 (CI 0.20 to 0.23) to 0.96 (CI 0.92 to 0.98), with 21 studies (47%) having moderate agreement (k=0.6 and above), and 13 (29%) studies having strong agreement. The studies were heterogeneous (I^2=100%, p <0.001).

Diagnostic agreement between teledermatologist and teledermatologist, F2F and F2F, and teledermatology and histopathology

Of the ten studies that reported diagnostic agreement rates between telermatologists, there were 17 unique comparisons made between F2F and teledermatology consults. **eFigure 2A** shows the mean percentage agreement of 76.4% (CI 69% to 82.5%) ranged from 37% to 91.5%, with 10/17 having percentage agreement above 70% and two studies having over 90% agreement. The studies were heterogeneous (I^2=97%, p <0.001).

From four studies that reported diagnostic agreement rates between F2F dermatologists there were 6 unique comparisons. **eFigure 2B** shows that the mean percentage agreement 82.4% (CI 76.7%-87.0%) ranged from 75.5% to 91%. The studies were heterogeneous (I^2=68%, p <0.001).

Five studies compared teledermatology to histopathology data, and there were six unique comparisons. **eFigure 2C** shows that the mean percentage agreement of 55.7% (CI 53% to 58.4%) ranged from 53.8% to 65.4%. The mean agreement rate between histopathology and teledermatology was 55.7% (CI 53.0 to 58.4). The studies were homogeneous (I^2=0%, p = 0.49).

Subgroup analyses

Diagnostic reliability of teledermatology vs F2F specialist and non-specialist

Within the same modality, **eFigure 3A** shows that teledermatologists had a diagnostic agreement rate of 70.96% (CI 69.8% to 72.1%) with F2F dermatologists, while the agreement rate with F2F non-specialists was 44.1% (CI 39.9% to 48.4%). Comparing telermatologists to non-specialists showed significantly lower agreement among non-specialists (p < 0.001, heterogeneity: I^2 = 98%). Among 35 studies reporting diagnostic agreement rates, 44 out of 64 comparisons between teledermatology and F2F dermatologists had a percentage agreement above 60%, with seven studies reporting over 90% agreement. The mean kappa concordance value for diagnostic agreement between teledermatology and F2F dermatologists shown in **eFigure 3B** was 0.69 (CI 0.60 to 0.75). Additionally, telermatologists had a mean concordance value of 0.52 (CI 0.25 to 0.71) when compared to non-specialists. Non-specialists showed significantly lower diagnostic concordance compared to dermatologists for F2F vs. teledermatology (p = 0.031, heterogeneity: I^2 = 100%). Moreover, studies comparing teledermatologists to F2F and teledermatology to histopathology showed a range of agreement rates, with heterogeneity observed in the former (I^2 = 97%, p < 0.001) and homogeneity in the latter (I^2 = 0%, p = 0.49).

Diagnostic reliability of teledermatology vs F2F by the inclusion of teledermoscopy in both teledermatology and F2F assessments

Overall, twelve studies with 22 unique comparisons used teledermoscopy for diagnosing suspicious lesions.[8 11 15 29 32 34 38 39 42 44] **eFigure 4A** shows that with teledermoscopy, the mean diagnostic agreement rates was 69.1% (CI 66.8% to 71.4%), and this percentage ranged between from 31.6% to 92.3%. Without the use of teledermsocopy, the mean agreement rate was 68.3% (CI 66.8% to 69.8%). The means were not significantly different between the two groups and the studies were heterogeneous (I^2=97%, p<0.001). **eFigure 4B** shows concordance values of seven studies that

adapted teledermoscopy had a mean of 0.71 (CI 0.58 to 0.80).[11 29 32 34 39 47 48] Without teledermsocopy, the mean was 0.65 (CI 0.54 to 0.74). This difference was not statistically significant, and the studies were heterogeneous (I^2=100%, p<0.001).

Diagnostic reliability of teledermatology vs F2F by the inclusion of lesion category

Twenty-six studies with 39 unique comparisons reporting percentage agreement rates that were inclusive to all lesion types as shown in e**Figure 5A.**[5-10 15-19 22 24-26 28-33 36 37 40 41 43] The mean percentage agreement was 69.9% (CI 67.9% to 71.7%) and ranged from 30.9% to 98%, with the majority (26/39) having percentage agreement above 60% and 4 studies having over 90%. Eleven studies only looked at suspicious lesions,[11 12 14 20 23 34 35 38 39 42 44] and the mean percentage agreement was 68.1% (CI 66.3% to 69.8%). Three studies excluded skin cancers[13 21 27] and the mean percentage agreement was 62.2% (CI 56.2% to 67.8%). No statistical significance could be identified between the three lesion groups and the studies were heterogeneous (I^2=98%, p<0.001).

Concordance values for studies inclusive to all lesions seen in **eFigure 5B** were reported in ten studies with a mean of 0.62 (CI 0.48 to 0.74).[5 6 17 22 24 25 28 29 32 33] Six studies that looked at cancerous skin lesions only reported a mean of 0.70 (CI 0.59 to 0.78).[11 14 20 23 34 39] Only one study that looked at all lesions except cancerous ones reported a concordance value.[22] No statistical significance could be identified between the three lesion groups and the studies were heterogeneous (I^2=100%, p<0.001).

Diagnostic reliability of teledermatology vs F2F by pre- and post-pandemic timelines

When comparing telermatologists to all F2F physicians, the average agreement rate was 65.5% (CI 64.0-66.9) for pre-pandemic studies, and 75.3% (CI 73.4% to 77.2%) for studies published after January 2020. When the percentage agreements were compared between the two groups, they were not statistically significant (p = 0.421) and also heterogeneous (I^2=98%, p<0.001). eTable not included.

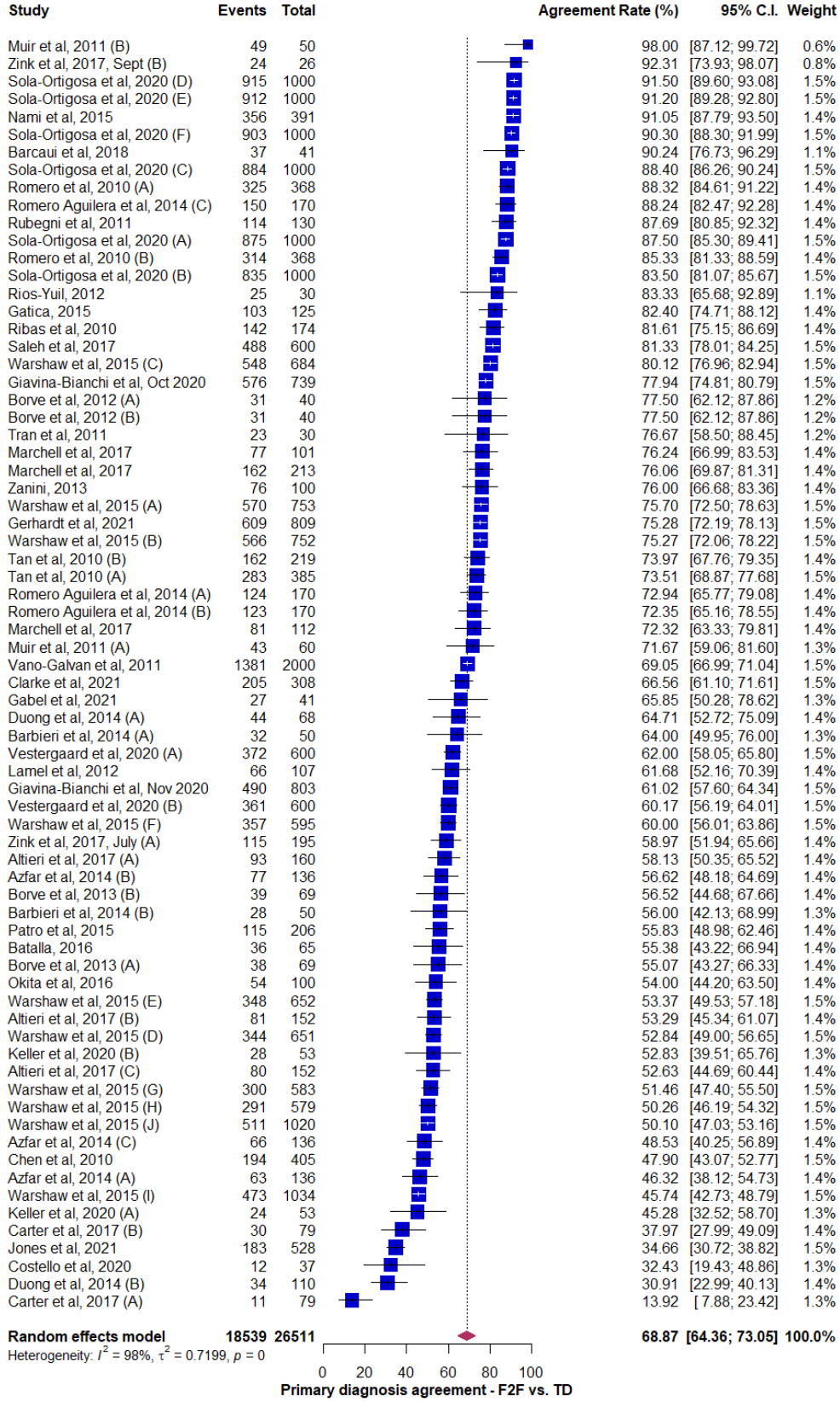
Risk of bias and quality assessment

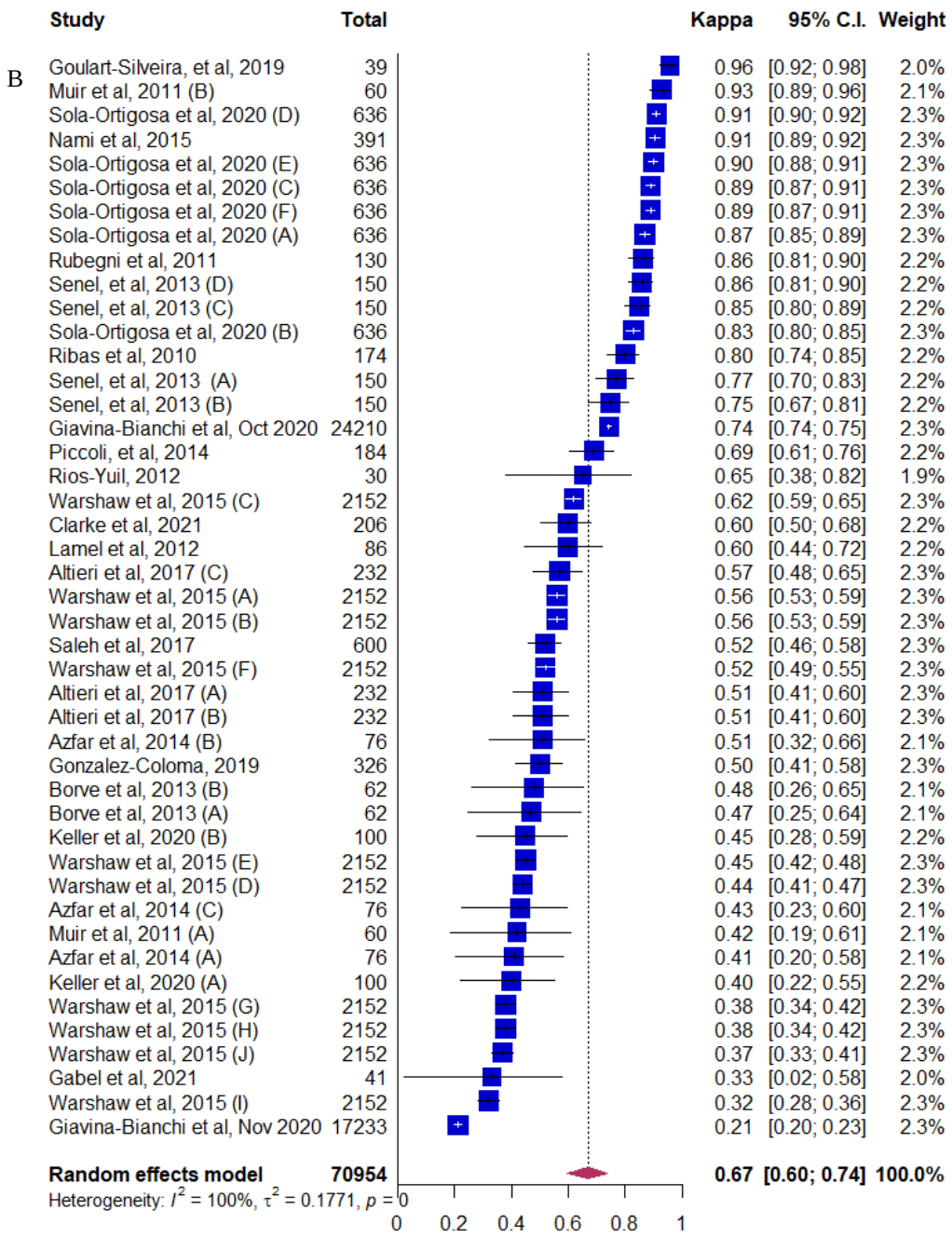
The QUADAS-2 framework was utilized to evaluate bias and applicability across four essential domains, ensuring that our conclusions are both accurate and applicable to real-life clinical situations. **eTable 6A** summarizes the QUADAS-2 criteria tailored to this study.

The results of quality assessment for risk of bias and applicability in individual studies are displayed in**. eTable 6B-E.** Six of the studies had low risk of bias, nine had moderate risk, and 29 had high-risk of bias. There were no systematic differences between the results of studies that attempted to reduce risk of bias, compared with those with higher risk of bias. The mean diagnostic agreement rate between F2F and teledermatology was 66.4% (CI 62.4% to 70.1%) for low risk, and 69.1% (CI 67.6% to 70.6%) for high risk (p = 0.932). When the percentage agreements were compared between groups, they were heterogeneous (I^ 2=98%, p<0.001). eTable not included.

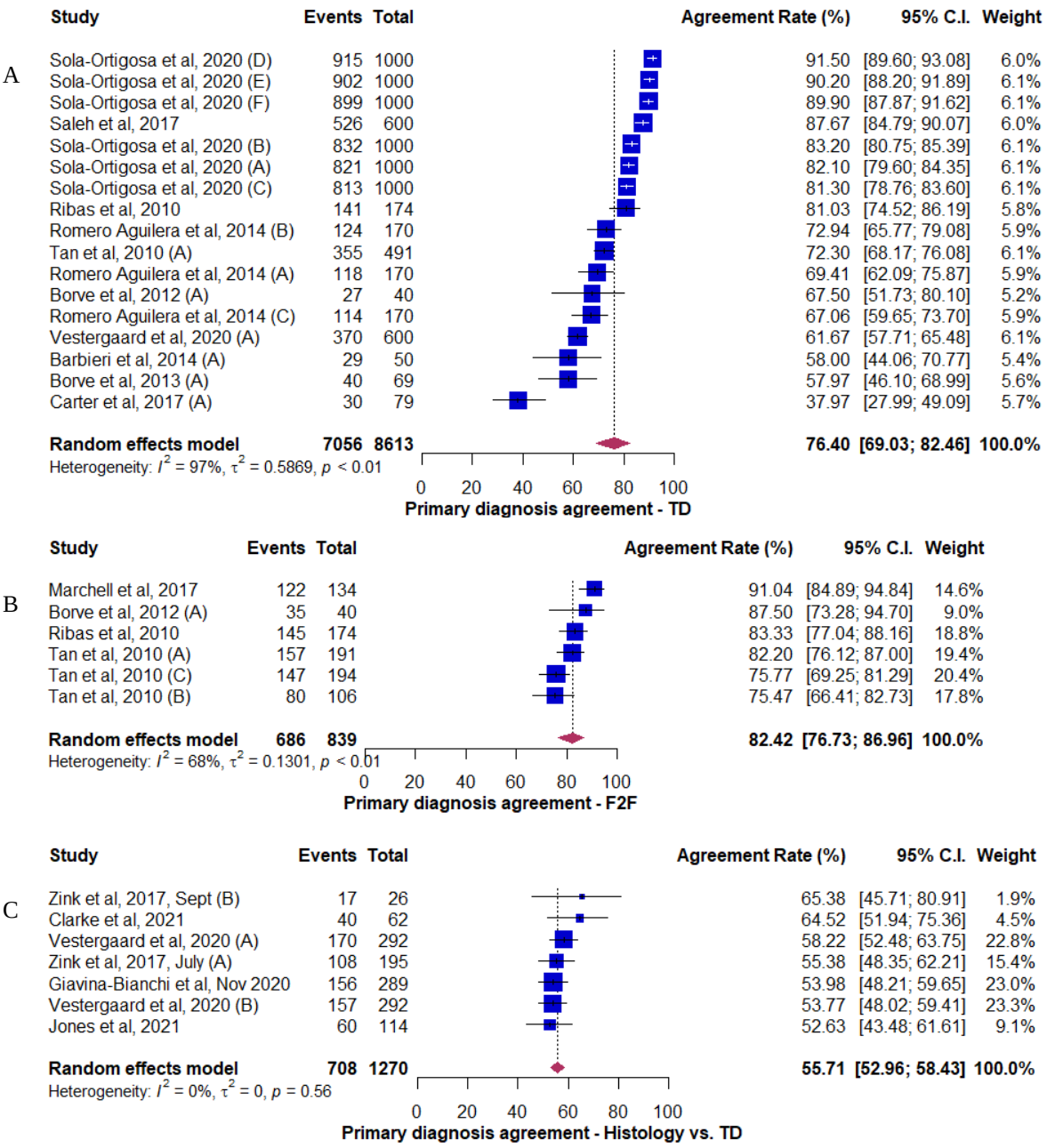
Supplementary eFigures and Legends

A



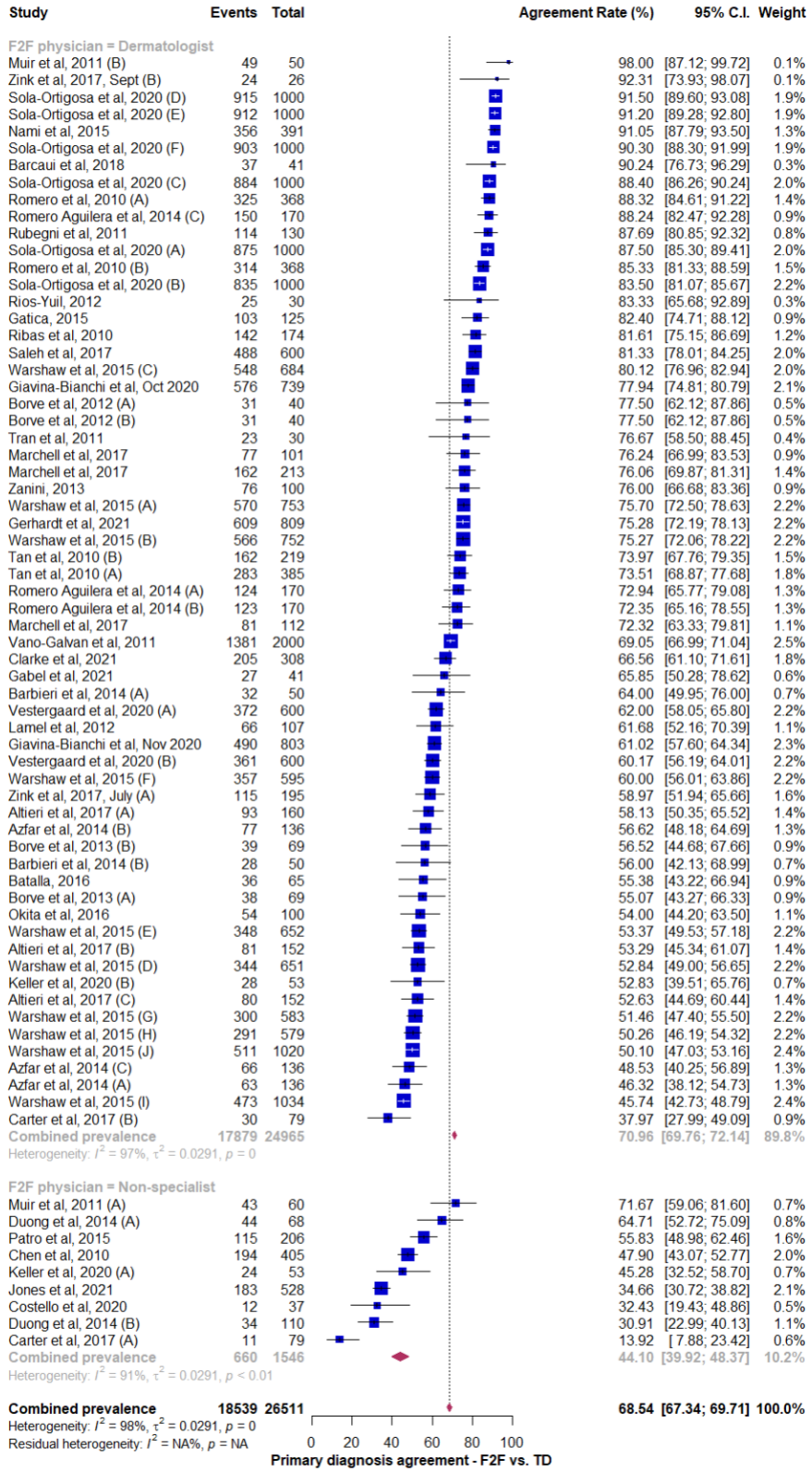


eFigure 1. Forest plot representing F2F and teledermatology primary diagnostic agreement. (A) Forest plot representing percentage agreement and 95% C.I. for overall concordance across 40 studies with a total of 72 unique number of comparisons, N of events and total included participants. (B) Forest plot representing kappa concordance and 95% C.I. for overall concordance across 21 studies with a total of 45 unique number of comparisons, N of total included participants. Abbreviations: F2F (Face-to-Face), PCP (Primary Care Provider), TD (Teledermatology or Teledermatologist).



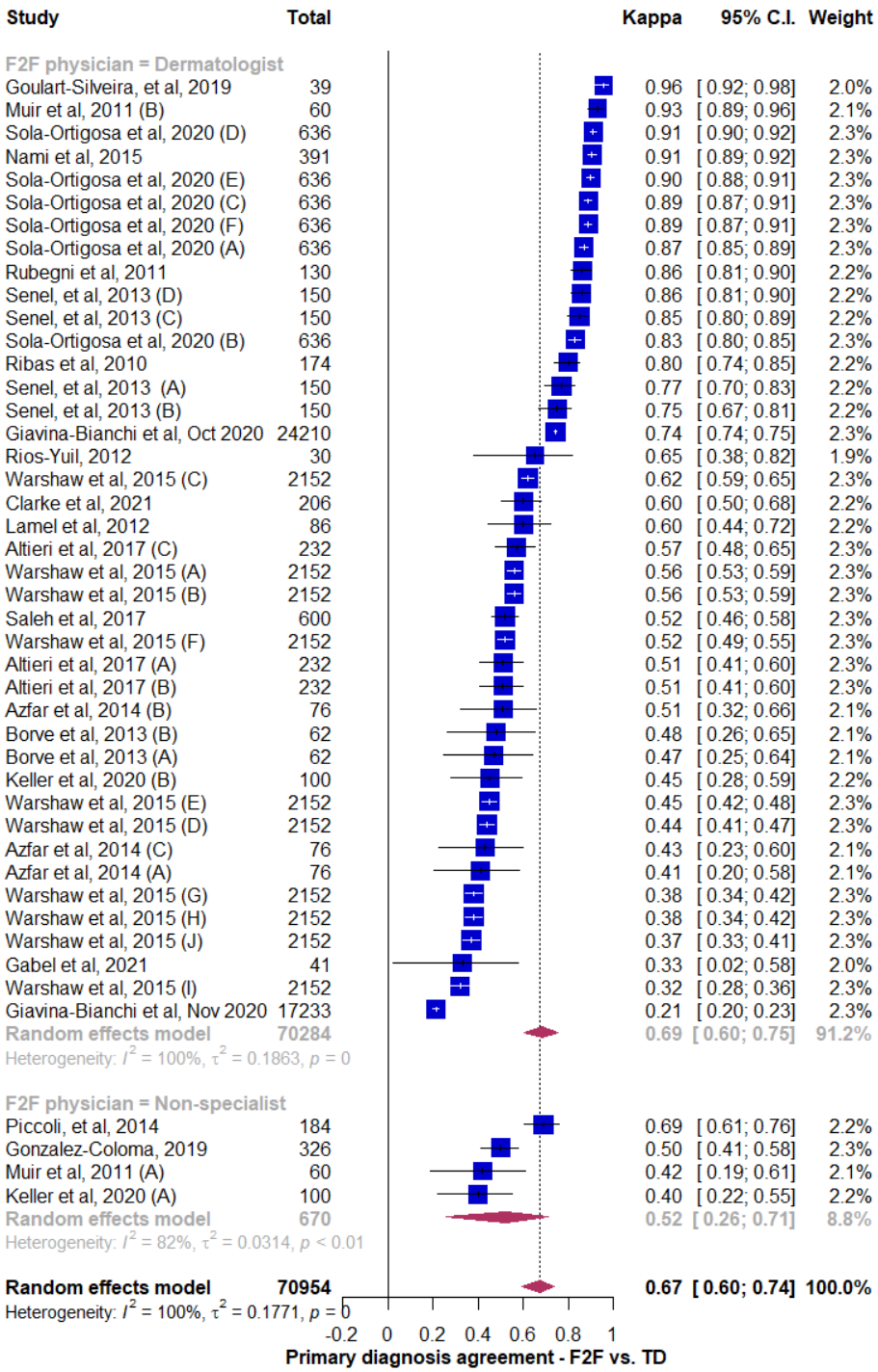
eFigure 2. Forest plot representing teledermatologists, F2F physicians, and histopathology primary diagnostic agreements. (A) Forest plot representing percentage agreement between teledermatologist and teledermatologist and 95% C.I. for overall concordance across ten studies with a total of 17 unique number of comparisons, N of events and total included participants. (B) Forest plot representing kappa concordance and 95% C.I. for overall concordance between two F2F physician diagnoses across four studies with a total of six unique number of comparisons, N of total included participants. (C) Forest plot representing percentage agreement between teledermatologists and histopathology with 95% C.I. for overall concordance across six studies, N of events and total included participants. Abbreviations: F2F (Face-to-Face), PCP (Primary Care Provider), TD (Teledermatology or Teledermatologist).

A



370

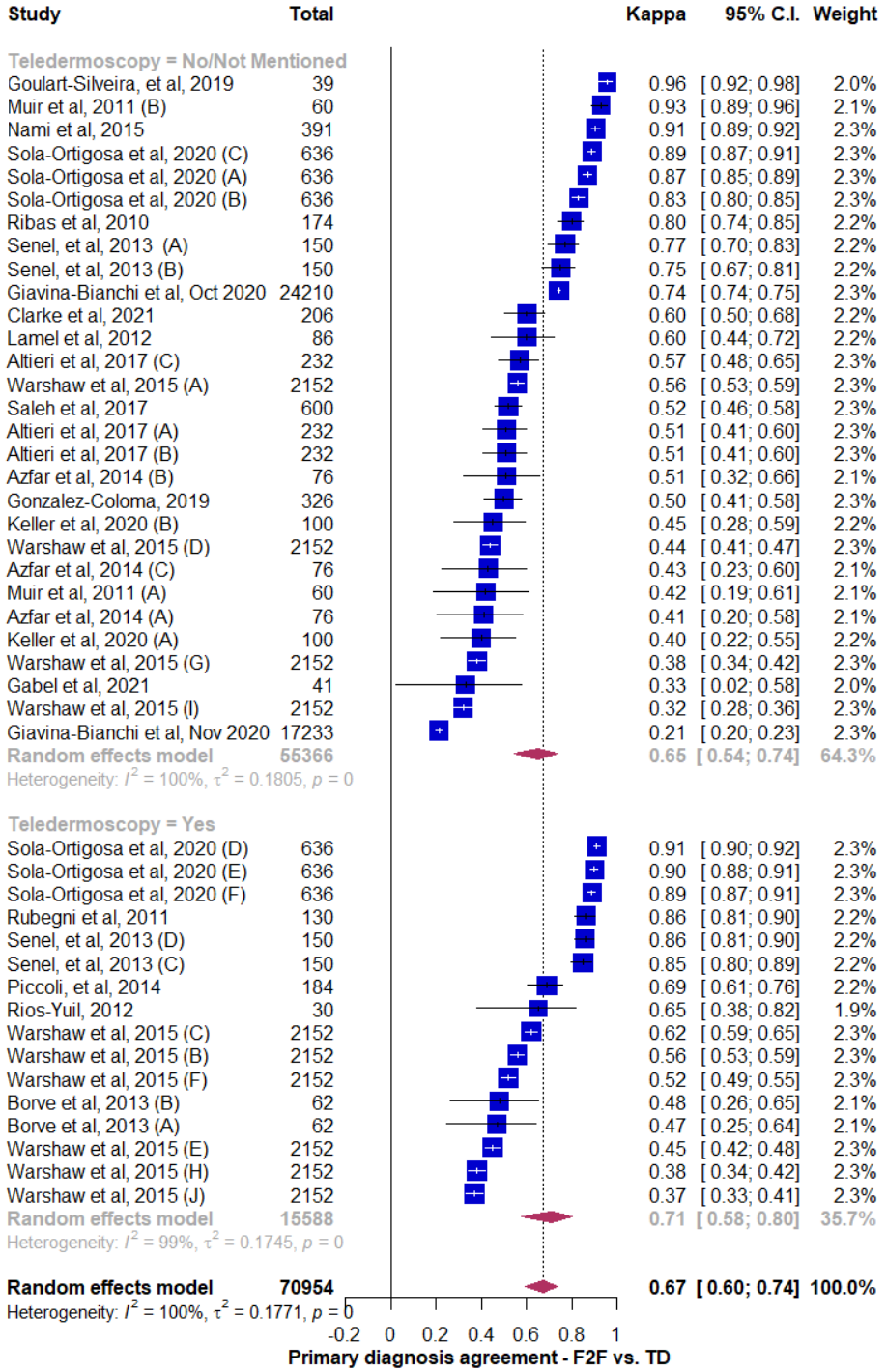
B



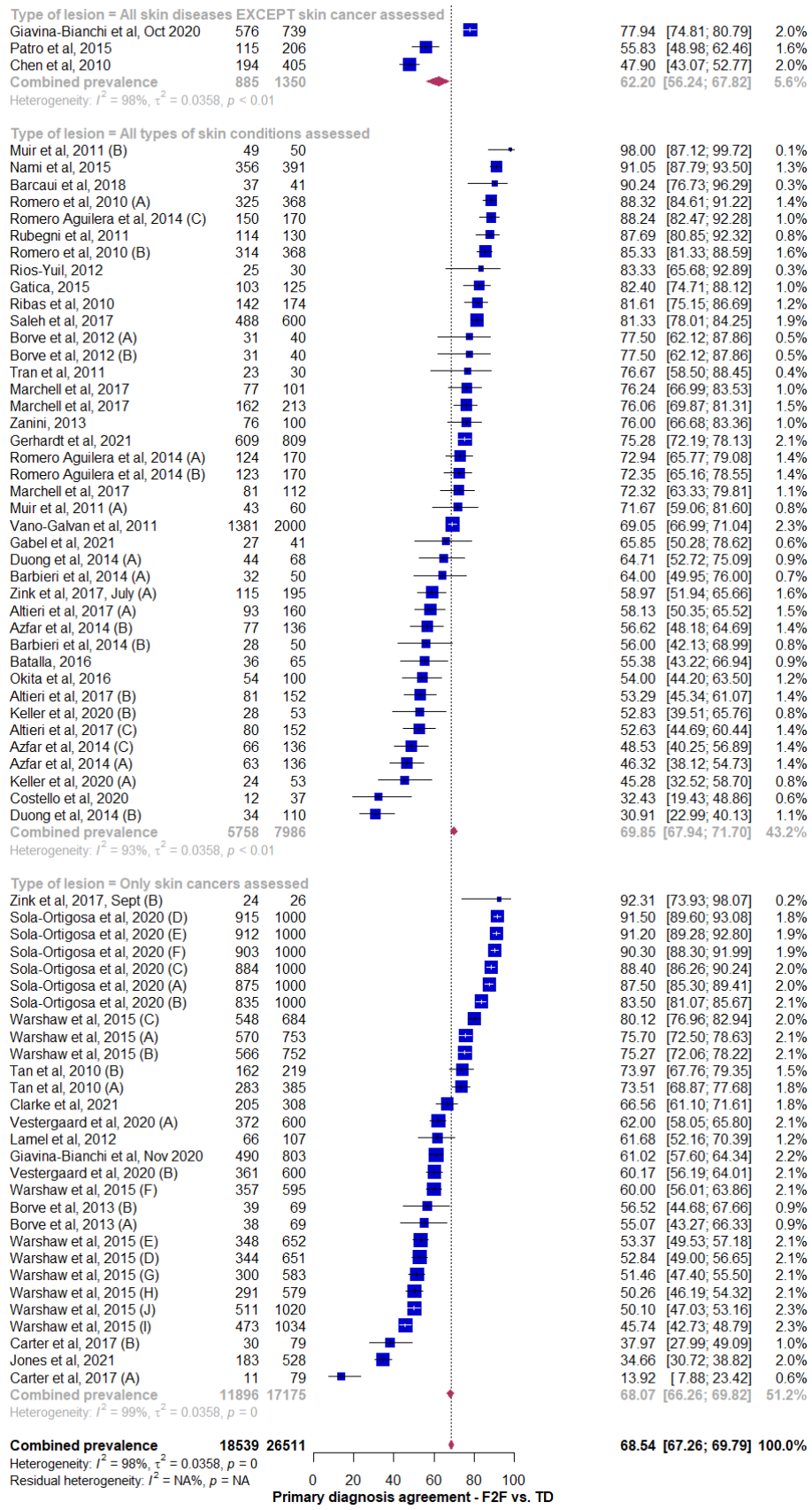
eFigure 3. Forest plot representing F2F and teledermatology primary diagnostic agreement by specialization status of the F2F physician. Studies were sorted into two groups, a) F2F diagnosis completed by a board-certified dermatologist; b) F2F diagnosis completed by a non-specialist (e.g., general practitioner). (A) Forest plot representing percentage agreement and 95% C.I. for overall concordance across 40 studies with a total of 72 unique number of comparisons, N of events and total included participants. (B) Forest plot representing kappa concordance and 95% C.I. for overall concordance across 21 studies with a total of 45 unique number of comparisons, N of total included

participants. Abbreviations: F2F (Face-to-Face), PCP (Primary Care Provider), TD (Teledermatology or Teledermatologist).

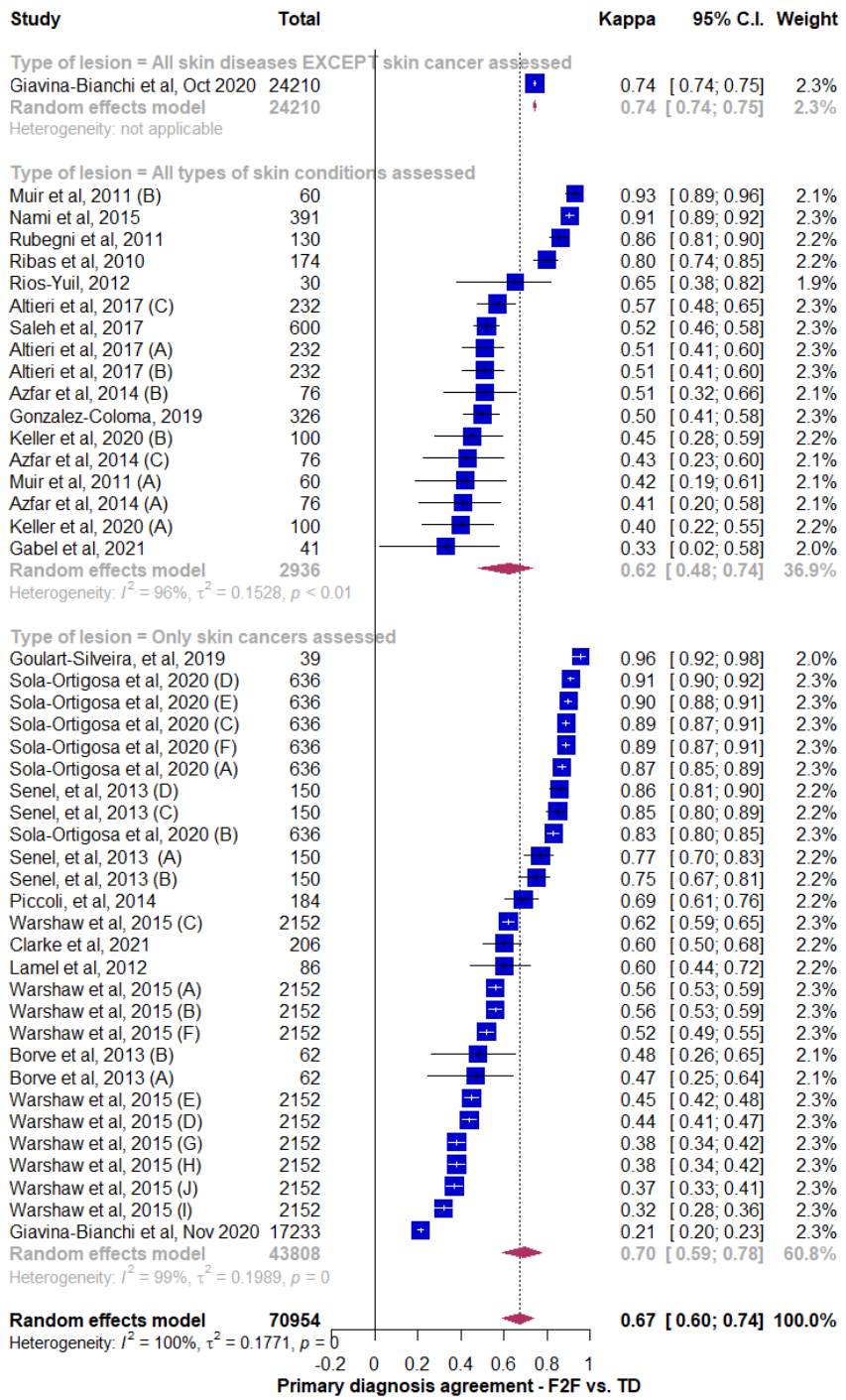
A



eFigure 4. Forest plot representing F2F and teledermatology primary diagnostic agreement by utilization of teledermoscopy. Studies were sorted into two groups, i) Did not use or did not report the use of teledermoscopy; ii) Used teledermoscopy. (A) Forest plot representing percentage agreement and 95% C.I. for overall concordance across 12 studies with a total of 22 unique number of comparisons, N of events and total included participants. (B) Forest plot representing kappa concordance and 95% C.I. for overall concordance across seven studies with a total of 16 unique number of comparisons, N of total included participants. Abbreviations: F2F (Face-to-Face), PCP (Primary Care Provider), TD (Teledermatology or Teledermatologist).



B



eFigure 5. Forest plot representing F2F and teledermatology primary diagnostic agreement by skin lesion category. Studies were sorted into three groups according to the type of lesions included, i) All skin conditions except likely malignant lesions; ii) All skin conditions; iii) Likely malignant lesions only. (A) Forest plot representing percentage agreement and 95% C.I. for overall concordance across 26 studies with a total of 39 unique number of comparisons, N of events and total included participants. (B) Forest plot representing kappa concordance and 95% C.I. for overall concordance across ten studies with a total of 27 unique number of comparisons, N of total included participants. Abbreviations: F2F (Face-to-Face), PCP (Primary Care Provider), TD (Teledermatology or Teledermatologist).

Supplementary eTables

Author, Year	Study design	Country	Funding reported	Intervention	*Outcome	Patients (n)	Female (%)	Mean Age (y)	Lesions (N)
TD vs F2F Dermatologist									
Altieri, et al, 2017	Prospective Cohort	USA	Y	TD and F2F dermatologists via clinical images taken by digital photography	Diagnostic agreement rate, Concordance	232	N/A	NA	232
Azfar, et al, 2014	Prospective Cohort	USA, Botswana	N	TD and F2F dermatologists via smartphone images	Diagnostic agreement rate, Concordance	76	57	39	159
Barbieri, et al, 2014	Prospective Cohort	USA	N	TD and F2F dermatologists via smartphone images using the AccessDerm smartphone platform	Diagnostic agreement rate	50	64	55.2	50
Barcaui, et al, 2018	Prospective Cohort	Brazil	N	TD and F2F consult by the same dermatologist via digital photography and dermoscopy images stored in WhatsApp	Diagnostic agreement rate	31	71	56.5	41
Batalla, 2015	Retrospective Cohort	Spain	N	TD and F2F dermatologists by via clinical images	Diagnostic agreement rate	183	66	9	65
Borve, et al, 2012	Prospective Cohort	Sweden	Y	TD and F2F consults by the same dermatologist via smartphone images stored in Tele-Dermis	Diagnostic agreement rate	40	57.5	49	40
Gabel, et al, 2021	Prospective Cohort	USA	Y	TD and F2F dermatologists via clinical images taken by digital photography and tablets	Diagnostic agreement rate, Concordance	41	N/A	N/A	41
Gatica, et al, 2015	Prospective Cohort	Chile	N	TD and F2F dermatologists via clinical images taken by digital photography	Diagnostic agreement rate	125	57.6	37.7	125
Gerhardt, et al, 2021	Observational	USA	Y	TD and F2F dermatologists via clinical images	Diagnostic agreement rate	809	N/A	N/A	809
Keller, et al, 2020	Prospective Cohort	USA	Y	TD and F2F dermatologists or hospitalists on clinical images taken by smartphones and tablets	Diagnostic agreement rate, Concordance	100	43.2	N/A	100
Marchell, et al., 2017	Quasi RCT	USA	Y	TD and F2F dermatologists via digital photography, compressed and uncompressed video	Diagnostic agreement rate (SFTD, video)	216	N/A	N/A	216
Muir, et al, 2011	Prospective Cohort	Australia	N	TD and F2F emergency derms and non-specialists via clinical images taken by digital photography	Diagnostic agreement rate, Concordance	50	65	47	50
Nami, et al, 2015	Prospective Cohort	Italy and Austria	Y	TD and F2F dermatologists via smartphone images stored in MugDerma	Diagnostic agreement rate, Concordance	391	52.2	54	391
Okita, et al, 2016	Prospective Cohort	Brazil	N	TD and F2F dermatologists via smartphone images	Diagnostic agreement rate	100	N/A	N/A	100
Ribas, et al, 2010	Prospective Cohort	Brazil	Y	TD and F2F dermatologists via digital photography	Diagnostic agreement rate, Concordance	174	53.4	34.7	174
Rios-Yuil, 2011	RCT	Panama	N	TD and F2F dermatologists via clinical images taken by digital photography for case conferences	Diagnostic agreement rate, Concordance	30	63.3	N/A	30
Romero Aguilera, et al, 2014	Prospective Cohort	Spain	Y	TD and F2F dermatologists via clinical images taken by digital photography stored in DERMARED.Some patients were seen by the same derm for F2F and TD.	Diagnostic agreement rate	457	56%	36	170
Romero, et al, 2010	RCT	Spain	Y	TD and F2F consults by the same dermatologist via digital photography and videoconferences via DERMARED software	Diagnostic agreement rate	328	56%	36	510
Rubegni, et al, 2011	Prospective Cohort	Italy	N	TD and F2F dermatologists via digital photography and dermoscopy images stored in Dermo-image.	Diagnostic agreement rate, Concordance	130	53.9	80.6	130
Saleh, et al, 2017	Prospective Cohort	Egypt	Y	TD and F2F dermatologists via clinical images taken by digital photography stored in Dropbox	Diagnostic agreement rate, Concordance	600	50.7	N/A	600
Tran, et al, 2011	Prospective Cohort	Egypt	Y	TD and F2F dermatologists via smartphone images stored in ClickDoc	Diagnostic agreement rate	30	N/A	N/A	30
Vano-Galvan, et al, 2010	Retrospective, Cross-sectional	Spain	N	TD and F2F dermatologists via clinical images taken by digital photography for case conferences	Diagnostic agreement rate, 100 patients each analyzed by 20 observers	100	N/A	N/A	100
Zanini, 2013	Prospective Cohort	Brazil	N	TD and F2F dermatologists via clinical images taken by digital photography	Diagnostic agreement rate	100	N/A	N/A	100
Zink, et al, 2017, July	Prospective Cohort	Germany	Y	TD and F2F dermatologists via smartphone images stored in the KLARA app	Diagnostic agreement rate	195	20.5	N/A	195

All lesions

Borve, et al, 2013	Prospective Cohort	Sweden	Y	TD and F2F consults by the same dermatologist via smartphone and dermoscopy images stored in iDoc 24 app	Diagnostic agreement rate, Concordance	62	38.7	64	69	Skin cancers only
Carter, et al, 2017	Prospective, retrospective cohort	USA	Y	TD and F2F dermatologists, as well as F2F PCP via clinical images stored using Epic EHR software	Diagnostic agreement rate	79	74	47	79	
Clarke, et al, 2021	Prospective Cohort	USA	Y	TD and F2F dermatologists via clinical images taken by digital photography stored in Research Electronic Data Capture	Diagnostic agreement rate, Concordance	206	49.5	56.9	308	
Giavina-Bianchi, et al, 2020 Nov	Retrospective Cohort	Brazil	N	TD and F2F dermatologists via smartphone images	Diagnostic agreement rate, Concordance	17,233	71.4	N/A	803	
Goulart-Silveira et al, 2019	Prospective Cohort	Brazil	N	TD and F2F dermatologists via smartphone images acquired and stored via Telederma app	Concordance	39	69	68	39	
Lamel, et al, 2012	Prospective Cohort	USA	N	TD and F2F dermatologists via smartphone images stored in ClickDerm	Diagnostic agreement rate, Concordance	86	58.1	45.2	107	
Senel, et al, 2013	Prospective Cohort	Turkey	N	TD and F2F dermatologists via digital photography and dermoscopy images	Concordance with and without dermoscopy	150	49	55	150	
Sola-Ortigosa, et al, 2020	Prospective Cohort	Spain	N	TD and F2F consults by the same dermatologist via dermoscopy and clinical images taken by digital photography and tablets	Diagnostic agreement rate, Concordance	636	43.2	72.8	1,000	
Tan, et al, 2010	Prospective Cohort	New Zealand	Y	TD and F2F consults by the same dermatologist via digital photography	Diagnostic agreement rate	200	63	N/A	491	
Vestergaard, et al, 2020	Prospective Cohort	Denmark	N	TD and F2F dermatologists via smartphone and dermoscopy images using FotoFinder Systems	Diagnostic agreement rate, Concordance	519	57	55	600	
Warshaw, et al, 2015	Prospective, Cross-sectional	USA	N	TD and F2F dermatologists via digital photography and dermoscopy images	Diagnostic agreement rate, Concordance	2,152	3.2	68	3,021	
Zink, et al, 2017, Sept	Prospective Cohort	Germany	Y	TD and F2F dermatologists via smartphone and dermoscopy images using Handyfotos	Diagnostic agreement rate	26	N/A	N/A	26	
Giavina-Bianchi, et al, 2020 Oct	Retrospective Cohort	Brazil	N	TD and F2F dermatologists via smartphone images	Diagnostic agreement rate, Concordance	24,210	70	N/A	739	B.
Author, Year	Study design	Country	Funding reported	Intervention	*Outcome	Patients (n)	Female (%)	Mean Age (y)	Lesions (N)	
TD vs F2F Non-specialist										
Costello, et al, 2019	Prospective Cross-sectional	USA	Y	TD and F2F PCP via smartphone and dermoscopy images using the Photo Exam app	Diagnostic agreement rate	37	65	47.9	37	All skin lesions
Duong, et al, 2014	Observational	France	Y	TD and F2F emergency physicians via smartphone images and videoconferences	Diagnostic agreement rate (SFTD, video)	194	N/A	N/A	178	
Gonzalez-Coloma, et al, 2019	Prospective, Cross-sectional	Chile	N	TD and F2F PCP via clinical images	Diagnostic concordance	326	59	35.8	326	
Keller, et al, 2020	Prospective Cohort	USA	Y	TD and F2F dermatologists or hospitalists on clinical images taken by smartphones and tablets	Diagnostic agreement rate, Concordance	100	43.2	N/A	100	
Muir, et al, 2011	Prospective Cohort	Australia	N	TD and F2F emergency physicians via clinical images taken by digital photography	Diagnostic agreement rate, Concordance	60	65	47	60	
Carter, et al, 2017	Prospective, retrospective cohort	USA	Y	TD and F2F dermatologists, as well as F2F PCP via clinical images stored using Epic EHR software	Diagnostic agreement rate	79	74	47	79	Skin cancers only
Jones, et al, 2021	Retrospective Cohort	New Zealand	Y	TD and F2F PCP via digital photography and dermoscopy images	SSC matched for age, sex, and ethnicity. Diagnostic agreement rate	481	64	N/A	528	
Piccoli, et al, 2015	Retrospective Cross-sectional	Brazil	Y	TD and F2F PCP via digital photography and dermoscopy images	Diagnostic concordance	184	73.4	54.7	184	
Chen, et al, 2010	Retrospective Cohort	USA	Y	TD and F2F PCP via clinical images stored in Second Opinion Software	Diagnostic agreement rate	405	50.6	5.9	405	B.
Patro, et al 2015	Prospective Cohort	India	Y	TD and F2F PCP via digital photography	Diagnostic agreement rate	206	58.7	N/A	206	

eTable 1. Study and patient characteristics for all included studies. The table is divided into two sections: one comparing teledermatology with Face-to-Face (F2F) dermatologists, and another comparing teledermatologists with F2F non-specialists. The studies are listed alphabetically and grouped by lesion type. *See supplementary **eTable 4** for agreement rates and

concordance values. Abbreviations used in the table include B (Benign lesions only), ED (Emergency Department), EHR (Electronic Health Record), F2F (Face-to-Face), Histo (Histopathology), ICD10 (International Classification of Diseases, 10th Edition), N (No), N/A (Not available), PCP (Primary Care Provider), PLD (Polarized Light Dermoscopy), RCT (Randomized Controlled Trial), SFTD (Store-and-Forward Teledermatology), SSC (Specialized Skin Clinic), TD (Teledermatology or Teledermatologist), and Y (Yes). Patient characteristics for all 44 included studies are also provided, grouped by lesion type, with a column describing special inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
Primary articles assessing diagnostic agreement where store-and-forward technology or live video conference consults were compared with a control group who attend in-person visits.	Survey articles, feasibility studies, studies regarding other forms of telemedicine unrelated to dermatology, cost-effectiveness studies, editorials, and review articles.
Primarily comparing teledermatology to F2F, sometimes using histopathology as the reference standard.	Studies that clearly stated they used telermatologists as the gold- or reference standard. Studies that only compared dermatoscopic images in the absence of clinical images. Studies where patients captured their own photographs.

eTable 2. Inclusion and exclusion criteria for screening of literature search results.
F2F: Face-to-Face.

Study characteristics Author, year, title, study type, objective, country of publication. Patient characteristics: total number of participants included declaration of funding source, number of participants per study, mean age +/- SD, age range, gender, mean BMI and range, race/ethnicity, type of lesions evaluated, type of patients evaluated.
Methodology - teledermatology and F2F consults Method of correspondence, platform used for the teledermatology consult, training on teledermatology platform, length of teledermatology and F2F consult, experience of the teledermatologist and F2F physician, location of the teledermatologist, number of teledermatologists and F2F physicians who made a diagnosis for each patient, total number of telermatologists and F2F physicians in study, order of visits, wait time between teledermatology and F2F consult, whether same specialist conducted teledermatology and F2F visit, specialization of the F2F physician, number of reviews; qualifications of the individual who acquired the clinical photographs and whether they received additional training on taking clinical photographs.
Metrics and results Technology used for image acquisition and for viewing images with, distance between camera and lesion, number of images taken, use of teledermoscopy & dermoscopy, brand of dermatoscope, use of histopathology, referral content provided to teledermatologist, primary and differential diagnoses agreement and concordance rates, diagnostic accuracy values (if available) such as sensitivity, specificity, PPV and NPV.

eTable 3. Data extraction form with details of domains record.
F2F: Face-to-Face, PPV: Positive Predictive Value, NPV: Negative Predictive Value.

Author and Year	Unique Study Grouping	Participants (n)	Lesions (N)	Primary Diagnosis Agreement F2F vs [illegible]	Diagnosis Agreement (N) / Total Diagnoses (N)	Primary Diagnosis Agreement TD vs [illegible]	Diagnosis Agreement (N) / Total Diagnoses (N)	Primary Diagnosis Agreement TD vs [illegible]	Diagnosis Agreement (N) / Total Diagnoses (N)	Primary Diagnosis Agreement TD vs Histo	Diagnosis Agreement (N) / Total Diagnoses (N)	Primary Diagnosis Kappa Value TD vs F2F	Primary Diagnosis Kappa Value TD vs Histo
Altieri et al, 2017 (A)	F2F Derm vs TD1	232	232					58	93/160			0.51	
Altieri et al, 2017 (B)	F2F Derm vs TD2	232	232					53	81/152			0.51	
Altieri et al, 2017 (C)	F2F Derm vs TD3	232	232					53	80/152			0.57	
Azfar et al, 2014 (A)	F2F Derm vs TD1	76	159					47	63/136			0.41	
Azfar et al, 2014 (B)	F2F Derm vs TD2	76	159					57	77/136			0.51	
Azfar et al, 2014 (C)	F2F Derm vs TD3	76	159					49	66/136			0.43	
Barbieri et al, 2014 (A)	F2F Derm vs TD1	50	50			58	29/50	64	32/50				
Barbieri et al, 2014 (B)	F2F Derm vs TD2	50	50					56	28/50				
Barcaui et al, 2018	F2F Derm vs TD	31	41					90	37/41				
Batalla, 2016	F2F Derm vs TD	183	183					55	36/65				
Borve et al, 2012 (A)	F2F Derm vs TD1	40	40	88	35/40	68	27/40	78	31/40				
Borve et al, 2012 (B)	F2F Derm vs TD2	40	40					78	31/40				

Borve et al, 2013 (A)	F2F Derm vs TD1	62	69	58	40/69	55	38/69			0.47	0.51
Borve et al, 2013 (B)	F2F Derm vs TD2	62	69			57	39/69			0.48	
Carter et al, 2017 (A)	F2F nonspecialist vs TD	79	79	38	30/79	14	11/79				
Carter et al, 2017 (B)	F2F Derm vs TD	79	79			38	30/79				
Chen et al, 2010	F2F nonspecialist vs TD	405	405			48	194/405				
Clarke et al, 2021	F2F Derm vs TD	206	308			67	205/308	65	40/62	0.6	
Costello et al, 2020	F2F nonspecialist vs TD	37	37			32	12/37				
Duong et al, 2014 (A)	F2F nonspecialist vs TD (Videoconference)	111	110			65	44/68				
Duong et al, 2014 (B)	F2F nonspecialist vs TD (SFTD)	111	110			31	34/110				
Gabel et al, 2021	F2F Derm vs TD	41	41			67	27/41			0.33	
Gatica, 2015	F2F Derm vs TD	125	125			82	103/125				
Gerhardt et al, 2021	F2F Derm vs TD	809	809			75	609809				
Giavina-Bianchi et al, Nov 2020	F2F Derm vs TD	17233	17233			61	490/803	54	156/289	0.21	0.09
Giavina-Bianchi et al, Oct 2020	F2F Derm vs TD	24210	27519			78	576/739			0.74	
Gonzalez-Coloma, 2019	F2F nonspecialist vs TD	326	326							0.5	
Goulart-Silveira, et al, 2019	F2F Derm vs TD	39	39							0.96	0.56
Jones et al, 2021	F2F nonspecialist vs TD (Suspicious Skin Cancer pathway)	NA	528			35	183/528	53	60/114		
Keller et al, 2020 (A)	F2F nonspecialist vs TD	100	100			45	24/53			0.4	
Keller et al, 2020 (B)	F2F Derm vs TD	100	100			53	28/53			0.45	
Lamel et al, 2012	F2F Derm vs TD	86	107			62	66/107			0.6	

Marchell et al, 2017	F2F Derm vs TD (SFTD)	216	216	91	122/134			76	162/213		
Marchell et al, 2017	F2F Derm vs TD (Uncompressed video)	216	216					76	77/101		
Marchell et al, 2017	F2F Derm vs TD (Compressed video)	216	216					72	81/112		
Muir et al, 2011 (A)	F2F nonspecialist vs TD	60	60					72	43/60		0.42
Muir et al, 2011 (B)	F2F Derm vs TD	60	60					98	49/50		0.93
Nami et al, 2015	F2F Derm vs TD	391	391					91	356/391		0.91
Okita et al, 2016	F2F Derm vs TD	100	100					54	54/100		
Patro et al, 2015	F2F nonspecialist vs TD	206	206					56	115/206		
Piccoli, et al, 2014	F2F nonspecialist vs TD	184	184								0.69
Ribas et al, 2010	F2F Derm vs TD	174	174	83	145/174	81	141/174	82	142/174		0.8
Rios-Yuil, 2012	F2F Derm vs TD	30	30					83	25/30	67	0.65
Romero Aguilera et al, 2014 (A)	F2F Derm vs TD1	457	192			69	118/170	73	124/170		
Romero Aguilera et al, 2014 (B)	F2F Derm vs TD2	457	192			73	124/170	72	123/170		
Romero Aguilera et al, 2014 (C)	F2F Derm vs TD3	457	192			67	114/170	88	150/170		
Romero et al, 2010 (A)	F2F Derm vs TD (SFTD)	457	192					88	325/368		
Romero et al, 2010 (B)	F2F Derm vs TD (SFTD and videoconferencing)	457	176					85	314/368		
Rubegni et al, 2011	F2F Derm vs TD	130	130					88	114/130		0.86
Saleh et al, 2017	F2F Derm vs TD	600	600			88	526/600	81	488/600		0.46-0.52
Senel, et al, 2013	F2F Derm vs TD1 (no dermoscopy)	150	150								0.77
Senel, et al, 2013	F2F Derm vs TD2 (no dermoscopy)	150	150								0.75

Senel, et al, 2013	F2F Derm vs TD1 (dermoscopy)	150	150									0.85
Senel, et al, 2013	F2F Derm vs TD2 (dermoscopy)	150	150									0.86
Sola-Ortigosa et al, 2020 (A)	F2F Derm vs TD1 (no dermoscopy)	636	1000			82	821/1000	88	875/1000			0.87
Sola-Ortigosa et al, 2020 (B)	F2F Derm vs TD2 (no dermoscopy)	636	1000			83	832/1000	84	835/1000			0.83
Sola-Ortigosa et al, 2020 (C)	F2F Derm vs TD3 (no dermoscopy)	636	1000			81	813/1000	88	884/1000			0.89
Sola-Ortigosa et al, 2020 (D)	F2F Derm vs TD1 (dermoscopy)	636	1000			92	915/1000	92	915/1000			0.91
Sola-Ortigosa et al, 2020 (E)	F2F Derm vs TD2 (dermoscopy)	636	1000			90	9021000	91	912/1000			0.9
Sola-Ortigosa et al, 2020 (F)	F2F Derm vs TD3 (dermoscopy)	636	1000			90	899/1000	90	903/1000			0.89
Tan et al, 2010 (A)	F2F Derm vs TD1, F2F Derm 1 vs F2F Derm 2	200	491	82	157/191	72	355/491	74	283/385			
Tan et al, 2010 (B)	F2F Derm vs TD2, F2F Derm 2 vs F2F Derm 3	200	491	76	80/106			74	162/219			
Tan et al, 2010 (C)	F2F Derm 1 vs F2F Derm 3	200	491	76	147/194							
Tran et al, 2011	F2F Derm vs TD	30	30					75	23/30			
Vano-Galvan et al, 2011	F2F Derm vs TD	100	100					69	1381/2000			
Vestergaard et al, 2020 (A)	A F2F Derm vs TD1	519	600			62	370/600	62	372/600	58	170/292	
Vestergaard et al, 2020 (B)	F2F Derm vs TD2	519	600					60	361/600	54	157/292	
Warshaw et al, 2015 (A)	F2F Derm vs TD (non biopsied pigmented lesions, Macro)	2152	3021					76	570/753			0.56
Warshaw et al, 2015 (B)	F2F Derm vs TD (non biopsied pigmented lesions, Macro+PLD)	2152	3021					75	566/752			0.56
Warshaw et al, 2015 (C)	F2F Derm vs TD (non biopsied pigmented lesions, Macro+PLD)	2152	3021					80	548/684			0.62

Warshaw et al, 2015 (D)	F2F Derm vs TD (biopsied pigmented lesions, Macro)	2152	3021	53	344/651			0.44
Warshaw et al, 2015 (E)	F2F Derm vs TD (biopsied pigmented lesions, Macro+PLD)	2152	3021	53	348/652			0.45
Warshaw et al, 2015 (F)	F2F Derm vs TD (biopsied pigmented lesions, Macro+PLD)	2152	3021	60	357/595			0.52
Warshaw et al, 2015 (G)	F2F Derm vs TD (NONbiopsied NONpigmented lesions, Macro)	2152	3021	52	300/583			0.38
Warshaw et al, 2015 (H)	F2F Derm vs TD (NONbiopsied NONpigmented lesions, Macro+PLD)	2152	3021	50	291/579			0.38
Warshaw et al, 2015 (I)	F2F Derm vs TD (biopsied NONpigmented lesions, Macro)	2152	3021	46	473/1034			0.32
Warshaw et al, 2015 (J)	F2F Derm vs TD (biopsied NONpigmented lesions, Macro+PLD)	2152	3021	50	511/1020			0.37
Zanini, 2013	F2F Derm vs TD	100	100	76	76/100			
Zink et al, 2017, July (A)	F2F Derm vs TD	195	195	59	115/195	56	108/195	
Zink et al, 2017, Sept (B)	F2F Derm vs TD	26	26	92	24/26	67	17/26	

eTable 4. Included unique study groupings and letter codes for individual agreement rates and kappa concordance values. The abbreviations used in the text are as follows: TD (Teledermatology or Teledermatologist), Derm (Dermatologist), F2F (Face-to-Face), SFTD (Store and Forward Technology), PLD (Polarized Light Dermoscopy), and Macro (Macroscopic clinical images).

Study ID	Journal	Reason For Exclusion
NCT03034694, 2016	ClinicalTrials.gov	Wrong study design
Andersson et al, 2017	Lakartidningen	Wrong study design
Romero et al, 2018	Actas dermo-sifiliograficas	Wrong study design
Orruno et al, 2016	Health Technology Assessment Database	Wrong study design
Batalla et al, 2016	Piel	Wrong study design
Kroemer et al, 2011	British Journal of Dermatology	Wrong study design
Ernstberger et al, 2014	Zentralblatt fur Chirurgie	Wrong study design
Totty et al, 2018	Journal of wound care	Wrong study design
Wurm et al, 2013	Journal of Telemedicine and Telecare	Wrong study design
Wang et al, 2017	Telemedicine journal and e-health : the official journal of the American Telemedicine Association	Wrong study design
Singh et al, 2011	Australasian Journal of Dermatology	Wrong study design
Grey et al, 2017	Dermatitis	Wrong study design
Crompton et al, 2010	Journal of Visual Communication in Medicine	Wrong study design
Ali et al, 2021	JMIR formative research	Wrong study design
Boyce et al, 2011	Dermatology	Wrong study design
Berg et al, 2017	Sarcoidosis Vasculitis and Diffuse Lung Diseases	Wrong study design
Shin et al, 2014	Journal of telemedicine and telecare	Wrong study design
Gacto-Sanchez et al, 2020	Burns : journal of the International Society for Burn Injuries	Wrong study design
Tian et al, 2017	Journal of Cosmetic Dermatology	Wrong study design
Thind et al, 2011	Clinical and Experimental Dermatology	Wrong study design
Silveira et al, 2014	BMC Dermatology	Wrong study design
O'Connor et al, 2017	JAMA Dermatology	Wrong study design
Janda et al, 2020	The Lancet. Digital health	Wrong study design
Day et al, 2020	Military medicine	Wrong study design
Karlsson et al, 2015	Acta Dermato-Venereologica	Wrong study design
Seghers et al, 2015	Australasian Journal of Dermatology	Wrong study design
Hazenberg et al, 2010	Journal of Medical Engineering and Technology	Wrong study design
Borve et al, 2015	Acta Dermato-Venereologica	Wrong study design
Boissin et al, 2015	Burns	Wrong study design
Da Silva et al, 2018	Dermatology online journal	Wrong study design
Devrim et al, 2019	BMC pediatrics	Wrong study design
Danielsson et al, 2016	Health Technology Assessment Database	Wrong study design
Berglund et al, 2020	Journal of the European Academy of Dermatology and Venereology : JEADV	Wrong study design
Forsblom et al, 2013	Clinical Infectious Diseases	Wrong study design
G Bianchi et al, 2020	Journal of medical Internet research	Wrong study design
Congalton et al, 2015	Journal of the European Academy of Dermatology and Venereology	Wrong study design
Ferrandiz et al, 2012	Archives of Dermatology	Wrong study design
Ismail et al, 2018	International Journal of Women's Dermatology	Wrong study design
Gamus et al, 2019	International journal of medical informatics	Wrong study design
Paudel et al, 2020	Case reports in dermatological medicine	Wrong study design
Georgesen et al, 2020	Telemedicine journal and e-health : the official journal of the American Telemedicine Association	Wrong study design
Gagnon et al, 2015	Dermatology Times	Wrong study design
Philp et al, 2013	Pediatric Dermatology	Wrong study design
Mooney et al, 2011	Skin Research and Technology	Wrong study design
Do Khac et al, 2021	JMIR mHealth and uHealth	Wrong study design
Chambers et al, 2012	Journal of the American Academy of Dermatology	Wrong study design
Garcia-Romero et al, 2011	Telemedicine journal and e-health : the official journal of the American Telemedicine Association	Wrong study design
Ahmed et al, 2020	Annals of internal medicine	Wrong study design
Marwaha et al, 2019	Journal of the American Academy of Dermatology	Wrong study design
NCT02122432, 2014	ClinicalTrials.gov	Wrong study design
Lowe et al, 2021	Clinical and experimental dermatology	Wrong study design

Bowling et al, 2011	Wound Repair and Regeneration	Wrong study design
Marin-Gomez et al, 2020	Journal of primary care & community health	Wrong study design
Veronese et al, 2021	Diagnostics (Basel, Switzerland)	Wrong study design
Ismail et al, 2018	International journal of dermatology	Wrong study design
NCT02905851, 2016	ClinicalTrials.gov	Wrong study design
Trinidad et al, 2020	Journal of the American Academy of Dermatology	Wrong study design
Tensen et al, 2019	Studies in health technology and informatics	Wrong study design
Karavan et al, 2014	Journal of telemedicine and telecare	Wrong study design
Viola et al, 2011	Archives of Dermatology	Wrong study design
van Netten et al, 2017	Scientific reports	Wrong study design
Cai et al, 2016	Burns : journal of the International Society for Burn Injuries	Wrong study design
Hazenberg et al, 2010	Diabetes Technology and Therapeutics	Wrong study design
Jacoby et al, 2021	Journal of drugs in dermatology : JDD	Wrong study design
Pak et al, 2018	Wound repair and regeneration : official publication of the Wound Healing Society [and] the European Tissue Repair Society	Wrong study design
Kummerow Broman et al, 2019	JAMA surgery	Wrong study design
Munoz-Lopez et al, 2021	Journal of the European Academy of Dermatology and Venereology : JEADV	Wrong study design
Markun et al, 2017	Medicine	Wrong study design
Piette et al, 2017	Journal of telemedicine and telecare	Wrong study design
Tan et al, 2010	British Journal of Dermatology	Wrong study design
Watson et al, 2010	Archives of Dermatology	Wrong study design
Wiseman et al, 2016	Journal of vascular surgery. Venous and lymphatic disorders	Wrong study design
Wolf et al, 2013	JAMA dermatology	Wrong study design
Laggis et al, 2020	The American Journal of dermatopathology	Wrong study design
Kazi et al, 2021	Telemedicine journal and e-health : the official journal of the American Telemedicine Association	Wrong study design
Kanthraj et al, 2013	Indian Journal of Dermatology, Venereology and Leprology	Wrong study design
Shah et al, 2016	Journal of the American Academy of Dermatology	Wrong study design
Kim et al, 2018	Skin research and technology	Wrong study design
Nguyen et al, 2017	Journal of Clinical and Aesthetic Dermatology	Wrong study design
Rizvi et al, 2020	PloS one	Wrong study design
Mehrtens et al, 2019	Clinical and experimental dermatology	Wrong study design
Knudsen et al, 2012	Lakartidningen	Research letter or letter to the editor
Korman et al, 2020	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Mercer et al, 2014	Journal of Cutaneous Medicine and Surgery	Research letter or letter to the editor
Grunig et al, 2015	JAMA Dermatology	Research letter or letter to the editor
Cartron et al, 2020	Dermatologic therapy	Research letter or letter to the editor
McAfee et al, 2020	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Wong et al, 2021	JAMA dermatology	Research letter or letter to the editor
Baranowski et al, 2020	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Micheletti et al, 2014	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Osei-Tutu et al, 2013	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Nair et al, 2015	International Journal of Dermatology	Research letter or letter to the editor
Miller et al, 2021	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Keleshian et al, 2017	Journal of the American Academy of Dermatology	Research letter or letter to the editor
HAYES; Inc et al, 2016	Health Technology Assessment Database	Research letter or letter to the editor
Jacob et al, 2017	Journal of telemedicine and telecare	Research letter or letter to the editor
Perkins et al, 2020	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Halpern et al, 2010	British Journal of Dermatology	Research letter or letter to the editor
Newman et al, 2020	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Hunt et al, 2020	Clinical and experimental dermatology	Research letter or letter to the editor
2018	Nursing	Research letter or letter to the editor
Taneja et al, 2021	Indian journal of dermatology, venereology and leprology	Research letter or letter to the editor
Echeverria-Garcia et al, 2019	Actas dermo-sifiliograficas	Research letter or letter to the editor
Henning et al, 2010	Archives of Dermatology	Research letter or letter to the editor

Demo et al, 2019	Clinical and experimental dermatology	Research letter or letter to the editor
Byamba et al, 2015	British Journal of Dermatology	Research letter or letter to the editor
Gupta et al, 2020	Journal of the American Academy of Dermatology	Research letter or letter to the editor
De Giorgi et al, 2017	Journal of the European Academy of Dermatology and Venereology	Research letter or letter to the editor
Duong et al, 2016	Annales de Dermatologie et de Venereologie	Research letter or letter to the editor
Mortimer et al, 2021	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Gravely et al, 2010	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Choi et al, 2021	International journal of dermatology	Research letter or letter to the editor
Motley et al, 2012	BMJ: British Medical Journal (Clinical Research Edition)	Research letter or letter to the editor
Leavitt et al, 2016	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Cheng et al, 2020	Dermatitis : contact, atopic, occupational, drug	Research letter or letter to the editor
Clark et al, 2021	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Fuesl et al, 2010	MMW-Fortschritte der Medizin	Research letter or letter to the editor
English III et al, 2013	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Cotes et al, 2021	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Abi Rafeh et al, 2021	Journal of cutaneous medicine and surgery	Research letter or letter to the editor
Okeke et al, 2020	The Journal of dermatological treatment	Research letter or letter to the editor
Splete et al, 2014	Emergency Medicine (00136654)	Research letter or letter to the editor
Khosravi et al, 2021	Clinical and experimental dermatology	Research letter or letter to the editor
Sivesind et al, 2021	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Stoecker et al, 2013	JAMA dermatology	Research letter or letter to the editor
Skayem et al, 2020	Journal of the European Academy of Dermatology and Venereology : JEADV	Research letter or letter to the editor
Su et al, 2020	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Massone et al, 2021	Anais brasileiros de dermatologia	Research letter or letter to the editor
Li et al, 2021	The Journal of infection	Research letter or letter to the editor
Afanasiev et al, 2021	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Varma et al, 2011	British Journal of Dermatology	Research letter or letter to the editor
Van Der Heijden et al, 2010	Journal of the European Academy of Dermatology and Venereology	Research letter or letter to the editor
Motley et al, 2012	BMJ (Online)	Research letter or letter to the editor
Villani et al, 2020	Dermatologic therapy	Research letter or letter to the editor
Portnoy et al, 2018	The journal of allergy and clinical immunology. In practice	Research letter or letter to the editor
Tschandl et al, 2018	British Journal of Dermatology	Research letter or letter to the editor
Poolworaluk et al, 2020	Future healthcare journal	Research letter or letter to the editor
Anonymous et al, 2020	Journal of drugs in dermatology : JDD	Research letter or letter to the editor
Tan et al, 2021	Annals of the Academy of Medicine, Singapore	Research letter or letter to the editor
Silva et al, 2021	Anais brasileiros de dermatologia	Research letter or letter to the editor
de Giorgi et al, 2016	International Journal of Dermatology	Wrong outcomes
Senel et al, 2014	Journal of telemedicine and telecare	Wrong outcomes
Goodier et al, 2021	Contact dermatitis	Wrong outcomes
Foolad et al, 2017	International Journal of Dermatology	Wrong outcomes
Wells et al, 2020	The Journal of clinical and aesthetic dermatology	Wrong outcomes
Arzberger et al, 2016	Acta Dermato-Venereologica	Wrong outcomes
Creighton-Smith et al, 2017	International Journal of Dermatology	Wrong outcomes
Marwaha et al, 2019	Journal of the American Academy of Dermatology	Wrong outcomes
Pasquali et al, 2021	Actas dermo-sifiliograficas	Wrong outcomes
Vestergaard et al, 2020	Family practice	Wrong outcomes
Kravets et al, 2018	Acta dermatovenerologica Alpina, Pannonica, et Adriatica	Wrong outcomes
Speiser et al, 2014	American Journal of Dermatopathology	Wrong outcomes
N/A	Journal of the American Academy of Dermatology	Wrong outcomes
Whited et al, 2013	Journal of Telemedicine and Telecare	Wrong outcomes

Abhishek et al, 2021	medRxiv	Wrong outcomes
Villa et al, 2020	Internal and emergency medicine	Wrong outcomes
Lubeek et al, 2016	Tijdschrift voor gerontologie en geriatrie	review
Ndegwa et al, 2016	Health Technology Assessment Database	review
Moreno-Ramirez et al, 2017	Acta dermato-venereologica	review
Moreno-Ramirez et al, 2017	Acta Dermato-Venereologica	review
Van Der Heijden et al, 2010	Huisarts en Wetenschap	review
Walocko et al, 2017	Dermatologic Clinics	review
Roman et al, 2014	Journal of the Dermatology Nurses' Association	review
Hart et al, 2011	Telemedicine journal and e-health : the official journal of the American Telemedicine Association	review
Elsner et al, 2020	Journal der Deutschen Dermatologischen Gesellschaft = Journal of the German Society of Dermatology : JDDG	review
Kaliyadan et al, 2020	Indian journal of dermatology	review
Burch et al,		review
Evans et al, 2017	Pharmazeutische Zeitung	Editorial
Anonymous. et al, 2016	Journal of AHIMA / American Health Information Management Association	Editorial
Luk et al, 2018	Hong Kong Journal of Dermatology and Venereology	Editorial
Queen et al, 2018	International wound journal	Editorial
Anguita et al, 2014	Nurse Prescribing	Editorial
Haworth et al, 2020	Clinical and experimental dermatology	Editorial
Romero-Aguilera et al, 2019	Actas dermo-sifiliograficas	Editorial
Barrio Garde et al, 2016	Piel	Editorial
Morand et al, 2010	Annales de dermatologie et de venereologie	Editorial
N/A	Journal of the American Academy of Dermatology	Abstract
N/A	Journal of the American Academy of Dermatology	Abstract
Bianchi et al, 2020	Journal of the American Academy of Dermatology	Abstract
Creadore et al, 2020	Journal of the American Academy of Dermatology	Abstract
N/A	Journal of the American Academy of Dermatology	Abstract
Tognetti L et al, 2020		Abstract
SPLETE et al, 2014	Emergency Medicine (00136654)	Abstract
N/A	Journal of the American Academy of Dermatology	Abstract
Dahlen Gyllencreutz et al, 2017	Journal of the European Academy of Dermatology and Venereology	Wrong intervention
Tandjung et al, 2015	Journal of Evaluation in Clinical Practice	Wrong intervention
Paradela-De-La-Morena et al, 2015	European Journal of Dermatology	Wrong intervention
Horsham et al, 2015	British Journal of Dermatology	Wrong intervention
Saenz et al, 2018	International Journal of Telemedicine and Applications	Wrong intervention
Kochmann et al, 2016	Telemedicine journal and e-health : the official journal of the American Telemedicine Association	Wrong comparator
Markun et al, 2017	Medicine (United States)	Wrong comparator
Feigenbaum et al, 2017	Pediatric Dermatology	Wrong comparator
Massone et al, 2014	Journal of the European Academy of Dermatology and Venereology	Wrong comparator
MacLellan et al, 2021	Journal of the American Academy of Dermatology	Wrong comparator
Koysombat et al, 2021	Journal of plastic, reconstructive & aesthetic surgery : JPRAS	Corrrespondence
Jakhar et al, 2020	Clinical and experimental dermatology	Corrrespondence
Alkmim et al, 2013	Journal of Telemedicine and Telecare	Corrrespondence
NCT02836665, 2016	ClinicalTrials.gov	Clinical trial - no associated manuscript
JPRN-UMIN000020873 et al, 2016		Clinical trial - no associated manuscript
Fogel et al, 2016	Journal of the American Academy of Dermatology	Commentary
Hoyer et al, 2020	Cutis	Commentary
Pasadyn et al, 2020	Journal of the American Academy of Dermatology	Duplicate

Moreno-Ramirez et al, 2017	American Journal of Clinical Dermatology	Erratum
Trovato et al, 2011	Eplasty	Wrong patient population
Bowns et al, 2016	Health Technology Assessment Database	Wrong publication date
Gemelas et al, 2019	Telemedicine journal and e-health : the official journal of the American Telemedicine Association	Wrong setting

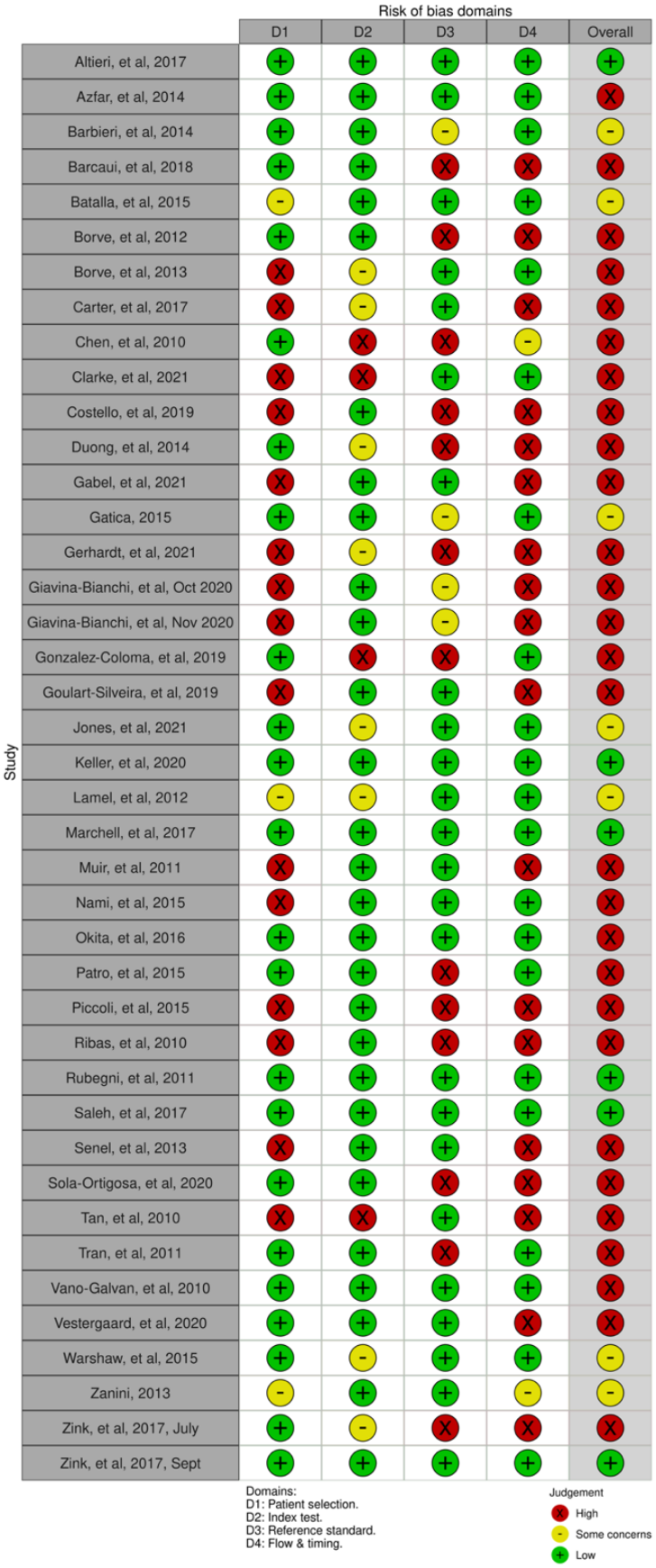
eTable 5. List of studies excluded at the full-text screening stage.

A

Domain 1: SAMPLE SELECTION		
Signalling Q1	Was a consecutive or random sample of patients enrolled? - In the study by Giavina-Bianchi et al., a consecutive sample of patients was enrolled, introducing less bias. Skewed patient demographics: e.g., over 70% female, select age groups, studies. that do not disclose age range and or sex/gender of the patients. - In the study by Carter et al., over 70% of the patients were female, which may introduce bias and reduce applicability.	Yes/No/Unclear
Signalling Q2	Was a case-control design avoided? - Gabel et al. avoided a case-control design, which reduces the risk of bias.	Yes/No/Unclear
Signalling Q3	Did the study avoid inappropriate exclusions? - In the study by Giavina-Bianchi et al., complex, and severe cases were excluded, which may introduce bias and affect applicability.	Yes/No/Unclear
Risk of bias	**Could the selection of patients have introduced bias?** - For example, Giavina-Bianchi removed the most complex/severe cases and then excluded any non-skin neoplasms, and then they further filtered to only include the 10 most common skin neoplasms.	RISK: LOW/HIGH/ UNCLEAR
Concerns regarding applicability	**Is there concern that the included patients do not match the review question?** - 'High' if the study only looked at a specific lesion category such as skin cancers only, or pigmented lesions only, or if they had a skewed patient demographics (e.g., 70% female, or geriatric population only). Our study is focuses on generalizability of teledermatology in all skin conditions.	RISK: LOW/HIGH/ UNCLEAR
Domain 2: INDEX TEST (Teledermatology consult)		
Signalling Q1	Were the derms/physicians making the index diagnoses unaware of the reference diagnosis? - Same dermatologist doing F2F and teledermatology consuls? Is there blinding of dermatologists to each other's diagnoses? In the study by Tan et al., the same dermatologist performed both the F2F and teledermatology consultations, which may introduce bias if they were not blinded to each other's diagnoses.	Yes/No/Unclear
Signalling Q2	Did the study require physicians to provide a specific primary diagnosis, or were they only required to provide a general grouping, e.g., inflammatory vs. skin neoplasm. Was analysis only performed for categories instead of complete primary diagnoses (such as skin neoplasm vs basal cell carcinoma)? Did physicians use standardized referral/consult sheet with set diagnoses? Did they group similar / synonymous diagnoses (e.g dermatitis / eczema together? Was a non-specialist in charge of comparing diagnoses and deciding if there was agreement? - In the study by Warshaw et al., physicians were required to provide a categorical or pooled diagnosis (e.g., skin neoplasm instead of basal cell carcinoma), which may introduce bias and reduce applicability.	Yes/No/Unclear
Risk of bias	**Could the conduct (technology used for taking images/viewing images) or interpretation (what constituted primary diagnosis/ complete agreement) of the index test have introduced bias?**	RISK: LOW/HIGH/ UNCLEAR
Concerns regarding applicability	Is there concern that the index test, its conduct, or interpretation differ from the review question?	RISK: LOW/HIGH/ UNCLEAR
Domain 3: REFERENCE TEST (F2F, in some cases histopathology)		
Signalling Q1	Describe the reference standard and how it was conducted and interpreted:	Yes/No/Unclear

	What was the order of visits? What was the experience level and specialization of the F2F physician? Did the same dermatologist do both teledermatology and F2F consult?	
Signalling Q2	Is the reference standard likely to correctly classify the target condition?	Yes/No/Unclear
Risk of bias	**Could the reference standard, its conduct, or its interpretation have introduced bias?** - In studies where the reference standard was a consultation with a non-specialist, such as Costello et al., there is a risk of introducing bias.	RISK: LOW/HIGH/ UNCLEAR
Concerns regarding applicability	**Could the reference standard, its conduct, or its interpretation have introduced bias?** - Applicability was impacted by physician specialization.	RISK: LOW/HIGH/ UNCLEAR
Domain 4: FLOW AND TIMING		
Signalling Q1	Was there an appropriate interval between index test(s) and reference standard? - Was the time interval greater than 2 weeks? In studies where the same dermatologist did F2F and teledermatology -> Say 'No' regardless of the time between teledermatology and F2F consult. - In the study by Gerhardt et al., there was a 30-day interval between teledermatology and F2F, which may introduce bias.	Yes/No/Unclear
Signalling Q2	Did all patients receive a reference standard?	
Signalling Q3	Did all patients receive the same reference standard? - In studies like Sola-Ortigosa et al., all patients received a reference standard, either histopathology or F2F consultation. Did a paper use histopathology as the reference standard for cancer lesions but F2F for non-cancer lesions? Were all patients evaluated by physicians with similar level of experience?	Yes/No/Unclear
Signalling Q4	Were all patients included in the analysis? - In studies like Gabel et al., all patients were included in the analysis, reducing the risk of bias.	Yes/No/Unclear
Risk of bias	Could the patient flow have introduced bias?	RISK: LOW/HIGH/UNCLEAR

B



eTable 6. Risk of Bias (ROB) results.
(A) QUADAS-2 summary sheet. **(B,C)** QUADAS-2 RoB analysis of 41 observational studies. **(D,E)** ROB-2 analysis of three randomized controlled trials.

eReferences.

1. Hoyer P, Ahatov R, Ross L. Utilization of telehealth services during the COVID-19 pandemic. *Cutis* 2020;106(2):70-71. doi: https://dx.doi.org/10.12788/cutis.0034
2. Gomez Arias PJ, Arias Blanco MC, Redondo Sanchez J, et al. [Usefulness and efficiency of teledermoscopy in skin cancer management in primary care]. *Semergen* 2020;46(8):553-59. doi: https://dx.doi.org/10.1016/j.semerg.2020.06.026
3. Jacoby T, Woolard A, Chamoun S, et al. Asynchronous Teledermatology Assessment of Young Adult Acne Likely Concordant With In-Person Evaluation. *Journal of drugs in dermatology : JDD* 2021;20(4):432-35. doi: https://dx.doi.org/10.36849/JDD.2021.5688
4. McHugh ML. Interrater reliability: the kappa statistic. *Biochem Med (Zagreb)* 2012;22(3):276-82. [published Online First: 2012/10/25]
5. Altieri L, Hu J, Nguyen A, et al. Interobserver reliability of teledermatology across all Fitzpatrick skin types. *Journal of telemedicine and telecare* 2017;23(1):68-73. doi: http://dx.doi.org/10.1177/1357633X15621226
6. Castelo-Soccio L, Kovarik CL, Azfar RS, et al. Reliability and validity of mobile teledermatology in human immunodeficiency virus-positive patients in botswana a pilot study. *JAMA Dermatology* 2014;150(6):601-07. doi: http://dx.doi.org/10.1001/jamadermatol.2013.7321
7. Barbieri JS, Nelson CA, James WD, et al. The reliability of teledermatology to triage inpatient dermatology consultations. *JAMA Dermatology* 2014;150(4):419-24. doi: http://dx.doi.org/10.1001/jamadermatol.2013.9517
8. Barcaui CB, Lima PMO. Application of teledermoscopy in the diagnosis of pigmented lesions. *International Journal of Telemedicine and Applications* 2018;2018((Barcaui) Adjunct Professor of Dermatology, Faculty of Medical Sciences, State University of Rio de Janeiro, PhD in Medicine (Dermatology), University of Sao Paulo, Dermatology Department, Pedro Ernesto University Hospital, Rio de Janeiro State University):1624073. doi: http://dx.doi.org/10.1155/2018/1624073
9. Batalla A, Suh-Oh HJ, Abalde T, et al. Teledermatology in Paediatrics. Observations in daily clinical practice. *Anales de pediatria (Barcelona, Spain : 2003)* 2016;84(6):324-30. doi: http://dx.doi.org/10.1016/j.anpedi.2015.07.005
10. Borve A, Holst A, Gente-Lidholm A, et al. Use of the mobile phone multimedia messaging service for teledermatology. *Journal of Telemedicine and Telecare* 2012;18(5):292-96. doi: http://dx.doi.org/10.1258/jtt.2012.120206
11. Borve A, Terstappen K, Sandberg C, et al. Mobile teledermoscopy-there's an app for that! *Dermatology practical & conceptual* 2013;3(2):41-8. doi: https://dx.doi.org/10.5826/dpc.0302a05
12. Carter ZA, Li X, Goldman S, et al. Creation of an internal teledermatology store-and-forward system in an existing electronic health record: A pilot study in a safety-net public health and hospital system. *JAMA Dermatology* 2017;153(7):644-50. doi: http://dx.doi.org/10.1001/jamadermatol.2017.0204
13. Chen TS, Goldyne ME, Mathes EFD, et al. Pediatric teledermatology: Observations based on 429 consults. *Journal of the American Academy of Dermatology* 2010;62(1):61-66. doi: http://dx.doi.org/10.1016/j.jaad.2009.05.039
14. Clarke EL, Reichenberg JS, Ahmed AM, et al. The utility of teledermatology in the evaluation of skin lesions. *Journal of telemedicine and telecare* 2021(9506702, cpj):1357633X20987423. doi: https://dx.doi.org/10.1177/1357633X20987423
15. Costello CM, Cumsky HJL, Maly CJ, et al. Improving Access to Care Through the Establishment of a Local, Teledermatology Network. *Telemedicine journal and e-health : the official journal of the American Telemedicine Association* 2020;26(7):935-40. doi: https://dx.doi.org/10.1089/tmj.2019.0051
16. Duong TA, Cordoliani F, Julliard C, et al. Emergency department diagnosis and management of skin diseases with real-time teledermatologic expertise. *JAMA Dermatology* 2014;150(7):743-47. doi: http://dx.doi.org/10.1001/jamadermatol.2013.7792
17. Gabel CK, Nguyen E, Karmouta R, et al. Use of teledermatology by dermatology hospitalists is effective in the diagnosis and management of inpatient disease. *Journal of the American Academy of Dermatology* 2021;84(6):1547-53. doi: https://dx.doi.org/10.1016/j.jaad.2020.04.171
18. Gatica JL, Bertolo S, Morales E, et al. Store-and-forward teledermatogy in Chile: A contribution to primary health care. *Piel* 2015;30(3):148-54. doi: http://dx.doi.org/10.1016/j.piel.2014.07.007
19. Gerhardt CA, Foels R, Grewe S, et al. Assessing the Diagnostic Accuracy of Teledermatology Consultations at a Local Veterans Affairs Dermatology Clinic. *Cureus* 2021;13(6):e15406. doi: https://dx.doi.org/10.7759/cureus.15406

20. Giavina-Bianchi M, Azevedo MFD, Sousa RM, et al. Part II: Accuracy of Teledermatology in Skin Neoplasms. *Frontiers in medicine* 2020;7(101648047):598903. doi: https://dx.doi.org/10.3389/fmed.2020.598903
21. Giavina-Bianchi M, Sousa R, Cordioli E. Part I: Accuracy of Teledermatology in Inflammatory Dermatoses. *Frontiers in medicine* 2020;7(101648047):585792. doi: https://dx.doi.org/10.3389/fmed.2020.585792
22. Keller JJ, Johnson JP, Latour E. Inpatient teledermatology: Diagnostic and therapeutic concordance among a hospitalist, dermatologist, and teledermatologist using store-and-forward teledermatology. *Journal of the American Academy of Dermatology* 2020;82(5):1262-67. doi: https://dx.doi.org/10.1016/j.jaad.2020.01.030
23. Lamel SA, Haldeman KM, Ely H, et al. Application of mobile teledermatology for skin cancer screening. *Journal of the American Academy of Dermatology* 2012;67(4):576-81. doi: http://dx.doi.org/10.1016/j.jaad.2011.11.957
24. Muir J, Xu C, Singh P, et al. Incorporating teledermatology into emergency medicine. *EMA - Emergency Medicine Australasia* 2011;23(5):562-68. doi: http://dx.doi.org/10.1111/j.1742-6723.2011.01443.x
25. Nami N, Rubegni P, Fimiani M, et al. Concordance and Time Estimation of Store-and-Forward Mobile Teledermatology Compared to Classical Face-to-Face Consultation. *Acta Dermato-Venereologica* 2015;95(1):35-39. doi: http://dx.doi.org/10.2340/00015555-1876
26. Okita AL, Molina Tinoco LJ, Criado PR, et al. Use of Smartphones in Telemedicine: Comparative Study Between Standard and Teledermatological Evaluation of High-Complex Care Hospital Inpatients. *Telemedicine journal and e-health : the official journal of the American Telemedicine Association* 2016;22(9):755-60. doi: http://dx.doi.org/10.1089/tmj.2015.0086
27. Patro BK, Tripathy JP, De D, et al. Diagnostic agreement between a primary care physician and a teledermatologist for common dermatological conditions in North India. *Indian dermatology online journal* 2015;6(1):21-6. doi: https://dx.doi.org/10.4103/2229-5178.148927
28. Ribas J, Schettini APM, Ribas CBDR, et al. Agreement between dermatological diagnoses made by live examination compared to analysis of digital images. *Anais Brasileiros de Dermatologia* 2010;85(4):441-47. doi: http://dx.doi.org/10.1590/s0365-05962010000400004
29. Rios-Yuil JM. [Correlation between face-to-face assessment and telemedicine for the diagnosis of skin disease in case conferences]. *Actas dermo-sifiliograficas* 2012;103(2):138-43. doi: https://dx.doi.org/10.1016/j.ad.2011.05.011
30. Romero Aguilera G, Cortina De La Calle P, Vera Iglesias E, et al. Interobserver reliability of store-and-forward teledermatology in a clinical practice setting. *Actas Dermo-Sifiliograficas* 2014;105(6):605-13. doi: http://dx.doi.org/10.1016/j.adengl.2014.05.018
31. Romero G, Sanchez P, Garcia M, et al. Randomized controlled trial comparing store-and-forward teledermatology alone and in combination with web-camera videoconferencing. *Clinical and Experimental Dermatology* 2010;35(3):311-17. doi: http://dx.doi.org/10.1111/j.1365-2230.2009.03503.x
32. Rubegni P, Nami N, Poggiali S, et al. Geriatric teledermatology: Store-and-forward vs. face-to-face examination. *Journal of the European Academy of Dermatology and Venereology* 2011;25(11):1334-39. doi: http://dx.doi.org/10.1111/j.1468-3083.2011.03986.x
33. Saleh N, Abdel Hay R, Hegazy R, et al. Can teledermatology be a useful diagnostic tool in dermatology practice in remote areas? An Egyptian experience with 600 patients. *Journal of telemedicine and telecare* 2017;23(2):233-38. doi: http://dx.doi.org/10.1177/1357633X16633944
34. Sola-Ortigosa J, Munoz-Santos C, Masat-Tico T, et al. The Role of Teledermatology and Teledermoscopy in the Diagnosis of Actinic Keratosis and Field Cancerization. *The Journal of investigative dermatology* 2020;140(10):1976-84.e4. doi: https://dx.doi.org/10.1016/j.jid.2020.02.013
35. Tan E, Yung A, Oakley A, et al. Successful triage of patients referred to a skin lesion clinic using teledermoscopy (IMAGE IT trial). *British Journal of Dermatology* 2010;162(4):803-11. doi: http://dx.doi.org/10.1111/j.1365-2133.2010.09673.x
36. Tran K, Ayad M, Monir S, et al. Mobile teledermatology in the developing world: Implications of a feasibility study on 30 Egyptian patients with common skin diseases. *Journal of the American Academy of Dermatology* 2011;64(2):302-09. doi: http://dx.doi.org/10.1016/j.jaad.2010.01.010
37. Vano-Galvan S, Aguayo-Leiva I, Rios-Buceta L, et al. Store-and-forward teledermatology: Assessment of validity in a series of 2000 observations. *Actas Dermo-Sifiliograficas* 2011;102(4):277-83. doi: http://dx.doi.org/10.1016/S1578-2190(11)70803-4
38. Vestergaard T, Prasad SC, Schuster A, et al. Diagnostic accuracy and interobserver concordance: teledermoscopy of 600 suspicious skin lesions in Southern Denmark. *Journal of the European Academy of Dermatology and Venereology : JEADV* 2020;34(7):1601-08. doi: https://dx.doi.org/10.1111/jdv.16275

39. Gravely AA, Warshaw EM, Nelson DB. Reliability of store and forward teledermatology for skin neoplasms. *Journal of the American Academy of Dermatology* 2015;72(3):426-35. doi: http://dx.doi.org/10.1016/j.jaad.2014.11.001
40. Zanini M. Analyze of diagnostic concordance between face-to-face and teledermatology diagnosis. *Medicina Cutanea Ibero-Latino-Americana* 2013;41(2):60-62. doi: http://dx.doi.org/10.4464/MC.2013.41.2.5058
41. Zink A, Kolbinger A, Leibl M, et al. The value of teledermatology using a mobile app compared to conventional dermatology. *European Journal of Dermatology* 2017;27(4):429-31. doi: http://dx.doi.org/10.1684/ejd.2017.3044
42. Zink A, Kolbinger A, Leibl M, et al. Teledermoscopy by mobile phones: Reliable help in the diagnosis of skin lesions? *Hautarzt* 2017;68(11):890-95. doi: http://dx.doi.org/10.1007/s00105-017-4042-0
43. Marchell R, Locatis C, Liu W-L, et al. Comparing High Definition Live Interactive and Store-and-Forward Consultations to In-Person Examinations. *Telemedicine journal and e-health : the official journal of the American Telemedicine Association* 2017;23(3):213-18. doi: http://dx.doi.org/10.1089/tmj.2016.0093
44. Jones L, Jameson M, Oakley A. Remote Skin Cancer Diagnosis: Adding Images to Electronic Referrals Is More Efficient Than Wait-Listing for a Nurse-Led Imaging Clinic. *Cancers (Basel)* 2021;13(22) doi: 10.3390/cancers13225828 [published Online First: 2021/11/28]
45. Gonzalez Coloma F, Sandoval Garces M, Gedda Quiroga V, et al. Teledermatology in Remote Parts of Chile: Experience in 4 Isolated Rural Areas. *Actas dermo-sifiliograficas* 2019;110(8):653-58. doi: https://dx.doi.org/10.1016/j.ad.2019.01.009
46. Goulart Silveira CE, Carcano C, Mauad EC, et al. Call phone usefulness to improve the skin cancer screening: preliminary results and critical analysis of mobile app development. *Rural & Remote Health* 2019;19(1):1-7. doi: 10.22605/RRH4895
47. Piccoli MF, Amorim BDB, Wagner HM, et al. Teledermatology protocol for screening of Skin cancer. *Anais Brasileiros de Dermatologia* 2015;90(2):202-10. doi: http://dx.doi.org/10.1590/abd1806-4841.20153163
48. Senel E, Baba M, Durdu M. The contribution of teledermatoscopy to the diagnosis and management of non-melanocytic skin tumours. *Journal of Telemedicine and Telecare* 2013;19(1):60-63. doi: http://dx.doi.org/10.1177/1357633X12474961
49. Gravely AA, Nelson DB, Warshaw EM. Accuracy of teledermatology/teledermoscopy and clinic-based dermatology for specific categories of skin neoplasms. *Journal of the American Academy of Dermatology* 2010;63(2):348-52. doi: http://dx.doi.org/10.1016/j.jaad.2009.10.037

This supplementary material has been provided by the authors to give readers additional information about their work.

MOOSE Checklist for Meta-analyses of Observational Studies

Item No	Recommendation	Reported on Page No
Reporting of background should include		
1	Problem definition	4
2	Hypothesis statement	4
3	Description of study outcome(s)	4-5
4	Type of exposure or intervention used	6-8
5	Type of study designs used	6-8
6	Study population	6-8
Reporting of search strategy should include		
7	Qualifications of searchers (eg, librarians and investigators)	6
8	Search strategy, including time period included in the synthesis and key words	6-8
9	Effort to include all available studies, including contact with authors	6-8
10	Databases and registries searched	6-8
11	Search software used, name and version, including special features used (eg, explosion)	6-8
12	Use of hand searching (eg, reference lists of obtained articles)	6-8
13	List of citations located and those excluded, including justification	Supplement
14	Method of addressing articles published in languages other than English	6-8
15	Method of handling abstracts and unpublished studies	6-8, Supplement
16	Description of any contact with authors	6-8, Supplement
Reporting of methods should include		
17	Description of relevance or appropriateness of studies assembled for assessing the hypothesis to be tested	9-12
18	Rationale for the selection and coding of data (eg, sound clinical principles or convenience)	9-12
19	Documentation of how data were classified and coded (eg, multiple raters, blinding and interrater reliability)	9-12
20	Assessment of confounding (eg, comparability of cases and controls in studies where appropriate)	9-12
21	Assessment of study quality, including blinding of quality assessors, stratification or regression on possible predictors of study results	9-12
22	Assessment of heterogeneity	9-12
23	Description of statistical methods (eg, complete description of fixed or random effects models, justification of whether the chosen models account for predictors of study results, dose-response models, or cumulative meta-analysis) in sufficient detail to be replicated	9-12
24	Provision of appropriate tables and graphics	9-12, Supplement
Reporting of results should include		
25	Graphic summarizing individual study estimates and overall estimate	Fig 1-3, Supplement
26	Table giving descriptive information for each study included	Tables 1, 2, Supplement
27	Results of sensitivity testing (eg, subgroup analysis)	9-12
28	Indication of statistical uncertainty of findings	9-12

Item No	Recommendation	Reported on Page No
Reporting of discussion should include		
29	Quantitative assessment of bias (eg, publication bias)	9-12
30	Justification for exclusion (eg, exclusion of non-English language citations)	9-12
31	Assessment of quality of included studies	9-12
Reporting of conclusions should include		
32	Consideration of alternative explanations for observed results	13-17
33	Generalization of the conclusions (ie, appropriate for the data presented and within the domain of the literature review)	13-17
34	Guidelines for future research	13-17
35	Disclosure of funding source	18

From: Stroup DF, Berlin JA, Morton SC, et al, for the Meta-analysis Of Observational Studies in Epidemiology (MOOSE) Group. Meta-analysis of Observational Studies in Epidemiology. A Proposal for Reporting. *JAMA*. 2000;283(15):2008-2012. doi: 10.1001/jama.283.15.2008.

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	p1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	p3-4
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	p5-6
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	p5-6
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	p8, Supplementary p15
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	p7
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Supplementary p2
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	p8
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	p8
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Supplementary p15
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	p8 and Supplementary p15
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	p9
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	p8-9
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	p8-9
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	p 8-9 Supplementary p2
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	p 8-9 Supplementary p2
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	p 8-9 Supplementary p2
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	p 8-9 Supplementary p2
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	NA
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	p9
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	NA

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Figure 1, p10
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Supplementary p23-3
Study characteristics	17	Cite each included study and present its characteristics.	p10-11, Table 1, 2
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	p15, Supplementary eTable 5
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	p15, Supplementary eTable 5
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Figure 2, 3, Supplementary eFigure 1-5
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	p 11-13 Supplementary p3
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	p 11-13 Supplementary p3
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	NA
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Supplementary eTable 5
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	p 11-13 Supplementary p3
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	p14
	23b	Discuss any limitations of the evidence included in the review.	p15-16
	23c	Discuss any limitations of the review processes used.	p16
	23d	Discuss implications of the results for practice, policy, and future research.	p17
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	p7
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	p7
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	NA
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	p18
Competing interests	26	Declare any competing interests of review authors.	p18
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

BMJ Open

Diagnostic Reliability in Teledermatology: A Systematic Review and a Meta-Analysis

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2022-068207.R2
Article Type:	Original research
Date Submitted by the Author:	12-Jul-2023
Complete List of Authors:	Bourkas, Adrienn; Queen's University School of Medicine Barone, Natasha; McGill University Montreal, Faculty of Medicine and Health Sciences Bourkas, Matthew; University of Toronto, Department of Biochemistry Mannarino, Matthew; McGill University, Department of Surgery Fraser, Robert; Western University Arthur Labatt Family School of Nursing, Nursing; Swift Medical Lorincz, Amy; Independent researcher Wang, Sheila; McGill University Department of Medicine, Dermatology; Swift Medical Ramirez-GarciaLuna, Jose; McGill University, Department of Surgery
Primary Subject Heading:	Dermatology
Secondary Subject Heading:	Health informatics, General practice / Family practice
Keywords:	Telemedicine < BIOTECHNOLOGY & BIOINFORMATICS, DERMATOLOGY, PRIMARY CARE, Information technology < BIOTECHNOLOGY & BIOINFORMATICS, STATISTICS & RESEARCH METHODS

I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our licence.

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which Creative Commons licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

Title: Diagnostic Reliability in Teledermatology: A Systematic Review and a Meta-Analysis

Authors

Adrienn N. Bourkas*[1] (MSc), Natasha Barone*[2] (MD, MSc), Matthew E.C. Bourkas[3] (PhD), Matthew Mannarino[4] (PhD), Robert D. J. Fraser[5,6] (RN, MN), Amy Lorincz (MSc), Sheila C. Wang[5,7] (MD, PhD), Jose L. Ramirez-GarciaLuna[4] (MD, PhD)

* Authors contributed equally

Affiliations

[1]Faculty of Health Sciences, Queen's University School of Medicine, Kingston, Ontario, Canada

[2]Faculty of Medicine and Health Sciences, McGill University, Montreal, Quebec, Canada

[3]Temerty Faculty of Medicine, Department of Biochemistry, University of Toronto, Toronto, Ontario, Canada

[4]Department of Surgery, McGill University, Montreal, Quebec, Canada

[5]Swift Medical Inc., Toronto, Ontario, Canada

[6]Arthur Labatt Family School of Nursing, Western University, London, Ontario, Canada

[7]Department of Medicine, Division of Dermatology, McGill University Health Centre, Montreal, Quebec, Canada

Corresponding author

Jose L. Ramirez-GarciaLuna, MD, PhD

Research Institute-McGill University Health Centre

Montreal General Hospital 1650 Cedar Ave, Montreal, Quebec, Canada H3G 1A4

Tel: 514-934-1934 ext 44522

Email: ramirezgl@gmail.com

Abstract

Objectives: To compare teledermatology and face-to-face (F2F) agreement in primary diagnoses of dermatological conditions.

Design: Systematic Review and Meta-Analysis

Methods: MEDLINE, Embase, Cochrane Library (Wiley), CINAHL, and medRxiv were searched between January 2010 and May 2022. Observational studies and randomized clinical trials that reported percentage agreement or kappa concordance for primary diagnoses between teledermatology and F2F physicians were included. Titles, abstracts, and full-text articles were screened in duplicate. From 7,173 citations, 44 articles were included. A random-effects meta-analysis was conducted to estimate pooled estimates. Primary outcome measures were mean percentage and kappa concordance for assessing diagnostic matches between teledermatology and F2F physicians. Secondary outcome measures included the agreement between teledermatologists, F2F dermatologists, and teledermatology and histopathology results.

Results: 44 studies were extracted and reviewed. The pooled agreement rate was 68.9%, and kappa concordance was 0.67. When dermatologists conducted F2F and teledermatology consults, the overall diagnostic agreement was significantly higher at 71%, compared to 44% for non-specialists. Kappa concordance was 0.69 for teledermatologist vs specialist and 0.52 for non-specialists. Higher diagnostic agreements were also noted with image acquisition training and digital photography. The agreement rate was 76.4% between teledermatologsists, 82.4% between F2F physicians, and 55.7% between teledermatology and histopathology.

Conclusions and Relevance: Teledermatology can be an attractive option particularly in resource-poor settings. Future efforts should be placed on incorporating image acquisition training and access to high-quality imaging technologies.

Registration number: 10.17605/OSF.IO/FJDVG

Keywords: teledermatology, dermatology consultations, store-and-forward, telemedicine, remote consultation, dermatology hospitalists

Article Summary:

Strengths and limitations of this study:

- This is the most comprehensive systematic review and meta-analysis of the topic to date without language restrictions applied.
- Inclusion criteria were broad, including all types of dermatological diseases, imaging technologies, in-person physician specializations (GPs, hospitalists, and dermatologists), and the presence or absence of image acquisition training.
- The article search was limited to 2010 and later due to the recent incorporation of smartphones in teledermatology practices.
- Due to considerable heterogeneity between studies, meta-analysis and synthesis of predictors for accurate diagnoses remotely were limited even after subgrouping.

Introduction

With the emergence of COVID-19, the introduction of virtual consults in healthcare settings, especially dermatology, has been expanded to allow many patients the opportunity for equitable access to care when in-person appointments pose a challenge and risk to patients.(1) Different modalities were introduced to support teledermatology. This involves remote sharing of patient data, including synchronous video-streaming teledermatology and asynchronous sharing of still images via emails, or text messages, or store-and-forward teledermatology (SFTD).

Although both synchronous and asynchronous approaches have been shown to be cost-effective, SFTD is particularly popular as it requires fewer resources and less coordination than synchronous teledermatology.(2, 3) With the advent of higher resolution smartphone cameras, relatively minimal training is required to capture data for remote dermatologists correctly; multiple SFTD studies opted to provide no training in image capture and still found value in teledermatology.(4, 5)

There is valid concern over the reliability of teledermatology given the significant variability in diagnostic accuracy predicted across pre-pandemic research.(6) This is expected given the lack of standardization across studies and the potential for confounders across teledermatology methodologies and applications, e.g., level of training or skin lesion type. This variability in approach may benefit from an increased demand, which could provide greater impetus to optimize and standardize teledermatology.

To our knowledge, this is the first and most inclusive meta-analysis (MA) that compares teledermatology consults to face-to-face (F2F) that looked at all relevant studies without overly exclusive inclusion criteria. The primary objective of this study was to compare the reliability of teledermatology diagnoses to F2F consults, as determined by Cohen's kappa interrater agreement and total agreement rates. Teledermatology can assume important roles as a routine complement to primary care and an alternate route to the typical in-person referrals. Consequently, we wanted to determine agreement for teledermatology and all F2F consults, teledermatology and F2F primary care consults, and finally teledermatology and F2F dermatologist consults, which would arguably best capture the limitations introduced by the change in medium from F2F to teledermatology.

Additional subset analyses were performed to control for potential confounders (e.g., inflammatory vs. malignant, staff training for image acquisition, teledermoscopy, and smartphone vs digital cameras) introduced by the heterogenous methodology. The secondary objectives sought to determine the agreement rate within teledermatology diagnoses and F2F consults to provide an idea of each medium's consistency, and provide the best estimate of accuracy for the agreement rate between teledermatology and histopathology.

Methods

This study was reported in accordance with the Preferred Reported Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

Protocol Registration

Prior to the conduct of this review, a protocol which adhered to the PRISMA-protocols (i.e., PRISMA-P) guidelines was developed and then registered on Open Science Framework (OSF). Access: https://osf.io/fjdvg.(7)

Search Strategy

A comprehensive search of major bibliographic databases, MEDLINE, Embase, Cochrane Library (Wiley), CINAHL, and medRxiv was performed in August 2021. MEDLINE was searched again between August 2021 and May 2022 to screen any new articles published after our protocol was registered. The search strategy was developed by a medical librarian at Queen's University (Kingston, ON). Please see the supplementary appendix for additional information on the search strategy.

No restrictions were placed on the language or status of the publications. Search results were limited to studies published between January 2010 and May 2022 due to the novelty of incorporating smartphones in teledermatology remote consultations.(8) The International Prospective Register of Systematic Reviews (PROSPERO) and OSF were searched up to May 2022 for relevant ongoing systematic reviews using the terms 'telemedicine,' 'teledermatology,'

'dermatology,' 'diagnostic accuracy,' and 'diagnostic concordance.' Reference lists of included studies were screened to identify additional studies not captured in the search.

Eligibility Criteria

Studies evaluating the diagnostic reliability of teledermatology that reported on patients with dermatological conditions assessed by a clinician using asynchronous or synchronous telemedicine systems were included. All articles were required to compare tele- to F2F diagnoses conducted by a physician. In this context, an 'F2F physician' refers to healthcare professionals, such as dermatologists, general practitioners, or emergency department physicians, who conducted in-person assessments only. This term is used to represent the comparison group in our analyses, and these assessments may occur concurrently or sequentially with teledermatology consultations, depending on the case. Exclusion criteria encompassed survey articles, feasibility studies, non-dermatological telemedicine studies, cost-effectiveness studies, editorials, review articles, studies using teledermatology as the reference standard, studies comparing only dermatoscopic images without clinical images, and studies where patients captured their own photographs. The latter was excluded to ensure consistent image quality, enabling a more accurate comparison of diagnostic reliability between tele- and F2F methods. Included articles are summarized in **eTable 1** in the supplementary appendix. Inclusion and exclusion criteria are summarized in **eTable 2**, available in the supplementary appendix.

Data Selection & Extraction

Following the removal of duplicated citations, the titles and abstracts were screened. Following this step, a full-text assessment was conducted. At both stages, two reviewers performed screening

independently [AB and NB]. Any disagreements were resolved through consensus by the two reviewers and when necessary, through discussion with a third reviewer [JLRG].

A data collection form was created on the *Covidence* website and piloted by two reviewers [AB, NB]. Three additional reviewers assisted with data extraction [JLRG, MB, MM]. Two reviewers were assigned to each paper. One reviewer extracted all characteristics of the included literature, and the second reviewer validated the characteristics for accuracy. Any disagreements were resolved by consensus. In the supplementary appendix, **eTable 3** summarizes the information extracted from full-text articles.

Data Synthesis

This meta-analysis assessed the effectiveness of SFTD technologies and live video conferencing in diagnosing skin conditions. Outcomes regarding complete diagnostic percentage agreement rates and Cohen's kappa concordance were evaluated separately, with some studies being part of both analyses if they reported both variables. The patient, intervention type, lesion, and geographic characteristics were summarized qualitatively. Please see the supplementary appendix and **eTable 4** for more details on data synthesis and nomenclature for each study grouping.

Risk of Bias

Three reviewers [AB, NB, MB] completed the risk of bias assessment; all studies were independently reviewed. Version 2 of the Cochrane risk-of-bias tool for randomized trials (RoB 2) was used to assess the risk of bias in three randomized trials.(9, 10, 11) RoB 2 is structured into a fixed set of domains of bias, focusing on different aspects of trial design, conduct, and

reporting.(12) The Quality Assessment of Diagnostic Assessment of Diagnostic Accuracy (2nd Edition, QUADAS-2) was used to assess the risk of bias. Uncertain risk of bias was assigned to studies with insufficient information except for studies that were likely to be biased due to missing data. In the latter case, a high risk of bias was assigned.

Synthesis of Results

Statistical analysis was performed using the dmetar package in R v.4.0.1 (R Foundation for Statistical Computing, 2022). Agreement rates and Cohen's kappa concordances for unique study groupings were treated as individual and independent values. For the percentage of agreement, meta-analyses were conducted using the aggregated data, and proportions were calculated with the corresponding 95 percent confidence intervals (CI). Point-biserial correlations were utilized to calculate pooled kappa values. Statistical heterogeneity was investigated using the I^2 index and the τ^2 statistic, leading to the use of a random-effects model for overall complications with a logit transformation due to the high degree of heterogeneity. Possible sources of heterogeneity were explored through sub-group analysis, and confounding factors were controlled using meta-regression. A random-effects model, as proposed by DerSimonian and Laird, was chosen as the primary method to estimate all pooled estimates. Further details on the statistical analysis can be found in the supplementary appendix.

Patient and Public Involvement

Patients or the public were not involved in our research's design, conduct, reporting, or dissemination plans.

Results

A total of 7,173 studies were screened for eligibility of which 44 were included in this study. Of these, 40 studies reported diagnostic agreement rates (4, 5, 9, 10, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47) and 21 studies reported kappa concordance.(5, 9, 13, 14, 19, 22, 25, 28, 29, 30, 31, 32, 33, 35, 36, 37, 48, 49, 50, 51, 52) Further details are provided in the PRISMA diagram in **Figure 1**. The complete list of excluded studies can be found in the supplementary appendix, **eTable 5**.

Study and patient characteristics

eTable 1 summarizes the study and participant characteristics for the 44 included papers. Forty one of the included studies were observational, of which 32 were prospective, eight were retrospective. One study was ambispective. Two studies were randomized controlled trials and one study was a quasi-randomized trial. Studies selected for the review included a total of 52,075 patients (Range: 26 to 24,210 patients). Some patients had multiple lesions and the total number of lesions included in the study was 57,222 (Range: 26 to 27,519 lesions).

The mean age reported in 27 (61%) studies was 54.78 ± 15.69 years (Range: 0 to 100 years old). Thirty-four (77%) studies reported participant gender, with a mean of 57% females (Range: 3.2% to 74%). Only 13 (29%) studies reported information on Fitzpatrick skin types, ethnicity, or race. Twenty-eight studies (64%) included in this analysis were inclusive of all types of dermatoses, 13 (29%) studies looked specifically at suspicious lesions, and three (7%) studies excluded skin cancers completely.

Diagnostic reliability of teledermatology when compared to F2F (specialist and non-specialist) evaluation

We assessed the diagnostic reliability of teledermatology compared to F2F evaluations by analyzing diagnostic agreement rates and concordance. The overall diagnostic agreement rate ranged from 13.9% to 98.0% (mean 68.9%, CI 64.4% to 73.1%), with a concordance that ranged from 0.21 to 0.96 (mean 0.67, CI 0.60 to 0.74). See **eFigure 1** and the supplementary appendix for further details.

Sub-group analyses

Diagnostic agreement between teledermatologist and teledermatologist, F2F and F2F physicians, and teledermatology and histopathology

See supplementary appendix and **eFigure 2** for further details.

Diagnostic reliability of teledermatologist vs F2F specialist and non-specialist

Teledermatologists' 70.96% agreement rate with F2F dermatologists significantly exceeded the 44.1% rate from non-specialists ($p < 0.001$). Non-specialists consistently showed lower diagnostic concordance across studies; see supplementary appendix and **eFigure 3** for further details.

Diagnostic reliability of teledermatology vs F2F by training provided for image acquisition

Twenty studies with 37 unique comparisons explicitly provided training to those in charge of image acquisition shown in **Figure 2**.(9, 10, 11, 14, 15, 16, 19, 20, 23, 26, 29, 32, 35, 36, 37, 38,

39, 40, 41, 43, 44) The mean agreement rate between teledermatology and F2F physicians in these studies was 75.9% (CI 74.4% to 77.27%), significantly higher than the 62.1% (CI 60.5% to 63.7%) observed when no training was provided (p = 0.033, heterogeneity: I^2 = 98%). Concordance values were also higher when training was provided (mean 0.77, CI 0.66-0.84) compared to when no training was provided (mean 0.60, CI 0.49-0.69) (p = 0.01, I^2=98%).

Diagnostic reliability of teledermatology vs F2F by type of technology used for image acquisition

Approximately half of the studies with 41 unique comparisons that compared Teledermatologists with F2F physicians used digital cameras for image acquisition. Eighteen studies comparing F2F and teledermatology agreement rates with 26 unique comparisons reported the use of smartphones and tablets for image acquisition. **Figure 3** shows that the mean percentage agreement rate for digital cameras was 71.7% (CI 70.3% to 73.1% compared to 59.8% (CI 57.2% to 62.3%) for smartphones or tablets. The higher agreement rate with digital photography was statistically significant (p = 0.029, heterogeneity: I^2=98%). The concordance values for digital photography were reported for twelve studies with a mean of 0.70 (CI 0.61 to 0.76). Concordance values for smartphone or tablet technologies were reported for eight studies with a mean of 0.62 (CI 0.38 to 0.78). The higher concordance with digital photography was statistically significant (p = 0.003, heterogeneity: I^2=100%).

Other sub-group analyses

No statistically significant patterns could be identified with the inclusion of teledermoscopy in addition to clinical images (**eFigure 4**), lesion type (**eFigure 5**), grouping studies as pre- or post-

pandemic (figure not shown), or risk of bias (figure not shown). Please see the supplementary appendix for further details.

Quality assessment

The quality assessment results for risk of bias and applicability in individual studies are displayed in the supplementary appendix and **eTable 6**.

Discussion:

To our knowledge, this study constitutes the most extensive systematic review and meta-analysis on teledermatology, including 44 studies across four languages.

Our sub-group analyses revealed that agreement rates between teledermatology consultations and F2F physicians were significantly higher when dermatologists conducted in-person assessments compared to non-specialists. This finding suggests that teledermatology may be more beneficial in supplementing primary care than specialist care, as lower concordance with non-specialists indicates reduced reference test accuracy. Although we did not directly assess the impact of consulting teledermatologists on non-specialist accuracy, the included studies report high levels of non-specialist satisfaction with the teleconsultation process. In fact, 96% of non-specialists agreed that they learned about the dermatologic diagnosis, and 100% agreed that it helped patient care.(23) These results are consistent with prior research attributing high provider satisfaction to streamlined workflows, effective communication, and fast turnaround times in teledermatology.(2, 53)

The study emphasizes the importance of standardized training on image acquisition in improving agreement rates between in-person and remote care. Additionally, digital photography was linked to increased agreement rates, potentially due to enhanced image resolution and experienced staff conducting virtual consultations using standardized procedures. This suggests a crucial need for comprehensive training in image acquisition, highlighting the importance of equipping primary care providers supporting telehealth delivery with high-quality cameras and the latest smartphone models.(24, 54, 55)

Assessing agreement on the management plan is crucial in teledermatology as it serves as a triage tool for distinguishing mild/benign cases from severe/malignant/uncertain cases. Ensuring concordance in the management plan between telemedicine and face-to-face consultations is vital for optimizing patient care. Future research should explore the consistency of treatment recommendations and interventions between telemedicine and in-person consultations to further enhance the evaluation of telemedicine's effectiveness in guiding appropriate patient management.

Pathological assessment of skin lesions is the cornerstone of skin cancer diagnosis. This meta-analysis found a 55.7% (CI 53.0% to 58.4%) agreement rate between teledermatology and histopathology. This low agreement rate reflects all skin biopsies and specific diagnostic accuracy rates could not be calculated by lesion type due to the small number of studies that reported this value. Through sub-group analyses, we were able to compare cancerous and non-cancerous lesions; slightly higher concordance was seen with skin cancers compared to studies that also included non-suspicious lesions like dermatitis and psoriasis. However, the data was too heterogeneous for any significant conclusions. We also looked at the use of teledermoscopy,

another technique that could help improve the diagnostic accuracy of teledermatology for suspicious lesions, but no significant trends could be identified. These findings reflected the results of a 2016 systematic review on teledermatology.[6]

Many teledermoscopy studies grouped statistics from lesions analyzed with and without dermoscopy, preventing the assessment of the dermatoscope's incremental contributions without the influence of potentially less accurate, dermatoscope-free analysis. Supporting this explanation, the three teledermoscopy studies focused on cancer lesions demonstrated greater concordance rates than the teledermoscopy studies targeting broader lesions. One study identified agreement rates between teledermatology and F2F dermatology of 92.3% (24/26) and between teledermatology and histopathology of 66.7% (17/26), both above our identified median.(45) Another study found an agreement rate of 90% (37/41) when targeting pigmented lesions, although the rate may have been inflated due to recall bias introduced by having the same dermatologist perform teledermatology and F2F consults.(16) Finally, one study diagnosed keratotic lesions in sun-exposed areas, finding a high agreement rate of 92% (915/1000).(37) However, this study also risked bias from its experimental design, which excluded lesions with poor image quality. This fails to recapitulate the complexities of practical teledermatology, which must contend with potentially difficult image acquisition.

The 68.9% (CI 64.4% to 73.05%) combined agreement rate between teledermatology and F2F is lower than the agreement rates outlined in a recent review.(56) This suggests our greater sample size introduces more studies with poor agreement, which may better reflect the reality of adopting teledermatology at a larger scale and signal risk from a lack of standardization.(55) Our date cut-

off of 2010 means our dataset has little overlap with existing reviews, and more heavily features new relevant technologies like smartphone apps for image acquisition.(6, 57) The most recent MA(57) on teledermatology limited its dataset to studies with multiple teledermatology and F2F consults and variably choosing to filter low-frequency diagnoses from certain studies.[46]

We acknowledge several potential limitations. The heterogeneity of the data, though at first glance might limit generalizability, enhances the adaptability and applicability of teledermatology across diverse real-world contexts. Challenges exist due to the absence of stratification by study design and a limited number of randomized controlled trials. Nevertheless, our findings emphasize the critical importance of standardized processes for effective teledermatology, such as training in image acquisition, reporting guidelines, and addressing privacy concerns. Our study reveals a greater degree of heterogeneity compared to previous meta-analyses, reflecting real-world application and clinical practice, bolstering the robustness of our conclusions. We advocate for a nuanced interpretation when generalizing these findings across all settings, recognizing the demographic and technological diversity in our sample as an asset. While our attempts to filter biased studies didn't yield significant improvements to our meta-analysis model, we are mindful of the potential risk of publication bias in our review.

Furthermore, our study only included a limited number of live video conferencing studies,(11, 24, 46) and our ability to draw meaningful conclusions regarding the differences between live video conferencing and SFTD methods is therefore limited. A recent study by Duong et al. demonstrated that live video conferencing can significantly contribute to diagnosis in teledermatology by improving the quality of collected information and accuracy of the patient's status evaluation.(24)

The study found that videoconferencing significantly improved the diagnostic performance in 68.7% of cases. While these results are promising, further research is needed to explore the potential differences between clinical images and live video conferencing.

In addition, our search was limited to published literature and may have missed relevant studies in the grey literature and reports from low- and middle-income countries. Nonetheless, the variability across providers and settings underlines the need for a standardized framework to employ and assess teledermatologists. Future research is needed to explore the differences between these methods and other potential factors that may impact the efficacy of teledermatology, particularly in low- and middle-income countries. We acknowledge these limitations and encourage further research to address these gaps in the literature.

Current trends suggest that teledermatology will continue to expand, there have been many recent studies examining its accuracy without the design considerations necessary to allow comparisons beyond siloed investigations.(1) The implementation of evidence-informed processes is critical to the success of teledermatology services, and the accurate assessment of teledermatology will be required to assess which contexts it should be employed in, e.g., suspected malignancy vs. erythema.

While acknowledging the significant potential of artificial intelligence (AI) in enhancing teledermatology, particularly in areas like image recognition and diagnosis, it is crucial to note that our current study does not incorporate these aspects. The impact of AI on teledermatology, while

promising, introduces an additional layer of complexity, necessitating a dedicated, separate investigation beyond the scope of our current study.

The factors targeted by our sub-analysis are undoubtedly important to standardize with best practices requiring the inclusion of primary care provider training in image acquisition, explicitly outlined conditions where dermatoscope attachments are required, and standardized reporting with a lesion's anatomical site, size, distribution, morphology, and colour. Additional guidelines for data reporting could be designed with a mind to future research goals, e.g., the inclusion of Fitzpatrick grading to identify gaps in medical care. Finally, both clinical and research guidelines must address privacy concerns, as integrating EMR and sharing of patient images or videos presents potential vulnerabilities.

Conclusion:

This meta-analysis indicates that diagnostic agreement between remote and in-person dermatologists is acceptable in select conditions (i.e., when training for image acquisition is provided and technologies for high-quality images are used). Telemedicine adoption rates are accelerating globally, and teledermatology must be considered for enhanced accessibility, flexibility, reduced costs, and safer environments it can provide patients.

The results of this meta-analysis represent significant evidence to indicate the suitability of teledermatology for remote care, particularly as a complement to primary care, where it can serve as an intermediate step before F2F specialist consultations. Furthermore, the categorization of diagnostic concordance highlights important factors to further improve diagnostic accuracy. Additionally, it highlights the lack of standardization in teledermatology studies, calling for greater structure in clinical practice and conducting primary research.

Acknowledgements:

The authors would like to acknowledge Heba Tallah Mohammed affiliated with Swift Medical for reviewing the manuscript and adding their valuable insight. The search strategies were developed with Abdul Kareem Pullattayil (AKP), a health science librarian at Bracken Health Sciences Library Botterell Hall at Queen's University.

Author Contributions:

JLRG is the guarantor of the review and supervised study design. JLRG also contributed to data analysis and provided statistical expertise. AB and NB oversaw study design, data collection, data analysis, and original draft preparation. AB designed the search strategy with the guidance

of the medical librarian, AKP. AB, NB, MB, and MM participated in the abstract and full-text screen, data extraction, and risk of bias assessment. RDJF, AL, and SCW contributed to the draft review and editing. All authors read, provided feedback and approved the final manuscript.

Funding:

This work was supported by the Digital Technology Supercluster as part of the Telewound Care Canada project. The funder was not involved in the design or analysis of this study.

Competing interests:

RDJF is an employee, and SCW is a co-founder, chief medical officer, and shareholder of Swift Medical. JRGL and AL were formerly employees of Swift. No funding bodies have any role in study design, data collection and analysis, decision to publish, or preparation of the manuscript. All other authors declare no conflict of interest.

Data availability statement:

Data are available in a public, open access repository. All data relevant to the study are included in the article, uploaded as supplementary information, or deposited on Open Science Framework: https://osf.io/fjdvg. Data are available under the terms of the Creative Commons Zero "No rights reserved" data waiver (CC0 1.0 Public domain dedication). Our systematic review produced a large amount of information, and the arising database is available for future collaboration on additional analyses. Please contact the corresponding author with any inquiries.

Patient consent for publication:

Not required.

Ethics and dissemination

Ethics approval is not applicable for this study since no original data will be collected.

Abstract word count: 230 words; **Manuscript word count:** 3389 words

References

1. Mohammed HT, Hyseni L, Bui V, et al. Exploring the use and challenges of implementing virtual visits during COVID-19 in primary care and lessons for sustained use. PLoS One. 2021;16(6):e0253665.
2. Armstrong AW, Chambers CJ, Maverakis E, et al. Effectiveness of Online vs In-Person Care for Adults With Psoriasis: A Randomized Clinical Trial. JAMA Network Open. 2018;1(6):e183062-e.
3. Wang RH, Barbieri JS, Nguyen HP, et al. Clinical effectiveness and cost-effectiveness of teledermatology: Where are we now, and what are the barriers to adoption? Journal of the American Academy of Dermatology. 2020;83(1):299-307.
4. Okita AL, Molina Tinoco LJ, Criado PR, et al. Use of Smartphones in Telemedicine: Comparative Study Between Standard and Teledermatological Evaluation of High-Complex Care Hospital Inpatients. Telemedicine journal and e-health : the official journal of the American Telemedicine Association. 2016;22(9):755-60.
5. Saleh N, Abdel Hay R, Hegazy R, et al. Can teledermatology be a useful diagnostic tool in dermatology practice in remote areas? An Egyptian experience with 600 patients. Journal of telemedicine and telecare. 2017;23(2):233-8.
6. Finnane A, Dallest K, Janda M, et al. Teledermatology for the Diagnosis and Management of Skin Cancer: A Systematic Review. JAMA Dermatol. 2017;153(3):319-27.
7. Moher D, Shamseer L, Clarke M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. Syst Rev. 2015;4(1):1.
8. Brewer AC, Endly DC, Henley J, et al. Mobile applications in dermatology. JAMA Dermatol. 2013;149(11):1300-4.
9. Rios-Yuil JM. [Correlation between face-to-face assessment and telemedicine for the diagnosis of skin disease in case conferences]. Actas dermo-sifiliograficas. 2012;103(2):138-43.
10. Romero Aguilera G, Cortina De La Calle P, Vera Iglesias E, et al. Interobserver reliability of store-and-forward teledermatology in a clinical practice setting. Actas Dermo-Sifiliograficas. 2014;105(6):605-13.
11. Romero G, Sanchez P, Garcia M, et al. Randomized controlled trial comparing store-and-forward teledermatology alone and in combination with web-camera videoconferencing. Clinical and Experimental Dermatology. 2010;35(3):311-7.
12. Sterne JAC, Savović J, Page MJ, et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. BMJ. 2019;366:l4898.
13. Altieri L, Hu J, Nguyen A, et al. Interobserver reliability of teledermatology across all Fitzpatrick skin types. Journal of telemedicine and telecare. 2017;23(1):68-73.
14. Castelo-Soccio L, Kovarik CL, Azfar RS, et al. Reliability and validity of mobile teledermatology in human immunodeficiency virus-positive patients in botswana a pilot study. JAMA Dermatology. 2014;150(6):601-7.
15. Barbieri JS, Nelson CA, James WD, et al. The reliability of teledermatology to triage inpatient dermatology consultations. JAMA Dermatology. 2014;150(4):419-24.
16. Barcaui CB, Lima PMO. Application of teledermoscopy in the diagnosis of pigmented lesions. International Journal of Telemedicine and Applications. 2018;2018((Barcaui) Adjunct Professor of Dermatology, Faculty of Medical Sciences, State University of Rio de Janeiro, PhD in Medicine (Dermatology), University of Sao Paulo, Dermatology Department, Pedro Ernesto University Hospital, Rio de Janeiro State University):1624073.

17. Batalla A, Suh-Oh HJ, Abalde T, et al. Teledermatology in Paediatrics. Observations in daily clinical practice. Anales de pediatria (Barcelona, Spain : 2003). 2016;84(6):324-30.
18. Borve A, Holst A, Gente-Lidholm A, et al. Use of the mobile phone multimedia messaging service for teledermatology. Journal of Telemedicine and Telecare. 2012;18(5):292-6.
19. Borve A, Terstappen K, Sandberg C, et al. Mobile teledermoscopy-there's an app for that! Dermatology practical & conceptual. 2013;3(2):41-8.
20. Carter ZA, Li X, Goldman S, et al. Creation of an internal teledermatology store-and-forward system in an existing electronic health record: A pilot study in a safety-net public health and hospital system. JAMA Dermatology. 2017;153(7):644-50.
21. Chen TS, Goldyne ME, Mathes EFD, et al. Pediatric teledermatology: Observations based on 429 consults. Journal of the American Academy of Dermatology. 2010;62(1):61-6.
22. Clarke EL, Reichenberg JS, Ahmed AM, et al. The utility of teledermatology in the evaluation of skin lesions. Journal of telemedicine and telecare. 2021(9506702, cpj):1357633X20987423.
23. Costello CM, Cumsky HJL, Maly CJ, et al. Improving Access to Care Through the Establishment of a Local, Teledermatology Network. Telemedicine journal and e-health : the official journal of the American Telemedicine Association. 2020;26(7):935-40.
24. Duong TA, Cordoliani F, Julliard C, et al. Emergency department diagnosis and management of skin diseases with real-time teledermatologic expertise. JAMA Dermatology. 2014;150(7):743-7.
25. Gabel CK, Nguyen E, Karmouta R, et al. Use of teledermatology by dermatology hospitalists is effective in the diagnosis and management of inpatient disease. Journal of the American Academy of Dermatology. 2021;84(6):1547-53.
26. Gatica JL, Bertolo S, Morales E, et al. Store-and-forward teledermatogy in Chile: A contribution to primary health care. Piel. 2015;30(3):148-54.
27. Gerhardt CA, Foels R, Grewe S, et al. Assessing the Diagnostic Accuracy of Teledermatology Consultations at a Local Veterans Affairs Dermatology Clinic. Cureus. 2021;13(6):e15406.
28. Giavina-Bianchi M, Azevedo MFD, Sousa RM, et al. Part II: Accuracy of Teledermatology in Skin Neoplasms. Frontiers in medicine. 2020;7(101648047):598903.
29. Giavina-Bianchi M, Sousa R, Cordioli E. Part I: Accuracy of Teledermatology in Inflammatory Dermatoses. Frontiers in medicine. 2020;7(101648047):585792.
30. Keller JJ, Johnson JP, Latour E. Inpatient teledermatology: Diagnostic and therapeutic concordance among a hospitalist, dermatologist, and teledermatologist using store-and-forward teledermatology. Journal of the American Academy of Dermatology. 2020;82(5):1262-7.
31. Lamel SA, Haldeman KM, Ely H, et al. Application of mobile teledermatology for skin cancer screening. Journal of the American Academy of Dermatology. 2012;67(4):576-81.
32. Muir J, Xu C, Singh P, et al. Incorporating teledermatology into emergency medicine. EMA - Emergency Medicine Australasia. 2011;23(5):562-8.
33. Nami N, Rubegni P, Fimiani M, et al. Concordance and Time Estimation of Store-and-Forward Mobile Teledermatology Compared to Classical Face-to-Face Consultation. Acta Dermato-Venereologica. 2015;95(1):35-9.
34. Patro BK, Tripathy JP, De D, et al. Diagnostic agreement between a primary care physician and a teledermatologist for common dermatological conditions in North India. Indian dermatology online journal. 2015;6(1):21-6.

35. Ribas J, Schettini APM, Ribas CBDR, et al. Agreement between dermatological diagnoses made by live examination compared to analysis of digital images. Anais Brasileiros de Dermatologia. 2010;85(4):441-7.
36. Rubegni P, Nami N, Poggiali S, et al. Geriatric teledermatology: Store-and-forward vs. face-to-face examination. Journal of the European Academy of Dermatology and Venereology. 2011;25(11):1334-9.
37. Sola-Ortigosa J, Munoz-Santos C, Masat-Tico T, et al. The Role of Teledermatology and Teledermoscopy in the Diagnosis of Actinic Keratosis and Field Cancerization. The Journal of investigative dermatology. 2020;140(10):1976-84.e4.
38. Tan E, Yung A, Oakley A, et al. Successful triage of patients referred to a skin lesion clinic using teledermoscopy (IMAGE IT trial). British Journal of Dermatology. 2010;162(4):803-11.
39. Tran K, Ayad M, Monir S, et al. Mobile teledermatology in the developing world: Implications of a feasibility study on 30 Egyptian patients with common skin diseases. Journal of the American Academy of Dermatology. 2011;64(2):302-9.
40. Vano-Galvan S, Aguayo-Leiva I, Rios-Buceta L, et al. Store-and-forward teledermatology: Assessment of validity in a series of 2000 observations. Actas Dermo-Sifiliograficas. 2011;102(4):277-83.
41. Vestergaard T, Prasad SC, Schuster A, et al. Diagnostic accuracy and interobserver concordance: teledermoscopy of 600 suspicious skin lesions in Southern Denmark. Journal of the European Academy of Dermatology and Venereology : JEADV. 2020;34(7):1601-8.
42. Gravely AA, Warshaw EM, Nelson DB. Reliability of store and forward teledermatology for skin neoplasms. Journal of the American Academy of Dermatology. 2015;72(3):426-35.
43. Zanini M. Analyze of diagnostic concordance between face-to-face and teledermatology diagnosis. Medicina Cutanea Ibero-Latino-Americana. 2013;41(2):60-2.
44. Zink A, Kolbinger A, Leibl M, et al. The value of teledermatology using a mobile app compared to conventional dermatology. European Journal of Dermatology. 2017;27(4):429-31.
45. Zink A, Kolbinger A, Leibl M, et al. Teledermoscopy by mobile phones: Reliable help in the diagnosis of skin lesions? Hautarzt. 2017;68(11):890-5.
46. Marchell R, Locatis C, Liu W-L, et al. Comparing High Definition Live Interactive and Store-and-Forward Consultations to In-Person Examinations. Telemedicine journal and e-health : the official journal of the American Telemedicine Association. 2017;23(3):213-8.
47. Jones L, Jameson M, Oakley A. Remote Skin Cancer Diagnosis: Adding Images to Electronic Referrals Is More Efficient Than Wait-Listing for a Nurse-Led Imaging Clinic. Cancers (Basel). 2021;13(22).
48. Gonzalez Coloma F, Sandoval Garces M, Gedda Quiroga V, et al. Teledermatology in Remote Parts of Chile: Experience in 4 Isolated Rural Areas. Actas dermo-sifiliograficas. 2019;110(8):653-8.
49. Goulart Silveira CE, Carcano C, Mauad EC, et al. Call phone usefulness to improve the skin cancer screening: preliminary results and critical analysis of mobile app development. Rural & Remote Health. 2019;19(1):1-7.
50. Piccoli MF, Amorim BDB, Wagner HM, et al. Teledermatology protocol for screening of Skin cancer. Anais Brasileiros de Dermatologia. 2015;90(2):202-10.
51. Senel E, Baba M, Durdu M. The contribution of teledermatoscopy to the diagnosis and management of non-melanocytic skin tumours. Journal of Telemedicine and Telecare. 2013;19(1):60-3.

52. Gravely AA, Nelson DB, Warshaw EM. Accuracy of teledermatology/teledermoscopy and clinic-based dermatology for specific categories of skin neoplasms. Journal of the American Academy of Dermatology. 2010;63(2):348-52.
53. McFarland LV, Raugi GJ, Reiber GE. Primary care provider and imaging technician satisfaction with a teledermatology project in rural Veterans Health Administration clinics. Telemed J E Health. 2013;19(11):815-25.
54. Massone C, Javor S, Amato I, et al. Training of primary care physicians enhances performance of mobile teledermatology. Anais brasileiros de dermatologia. 2021;96(4):514-6.
55. Finnane A, Curiel-Lewandrowski C, Wimberley G, et al. Proposed Technical Guidelines for the Acquisition of Clinical Images of Skin-Related Conditions. JAMA Dermatol. 2017;153(5):453-7.
56. Lee JJ, English JC, 3rd. Teledermatology: A Review and Update. Am J Clin Dermatol. 2018;19(2):253-60.
57. Bastola M, Locatis C, Fontelo P. Diagnostic Reliability of In-Person Versus Remote Dermatology: A Meta-Analysis. Telemed J E Health. 2021;27(3):247-50.

Figure Legends

Figure 1. **PRISMA Flow diagram of study selection.**

Figure 2. Forest plot representing F2F and teledermatology primary diagnostic agreement by whether imaging acquisition training was indicated by the study.
Forest plot representing F2F and teledermatology primary diagnostic agreement when image acquisition training is involved. Studies were sorted into two groups, a) Did not conduct or did not report training personnel on image acquisition; b) Stated that person in charge of image acquisition was trained. **(Left)** Forest plot representing percentage agreement and 95% C.I. for overall concordance across 40 studies with a total of 72 unique number of comparisons, N of events and total included participants. **(Right)** Forest plot representing kappa concordance and 95% C.I. for overall concordance across 21 studies with a total of 45 unique number of comparisons, N of total included participants. Abbreviations: F2F (Face-to-Face), PCP (Primary Care Provider), TD (Teledermatology or Teledermatologist).

Figure 3. Forest plot representing F2F and teledermatology primary diagnostic agreement by device type used to capture clinical photographs.
Forest plot representing F2F and teledermatology primary diagnostic agreement by imaging technology used. Studies were sorted into three groups, i) Digital photography ii) Imaging technology not mentioned iii) Smartphone or tablet. **(Left)** Forest plot representing percentage agreement and 95% C.I. for overall concordance across 40 studies with a total of 72 unique number of comparisons, N of events and total included participants. **(Right)** Forest plot representing kappa concordance and 95% C.I. for overall concordance across 21 studies with a total of 45 unique number of comparisons, N of total included participants. Abbreviations: F2F (Face-to-Face), PCP (Primary Care Provider), TD (Teledermatology or Teledermatologist)

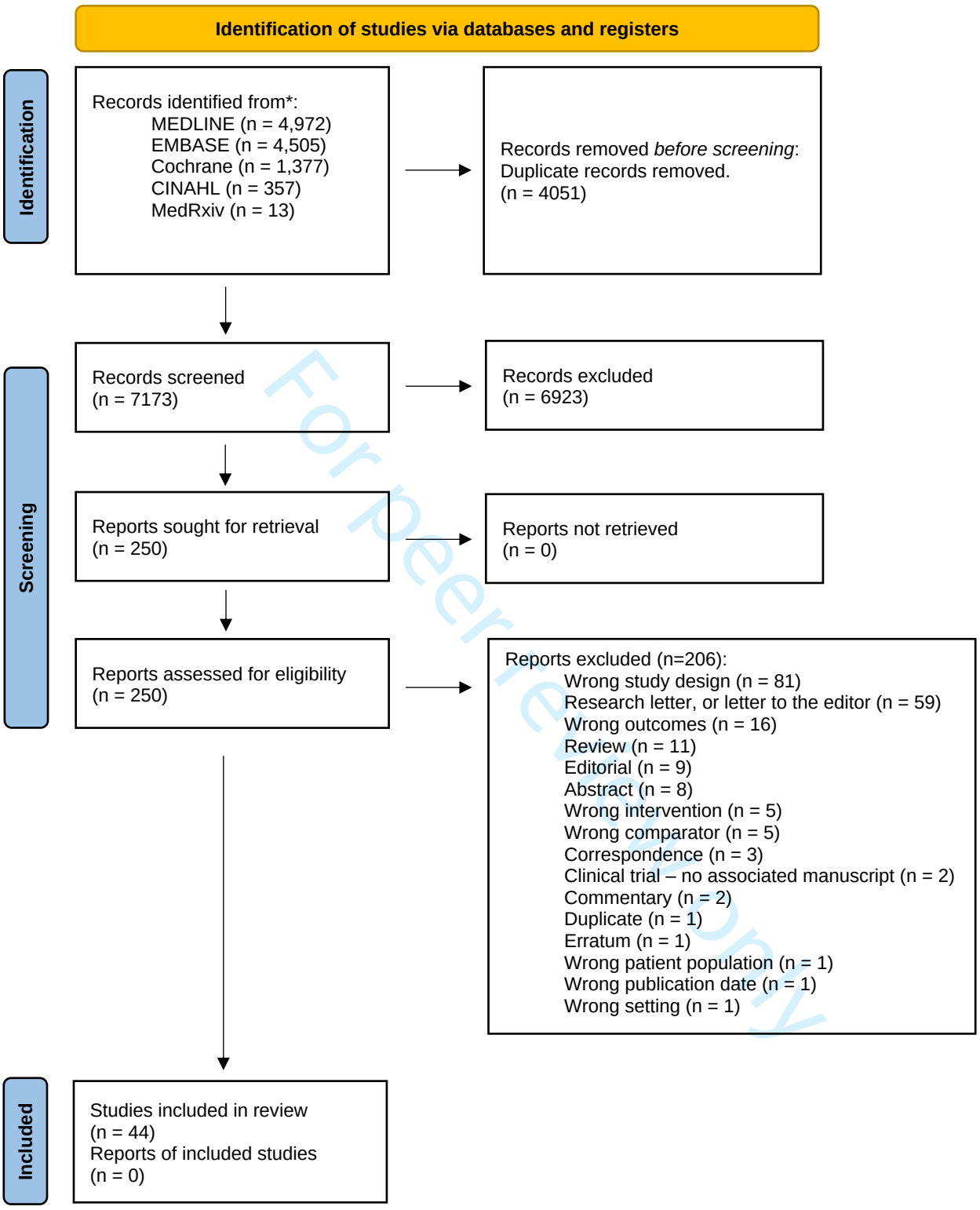
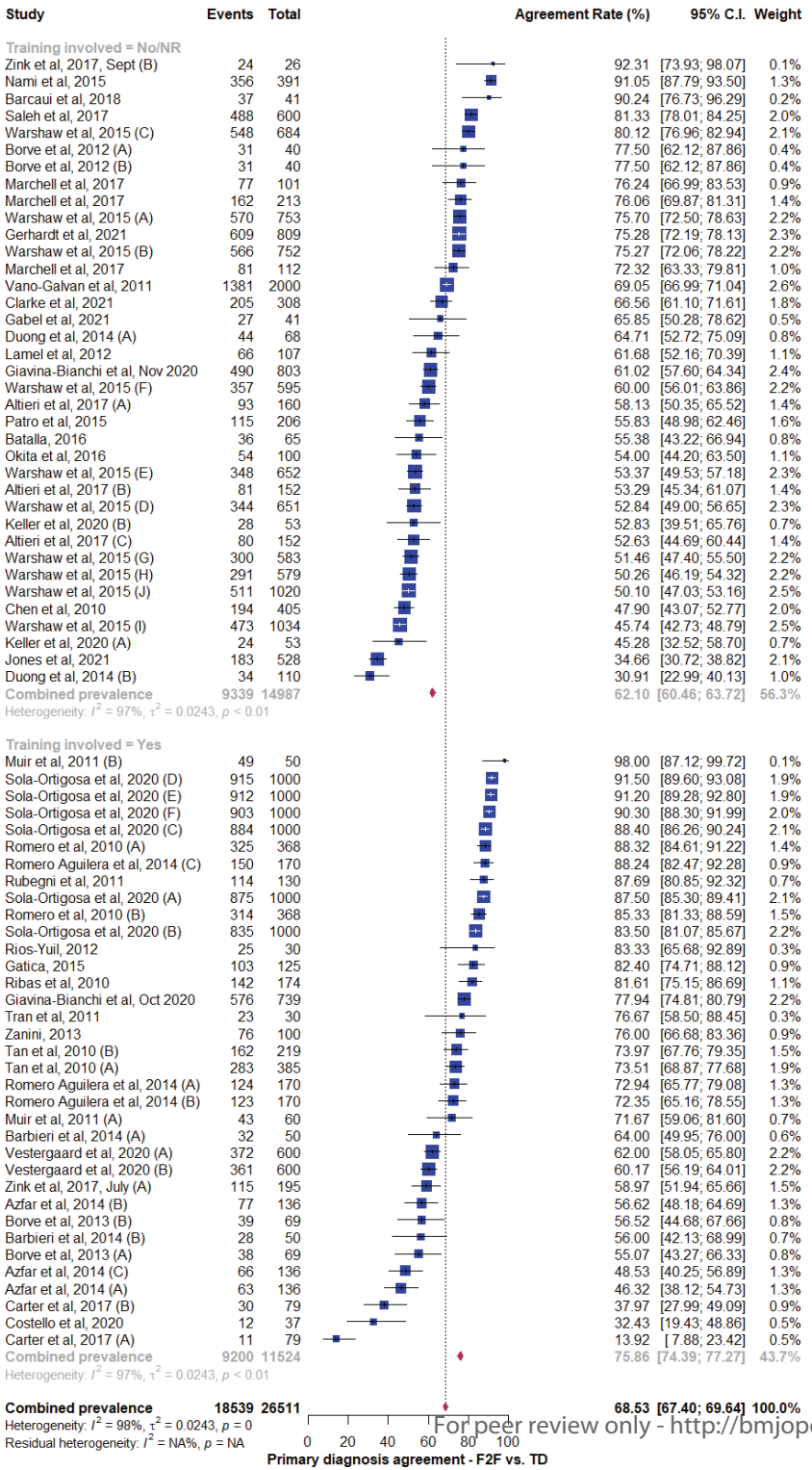
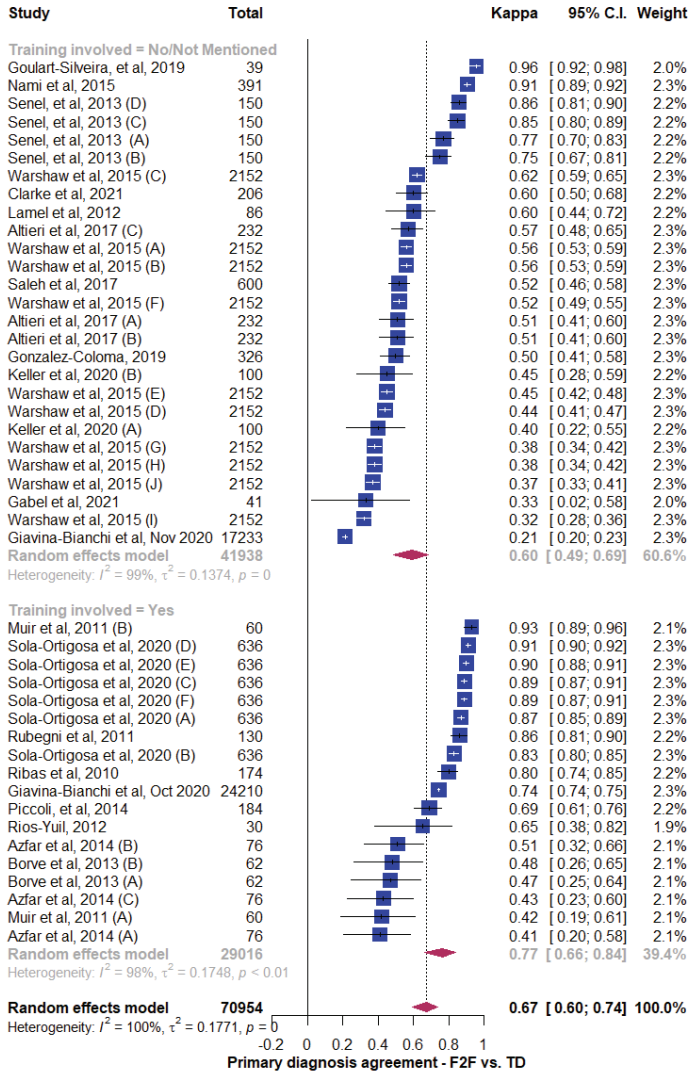
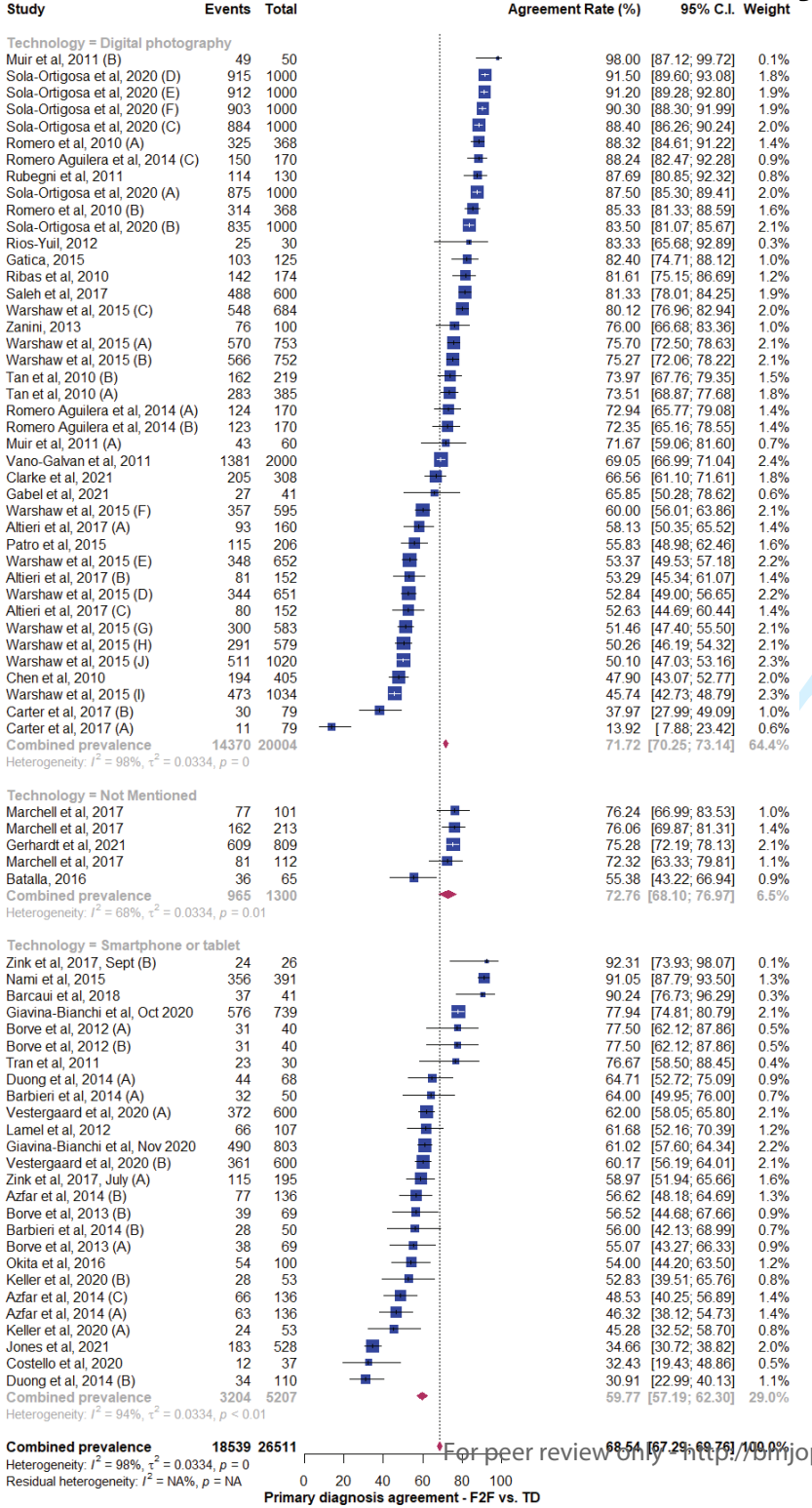
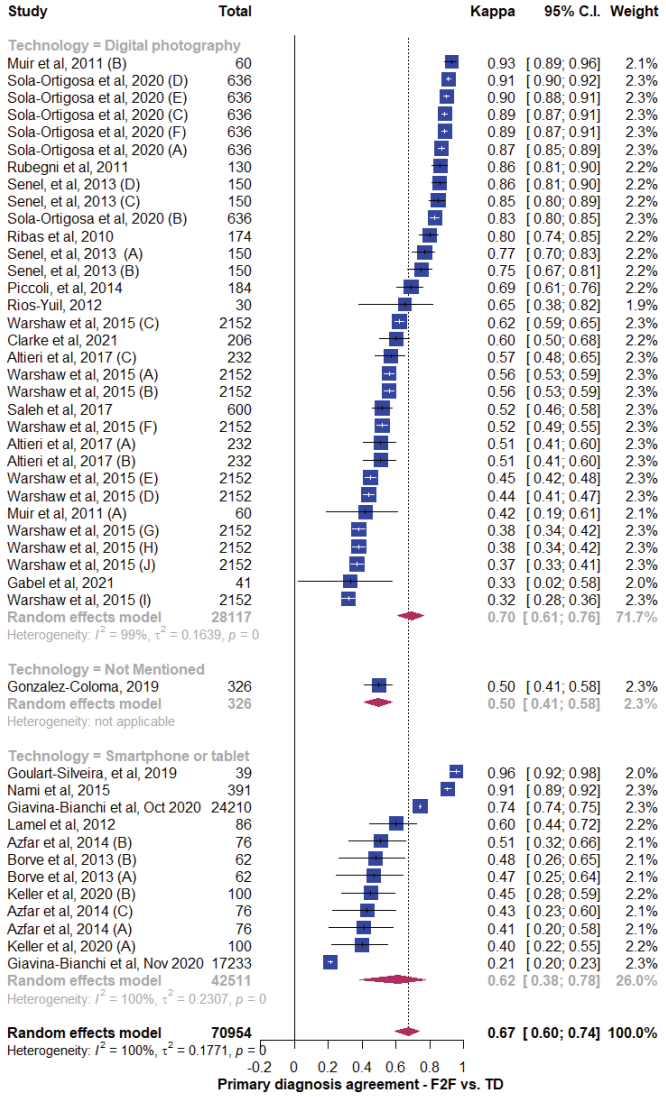


Figure 1. PRISMA Flow diagram of study selection.









Supplementary Online Content

Title: Diagnostic Reliability in Teledermatology: A Systematic Review and Meta-Analysis

Authors

Adrienn N. Bourkas*[1] (MSc), Natasha Barone*[2] (MD, MSc), Matthew E.C. Bourkas[3] (PhD), Matthew Mannarino[4] (PhD), Robert D. J. Fraser[5,6] (RN, MN), Amy Lorincz (MSc), Sheila C. Wang[5,7] (MD, PhD), Jose L. Ramirez-GarciaLuna[4] (MD, PhD)

* Authors contributed equally

Affiliations

[1]Faculty of Health Sciences, Queen's University School of Medicine, Kingston, Ontario, Canada

[2]Faculty of Medicine and Health Sciences, McGill University, Montreal, Quebec, Canada

[3]Temerty Faculty of Medicine, Department of Biochemistry, University of Toronto, Toronto, Ontario, Canada

[4]Department of Surgery, McGill University, Montreal, Quebec, Canada

[5]Swift Medical Inc., Toronto, Ontario, Canada

[6]Arthur Labatt Family School of Nursing, Western University, London, Ontario Canada

[7]Department of Medicine, Division of Dermatology, McGill University Health Centre, Montreal, Quebec, Canada

Supplementary eMethods

Search Strategy

The search strategy was written for Ovid Medline and translated using each database's syntax, controlled vocabulary, and search fields. MeSH terms, Emtree terms, and free text words were used for teledermatology and skin conditions such as melanoma and related synonyms. To identify additional articles not captured through the aforementioned search, a manual search was conducted via reference search of the included studies.

All database records were downloaded to EndNote X9 (Clarivate) and uploaded to web-based software for deduplication, screening, and full-text evaluation (Covidence; Veritas Health Innovation). We contacted three study authors to gain access to their published work.(1, 2, 3) The search strategy is available below.

Ovid MEDLINE Search

Ovid MEDLINE(R) and Epub Ahead of Print, In-Process, In-Data-Review & Other Non-Indexed Citations and Daily <1946 to 2022 May 02>

1	e consult*.mp.	322
2	econsult*.mp.	218
3	electronic consult*.mp.	366
4	e health.mp.	4095
5	ehealth.mp.	6823
6	e visit*.mp.	88
7	evisit*.mp.	26
8	home video visit*.mp.	4
9	internet/ or internet-based intervention/	82046
10	internet.mp.	128675
11	offsite care.mp.	4
12	off site care.mp.	9
13	ontario telemedicine network.mp.	19
14	Remote Consultation/	5689
15	remote consultation*.mp.	6406
16	remote visit*.mp.	95
17	tele care.mp.	40
18	telecare.mp.	945
19	tele consult*.mp.	208
20	teleconsult*.mp.	2208
21	tele diagnos*.mp.	46
22	telehealth.mp.	13222
23	tele health.mp.	287
24	telemedicine/	36763
25	telemedicine.mp.	47751
26	tele medicine.mp.	197
27	telemonitor*.mp.	2380
28	tele monitor*.mp.	209
29	Telepathology/	918
30	telepatholog*.mp.	1223
31	tele patholog*.mp.	25
32	telepractice*.mp.	276
33	tele practice*.mp.	16
34	Therapy, Computer-Assisted/	6969
35	video consult*.mp.	827
36	videoconsult*.mp.	41
37	virtual care.mp.	1177
38	web based.mp.	42402
39	Telepathology/	918

40	or/1-39	216985	
41	Dermatology/21077		
42	dermatolog*.mp.	110593	
43	dermatopatholog*.mp.	2990	
44	exp Skin Diseases/di [Diagnosis]	196739	
45	exp Skin Neoplasms/	142454	
46	skin.mp.	880457	
47	exp Skin Abnormalities/	34228	
48	burns/ or burns, chemical/ or burns, electric/ or sunburn/	59533	
49	burn*.mp.	141877	
50	wound healing/ or cicatrix/	127484	
51	wound*.mp.	446154	
52	or/41-51	1580012	
53	40 and 52	7160	
54	teledermatolog*.mp.	1273	
55	tele dermatolog*.mp.	35	
56	54 or 55	1298	
57	53 or 56	7448	
58	limit 57 to dt=20100101-20220501 [January 1st, 2010 to May 1st, 2022]	4972	

Embase Search

Embase Classic+Embase <1947 to 2021 July 15>

1	computer assisted therapy/	4772
2	e consult*.mp.	411
3	econsult*.mp.	283
4	electronic consult*.mp.	461
5	e health.mp.	4440
6	ehealth.mp.	5099
7	e visit*.mp.	83
8	evisit*.mp.	30
9	home video visit*.mp.	10
10	internet/ or web-based intervention/	114861
11	internet.mp.	143810
12	offsite care.mp.	5
13	off site care.mp.	12
14	ontario telemedicine network.mp.	36
15	remote consultation*.mp.	808
16	remote visit*.mp.	79
17	tele care.mp.	55
18	telecare.mp.	983
19	teleconsultation/	11686
20	tele consult*.mp.	243
21	teleconsult*.mp.	12352
22	tele diagnos*.mp.	53
23	telehealth.mp.	15276
24	tele health.mp.	389
25	telemedicine/	31867
26	telemedicine.mp.	38951
27	tele medicine.mp.	333
28	telemonitor*.mp.	4838
29	tele monitor*.mp.	344
30	Telepathology/	869
31	telepatholog*.mp.	1265
32	tele patholog*.mp.	41
33	telepractice*.mp.	162

34 tele practice*.mp. 9
35 video consult*.mp. 751
36 videoconsult*.mp. 54
37 virtual care.mp. 496
38 web based.mp. 49157
39 or/1-38 240118
40 dermatology/ or cosmetic dermatology/ or pediatric dermatology/ or psychodermatology/ 51419
41 dermatolog*.mp. 161210
42 dermatopatholog*.mp. 3737
43 burn/ or burn contracture/ or electric burn/ or face burn/ or hand burn/ or ionizing radiation burn/ or scald/ or sunburn/ 74890
44 burn*.mp. 189010
45 exp skin disease/di [Diagnosis] 209136
46 exp skin tumor/ 213775
47 skin*.mp. 1294867
48 or/40-47 1665263
49 39 and 48 7063
50 teledermatology/ 1295
51 tele dermatolog*.mp. 42
52 teledermatolog*.mp. 1798
53 50 or 51 or 52 1812
54 49 or 53 8004
55 limit 54 to (books or chapter or conference abstract or conference paper or "conference review") 1828
56 54 not 55 6176
57 limit 56 to yr="2010 -Current" 4505

Cochrane Search

EBM Reviews - Cochrane Database of Systematic Reviews <2005 to July 14, 2021> EBM Reviews - ACP Journal Club <1991 to June 2021> EBM Reviews - Database of Abstracts of Reviews of Effects <1st Quarter 2016> EBM Reviews - Cochrane Clinical Answers <June 2021> EBM Reviews - Cochrane Central Register of Controlled Trials <June 2021> EBM Reviews - Cochrane Methodology Register <3rd Quarter 2012> EBM Reviews - Health Technology Assessment <4th Quarter 2016> EBM Reviews - NHS Economic Evaluation Database <1st Quarter 2016>

1 e consult*.mp. 44
2 econsult*.mp. 22
3 electronic consult*.mp. 29
4 e health.mp. 617
5 ehealth.mp. 766
6 e visit*.mp. 14
7 evisit*.mp. 1
8 home video visit*.mp. 3
9 internet/ or internet-based intervention/ 4,275
10 internet.mp. 15,059
11 offsite care.mp. 2
12 off site care.mp. 2
13 ontario telemedicine network.mp. 7
14 Remote Consultation/ 460
15 remote consultation*.mp. 551
16 remote visit*.mp. 17
17 tele care.mp. 34
18 telecare.mp. 249
19 tele consult*.mp. 59
20 teleconsult*.mp. 822
21 tele diagnos*.mp. 4
22 telehealth.mp. 2,308
23 tele health.mp. 128

24	telemedicine/	2,617
25	telemedicine.mp.	4,819
26	tele medicine.mp.	57
27	telemonitor*.mp.	1,236
28	tele monitor*.mp.	115
29	Telepathology/	8
30	telepatholog*.mp.	22
31	tele patholog*.mp.	2
32	telepractice*.mp.	37
33	tele practice*.mp.	0
34	Therapy, Computer-Assisted/	1,391
35	video consult*.mp.	117
36	videoconsult*.mp.	8
37	virtual care.mp.	31
38	web based.mp.	9,110
39	Telepathology/	8
40	or/1-39	29,268
41	Dermatology/	124
42	dermatolog*.mp.	10,838
43	dermatopatholog*.mp.	80
44	exp Skin Diseases/di [Diagnosis]	630
45	exp Skin Neoplasms/	1,738
46	skin.mp.	67,534
47	exp Skin Abnormalities/	269
48	burns/ or burns, chemical/ or burns, electric/ or sunburn/	1,779
49	burn*.mp.	12,780
50	wound healing/ or cicatrix/	5,677
51	wound*.mp.	35,982
52	or/41-51	110,390
53	40 and 52	1,622
54	teledermatolog*.mp.	149
55	tele dermatolog*.mp.	20
56	54 or 55	151
57	53 or 56	1,684
58	limit 57 to yr="2010 -Current"	1,377

CINAHL Search

Searched keyword teledermatology and set limit to yr="2010-Current" 357

MedRxiv Search

Searched keyword teledermatology and set limit to yr="2010-Current" 13

Eligibility Criteria

Inclusion and exclusion criteria are summarized in **eTable 2**.

Data Selection and Extraction

Information extracted from full-text articles is summarized in **eTable 3**.

Data Analysis and Synthesis

In this study, a letter was assigned to each unique study grouping as explained in **eTable 4**. For both the percentage of agreement and kappa values, forest plots, the I^2 index, and the τ^2 statistic were used in combination to investigate statistical heterogeneity. To evaluate the statistical significance of differences between kappa values, we performed meta-regressions and derived corresponding p-values.

Cohen's kappa values for diagnostic concordance between teledermatology and F2F physicians were interpreted based on the following criteria.(4) Values between 0–.20 indicate no agreement, .21–.39 minimal agreement, .40–.59 weak agreement, .60–.79 moderate agreement, .80–.90 strong agreement, and above .90 almost perfect agreement.

Sub-group analysis included different skin conditions, specialization of the F2F physician, whether staff were trained on image acquisition, the technology used for image acquisition, the use of teledermoscopy, studies conducted pre- or post-pandemic, and the risk of bias. Confounding factors, such as technology type, year of publication, and training of study raters, were controlled using meta-regression.

Proportions meta-analysis looked at weighted averages, and 95% confidence intervals were reported. Given the unique properties of proportional data and the considerable heterogeneity observed, conventional publication bias tests, specifically designed for comparative data, were not considered applicable. As such, statistical pursuit of publication bias was not undertaken. Instead, a methodologically appropriate qualitative assessment of publication bias was implemented for this type of analysis. This approach was deemed to provide the most accurate and robust outcome.

Supplementary eResults

Our analysis incorporated forty-four relevant studies. Key study and participant details are summarized in **eTable 1**, with a concise overview provided in the main text. Articles excluded based on our criteria are listed in **eTable 5**.

Diagnostic reliability of teledermatology when compared to F2F (specialist and non-specialists) evaluation

Of the 40 studies that reported diagnostic agreement rates there were 72 unique comparisons made between F2F and teledermatology.(5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44) **eFigure 1A** shows that the mean percentage agreement of 68.9% (CI 64.4%-73.1%) ranged from 14% to 98%, where 35/72 had percentage agreement above 70% and 7 studies had over 90% agreement. The studies were heterogeneous (I^2=98%, p <0).

Of the 21 studies that reported concordance values, there were 45 unique comparisons made.(5, 6, 11, 14, 17, 20, 21, 22, 23, 24, 25, 28, 29, 32, 33, 34, 45, 46, 47, 48, 49) **eFigure 1B** shows that the mean diagnostic concordance of 0.67 (CI 0.60 to 0.74) ranged from 0.213 (CI 0.20 to 0.23) to 0.96 (CI 0.92 to 0.98), with 21 studies (47%) having moderate agreement (k=0.6 and above), and 13 (29%) studies having strong agreement. The studies were heterogeneous (I^2=100%, p <0.001).

Diagnostic agreement between teledermatologist and teledermatologist, F2F and F2F, and teledermatology and histopathology

Of the ten studies that reported diagnostic agreement rates between telermatologists, there were 17 unique comparisons made between F2F and teledermatology consults. **eFigure 2A** shows the mean percentage agreement of 76.4% (CI 69% to 82.5%) ranged from 37% to 91.5%, with 10/17 having percentage agreement above 70% and two studies having over 90% agreement. The studies were heterogeneous (I^2=97%, p <0.001).

From four studies that reported diagnostic agreement rates between F2F dermatologists there were 6 unique comparisons. **eFigure 2B** shows that the mean percentage agreement 82.4% (CI 76.7%-87.0%) ranged from 75.5% to 91%. The studies were heterogeneous (I^2=68%, p <0.001).

Five studies compared teledermatology to histopathology data, and there were six unique comparisons. **eFigure 2C** shows that the mean percentage agreement of 55.7% (CI 53% to 58.4%) ranged from 53.8% to 65.4%. The mean agreement rate between histopathology and teledermatology was 55.7% (CI 53.0 to 58.4). The studies were homogeneous (I^2=0%, p = 0.49).

Subgroup analyses

Diagnostic reliability of teledermatology vs F2F specialist and non-specialist

Within the same modality, **eFigure 3A** shows that teledermatologists had a diagnostic agreement rate of 70.96% (CI 69.8% to 72.1%) with F2F dermatologists, while the agreement rate with F2F non-specialists was 44.1% (CI 39.9% to 48.4%). Comparing telermatologists to non-specialists showed significantly lower agreement among non-specialists (p < 0.001, heterogeneity: I^2 = 98%). Among 35 studies reporting diagnostic agreement rates, 44 out of 64 comparisons between teledermatology and F2F dermatologists had a percentage agreement above 60%, with seven studies reporting over 90% agreement. The mean kappa concordance value for diagnostic agreement between teledermatology and F2F dermatologists shown in **eFigure 3B** was 0.69 (CI 0.60 to 0.75). Additionally, telermatologists had a mean concordance value of 0.52 (CI 0.25 to 0.71) when compared to non-specialists. Non-specialists showed significantly lower diagnostic concordance compared to dermatologists for F2F vs. teledermatology (p = 0.031, heterogeneity: I^2 = 100%). Moreover, studies comparing teledermatologists to F2F and teledermatology to histopathology showed a range of agreement rates, with heterogeneity observed in the former (I^2 = 97%, p < 0.001) and homogeneity in the latter (I^2 = 0%, p = 0.49).

Diagnostic reliability of teledermatology vs F2F by the inclusion of teledermoscopy in both teledermatology and F2F assessments

Overall, twelve studies with 22 unique comparisons used teledermoscopy for diagnosing suspicious lesions.(8, 11, 15, 29, 32, 34, 38, 39, 42, 44) **eFigure 4A** shows that with teledermoscopy, the mean diagnostic agreement rates was 69.1% (CI 66.8% to 71.4%), and this percentage ranged between from 31.6% to 92.3%. Without the use of

teledermsocopy, the mean agreement rate was 68.3% (CI 66.8% to 69.8%). The means were not significantly different between the two groups and the studies were heterogeneous (I^2=97%, p<0.001). **eFigure 4B** shows concordance values of seven studies that adapted teledermoscopy had a mean of 0.71 (CI 0.58 to 0.80).(11, 29, 32, 34, 39, 47, 48) Without teledermsocopy, the mean was 0.65 (CI 0.54 to 0.74). This difference was not statistically significant, and the studies were heterogeneous (I^2=100%, p<0.001).

Diagnostic reliability of teledermatology vs F2F by the inclusion of lesion category

Twenty-six studies with 39 unique comparisons reporting percentage agreement rates that were inclusive to all lesion types as shown in e**Figure 5A.**(5, 6, 7, 8, 9, 10, 15, 16, 17, 18, 19, 22, 24, 25, 26, 28, 29, 30, 31, 32, 33, 36, 37, 40, 41, 43) The mean percentage agreement was 69.9% (CI 67.9% to 71.7%) and ranged from 30.9% to 98%, with the majority (26/39) having percentage agreement above 60% and 4 studies having over 90%. Eleven studies only looked at suspicious lesions,(11, 12, 14, 20, 23, 34, 35, 38, 39, 42, 44) and the mean percentage agreement was 68.1% (CI 66.3% to 69.8%). Three studies excluded skin cancers(13, 21, 27) and the mean percentage agreement was 62.2% (CI 56.2% to 67.8%). No statistical significance could be identified between the three lesion groups and the studies were heterogeneous (I^2=98%, p<0.001).

Concordance values for studies inclusive to all lesions seen in **eFigure 5B** were reported in ten studies with a mean of 0.62 (CI 0.48 to 0.74).(5, 6, 17, 22, 24, 25, 28, 29, 32, 33) Six studies that looked at cancerous skin lesions only reported a mean of 0.70 (CI 0.59 to 0.78).(11, 14, 20, 23, 34, 39) Only one study that looked at all lesions except cancerous ones reported a concordance value.[22] No statistical significance could be identified between the three lesion groups and the studies were heterogeneous (I^2=100%, p<0.001).

Diagnostic reliability of teledermatology vs F2F by pre- and post-pandemic timelines

When comparing telermatologists to all F2F physicians, the average agreement rate was 65.5% (CI 64.0-66.9) for pre-pandemic studies, and 75.3% (CI 73.4% to 77.2%) for studies published after January 2020. When the percentage agreements were compared between the two groups, they were not statistically significant (p = 0.421) and also heterogeneous (I^2=98%, p<0.001). eTable not included.

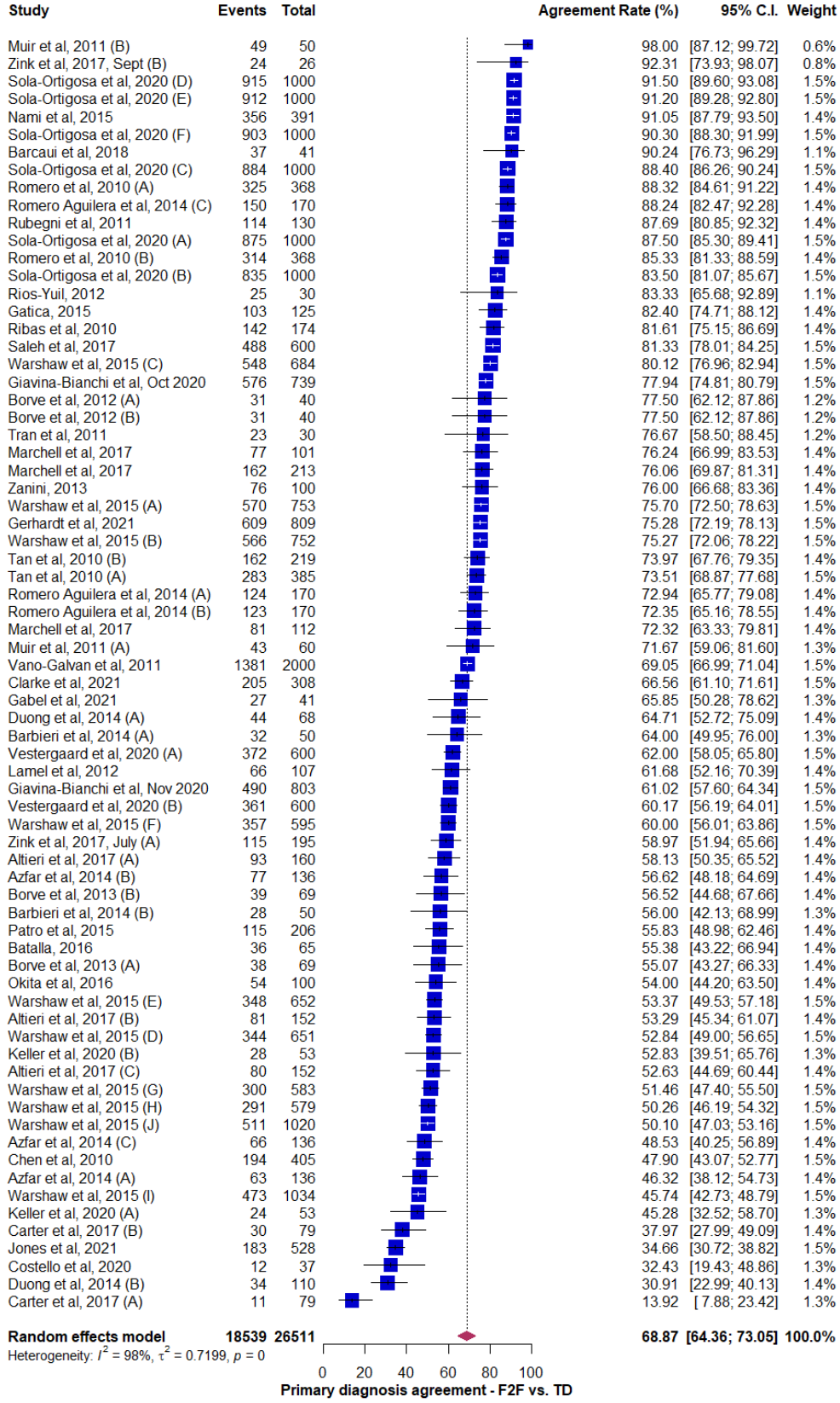
Risk of bias and quality assessment

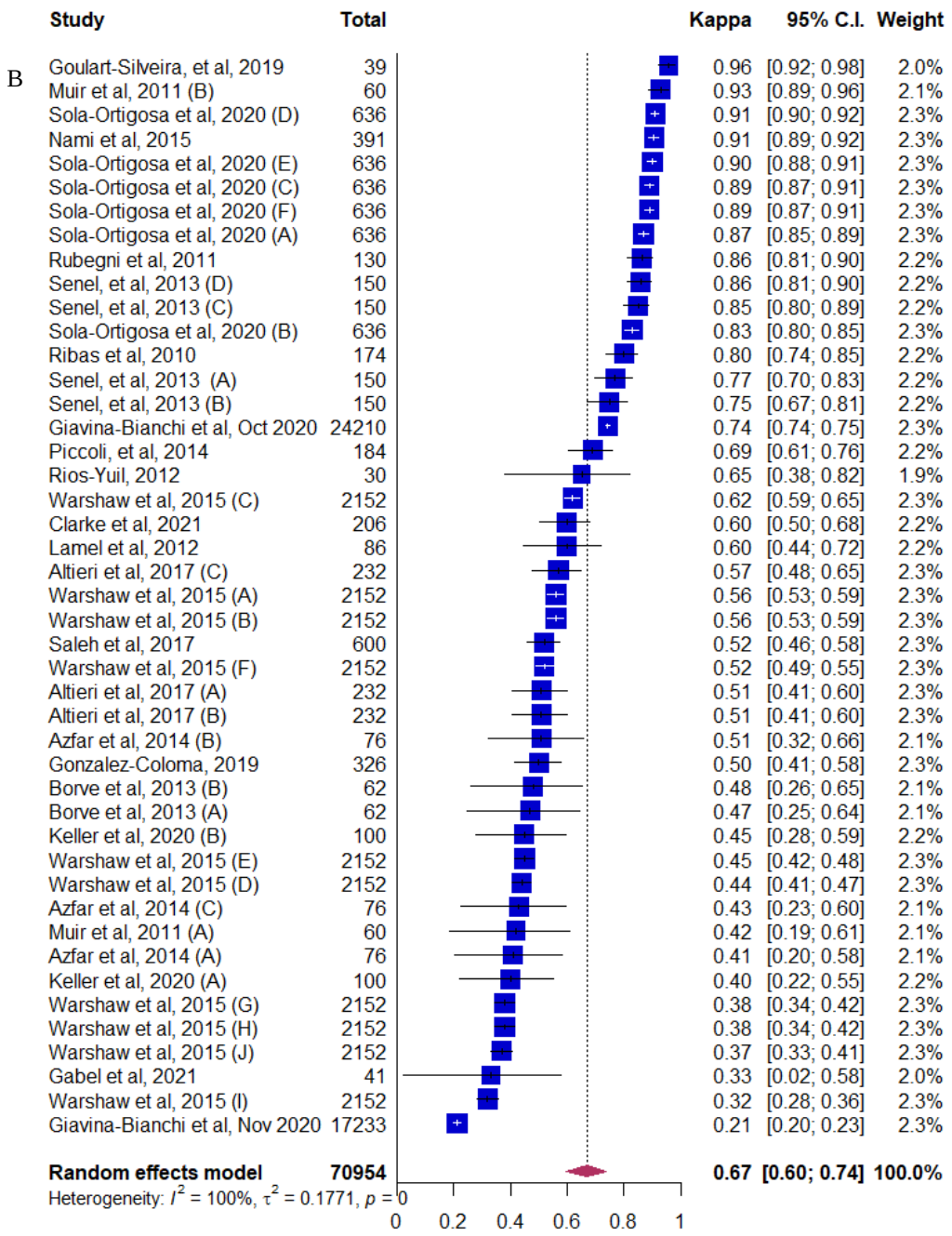
The QUADAS-2 framework was utilized to evaluate bias and applicability across four essential domains, ensuring that our conclusions are both accurate and applicable to real-life clinical situations. **eTable 6A** summarizes the QUADAS-2 criteria tailored to this study.

The results of quality assessment for risk of bias and applicability in individual studies are displayed in**. eTable 6B-E.** Six of the studies had low risk of bias, nine had moderate risk, and 29 had high-risk of bias. There were no systematic differences between the results of studies that attempted to reduce risk of bias, compared with those with higher risk of bias. The mean diagnostic agreement rate between F2F and teledermatology was 66.4% (CI 62.4% to 70.1%) for low risk, and 69.1% (CI 67.6% to 70.6%) for high risk (p = 0.932). When the percentage agreements were compared between groups, they were heterogeneous (I^ 2=98%, p<0.001). eTable not included.

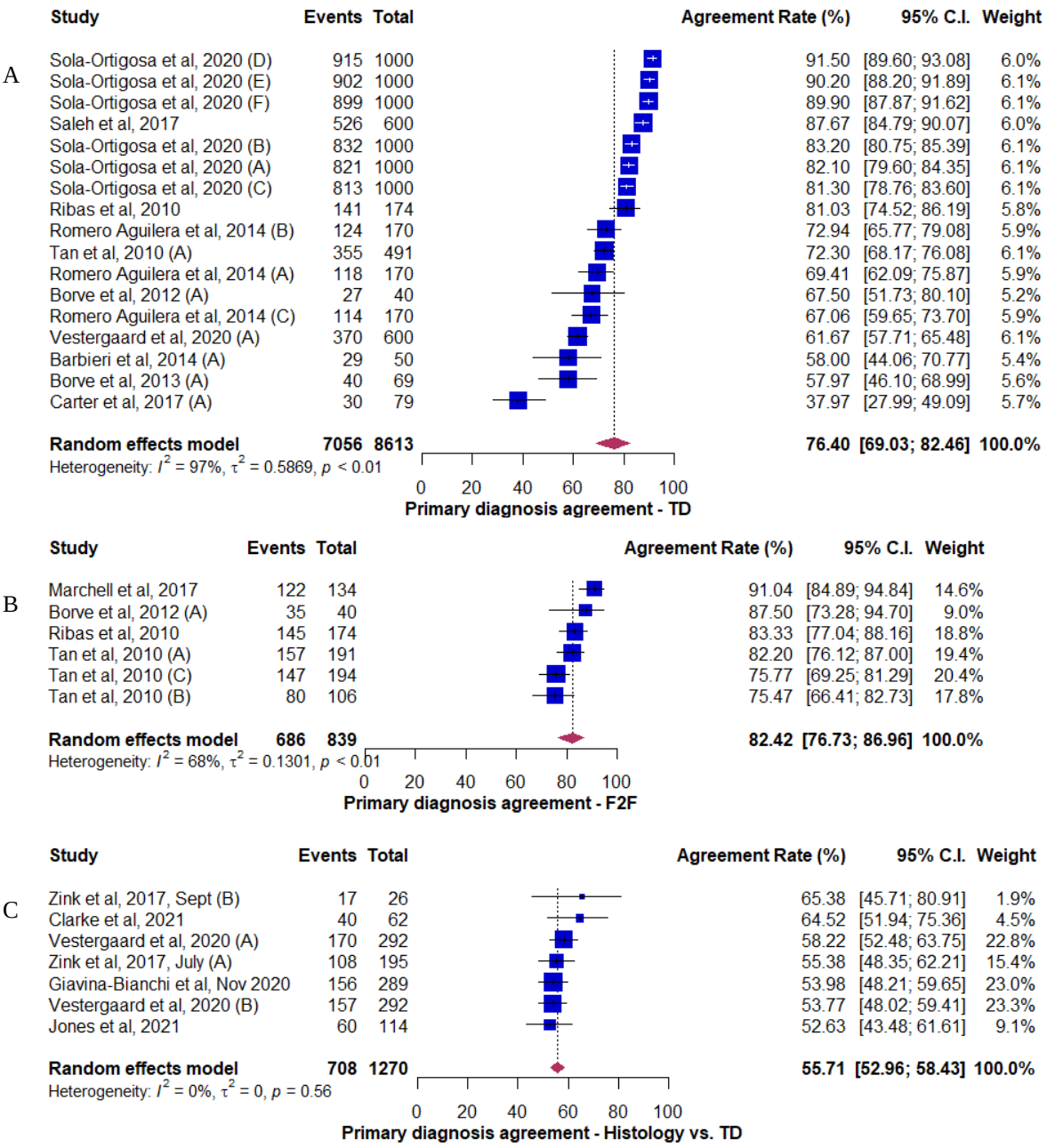
Supplementary eFigures and Legends

A



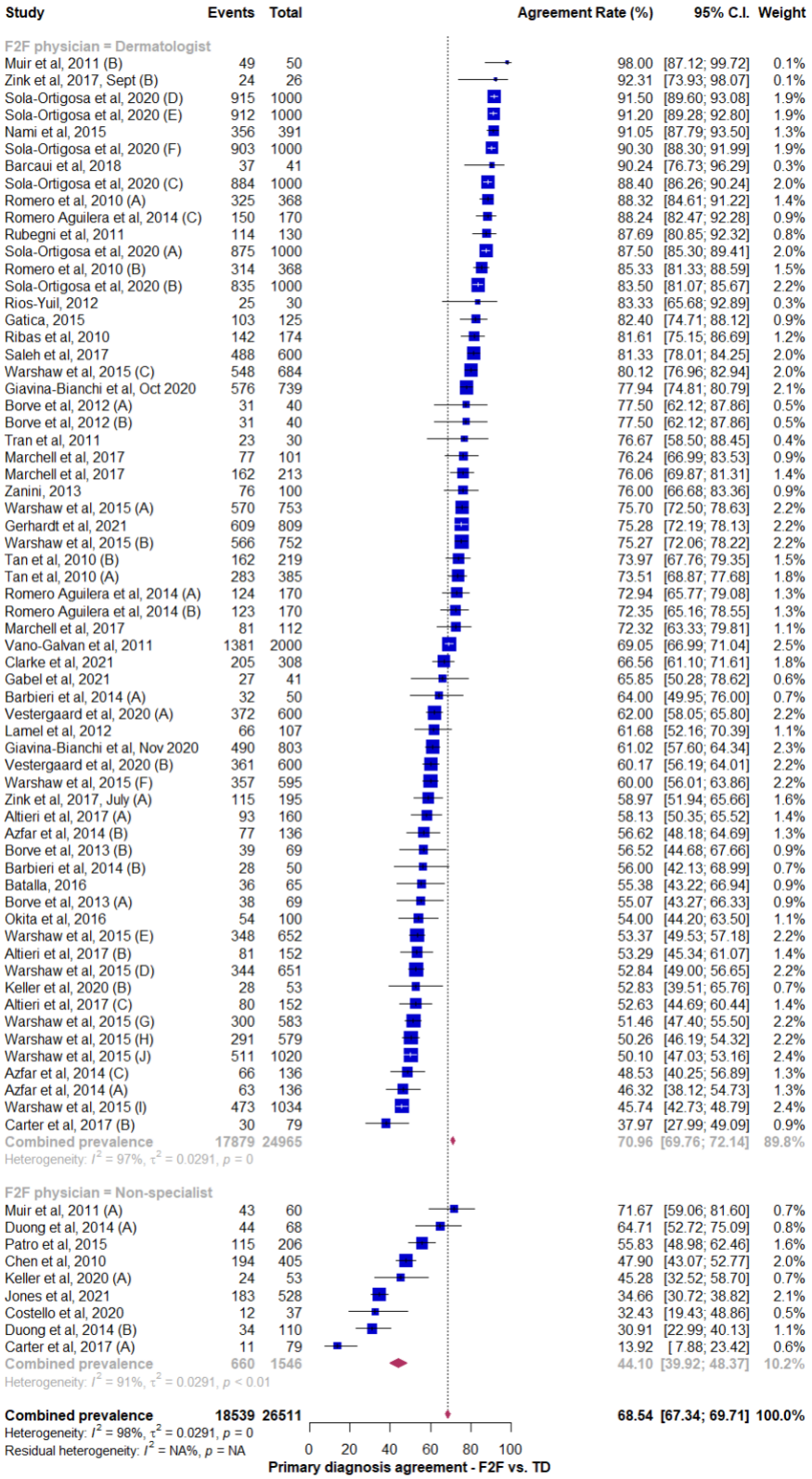


eFigure 1. Forest plot representing F2F and teledermatology primary diagnostic agreement. (A) Forest plot representing percentage agreement and 95% C.I. for overall concordance across 40 studies with a total of 72 unique number of comparisons, N of events and total included participants. (B) Forest plot representing kappa concordance and 95% C.I. for overall concordance across 21 studies with a total of 45 unique number of comparisons, N of total included participants. Abbreviations: F2F (Face-to-Face), PCP (Primary Care Provider), TD (Teledermatology or Teledermatologist)**.**



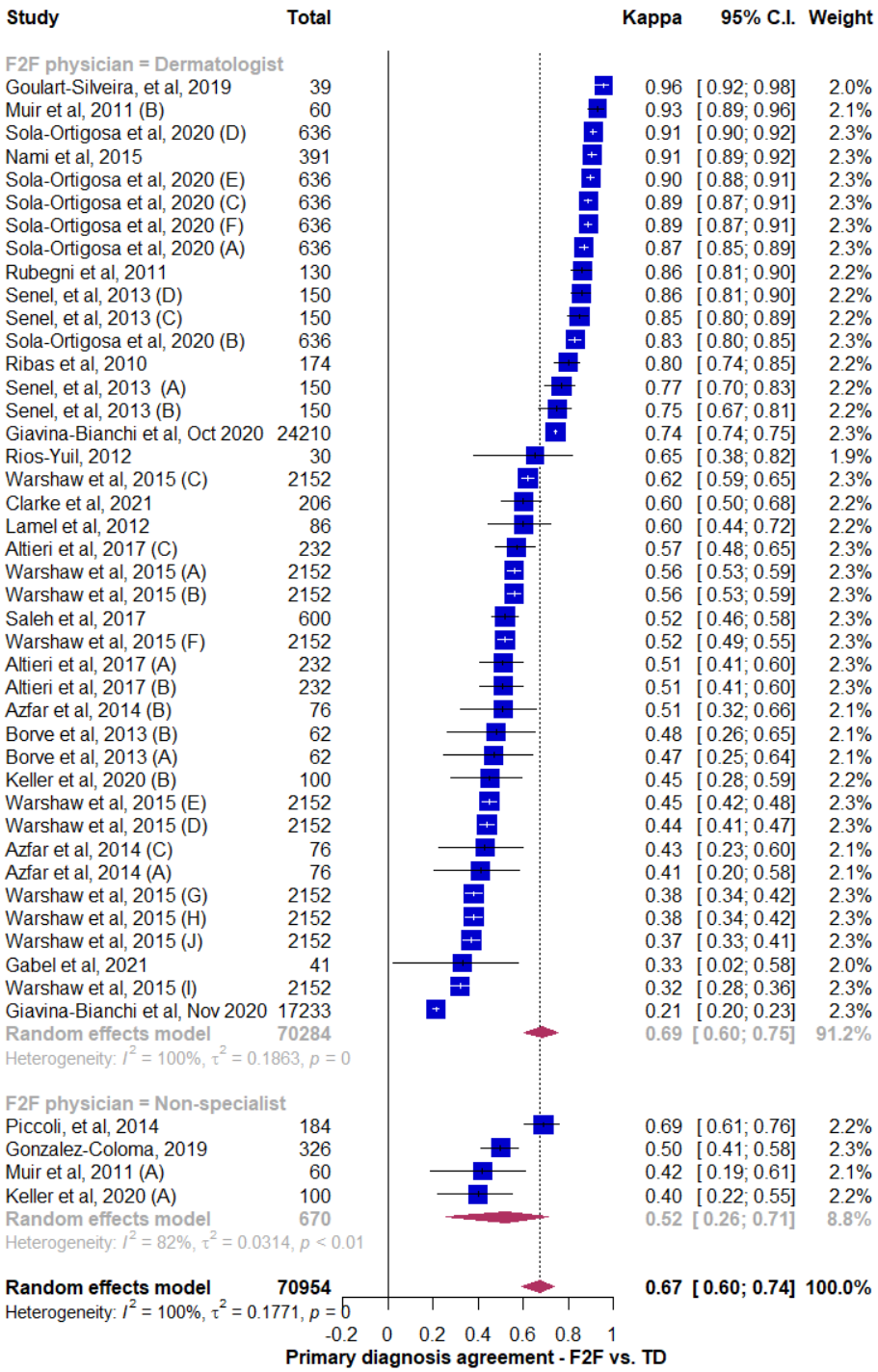
eFigure 2. Forest plot representing teledermatologists, F2F physicians, and histopathology primary diagnostic agreements. (A) Forest plot representing percentage agreement between teledermatologist and teledermatologist and 95% C.I. for overall concordance across ten studies with a total of 17 unique number of comparisons, N of events and total included participants. (B) Forest plot representing kappa concordance and 95% C.I. for overall concordance between two F2F physician diagnoses across four studies with a total of six unique number of comparisons, N of total included participants. (C) Forest plot representing percentage agreement between teledermatologists and histopathology with 95% C.I. for overall concordance across six studies, N of events and total included participants. Abbreviations: F2F (Face-to-Face), PCP (Primary Care Provider), TD (Teledermatology or Teledermatologist).

A



376

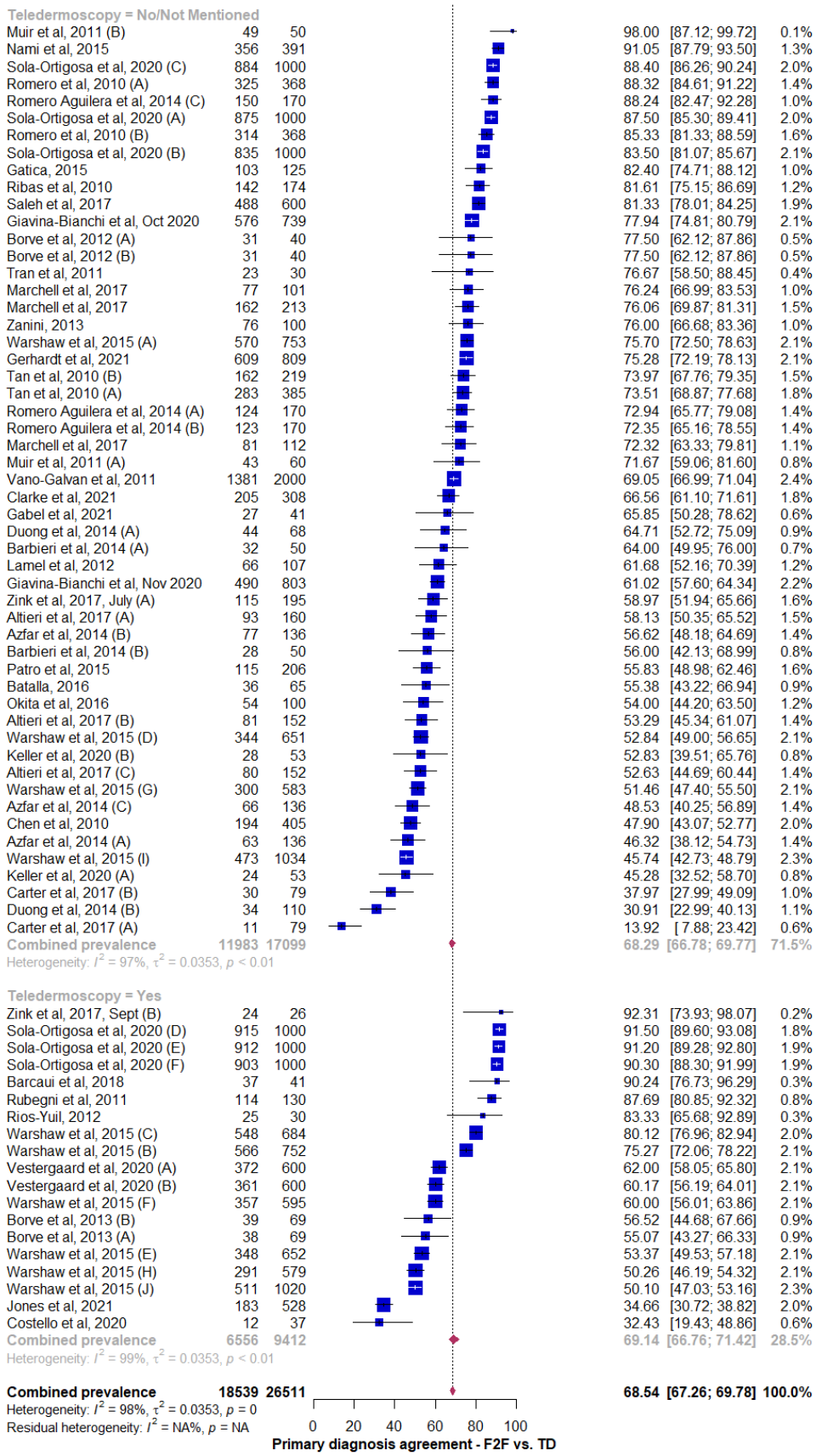
B



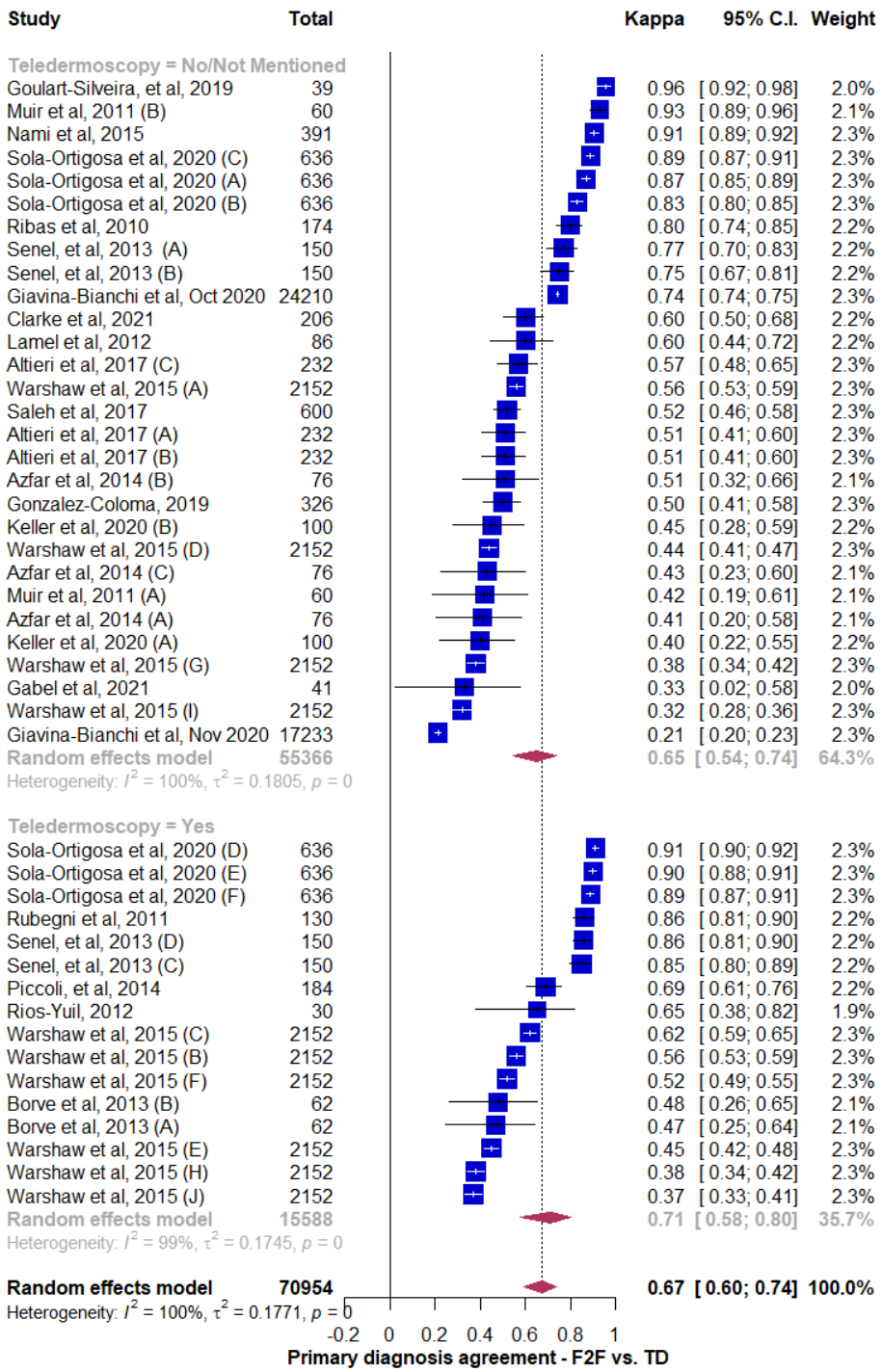
eFigure 3. Forest plot representing F2F and teledermatology primary diagnostic agreement by specialization status of the F2F physician. Studies were sorted into two groups, a) F2F diagnosis completed by a board-certified dermatologist; b) F2F diagnosis completed by a non-specialist (e.g., general practitioner). (A) Forest plot representing percentage agreement and 95% C.I. for overall concordance across 40 studies with a total of 72 unique number of comparisons, N of events and total included participants. (B) Forest plot representing kappa concordance and 95% C.I. for overall concordance across 21 studies with a total of 45 unique number of comparisons, N of total included

participants. Abbreviations: F2F (Face-to-Face), PCP (Primary Care Provider), TD (Teledermatology or Teledermatologist).

A

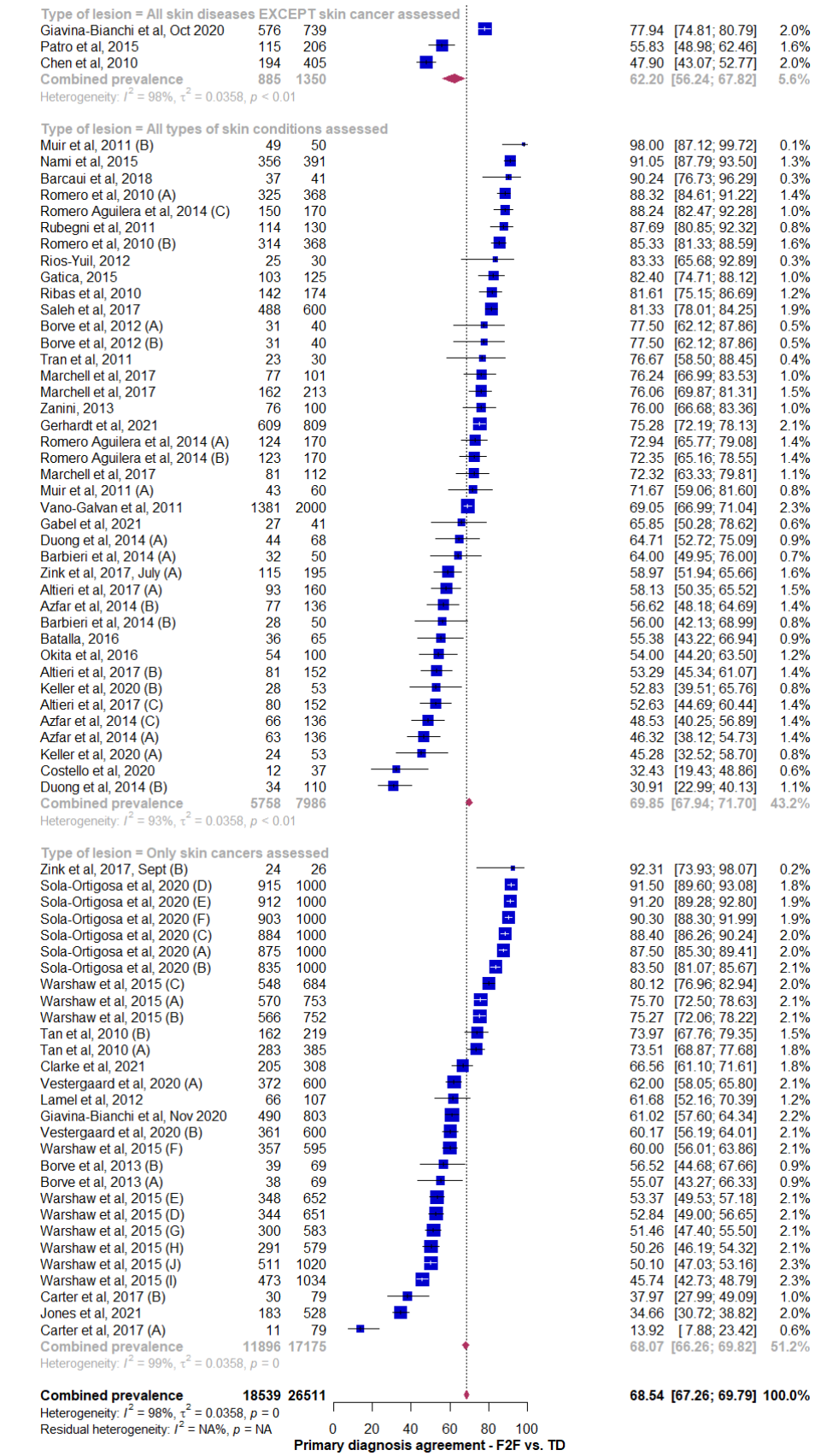


B

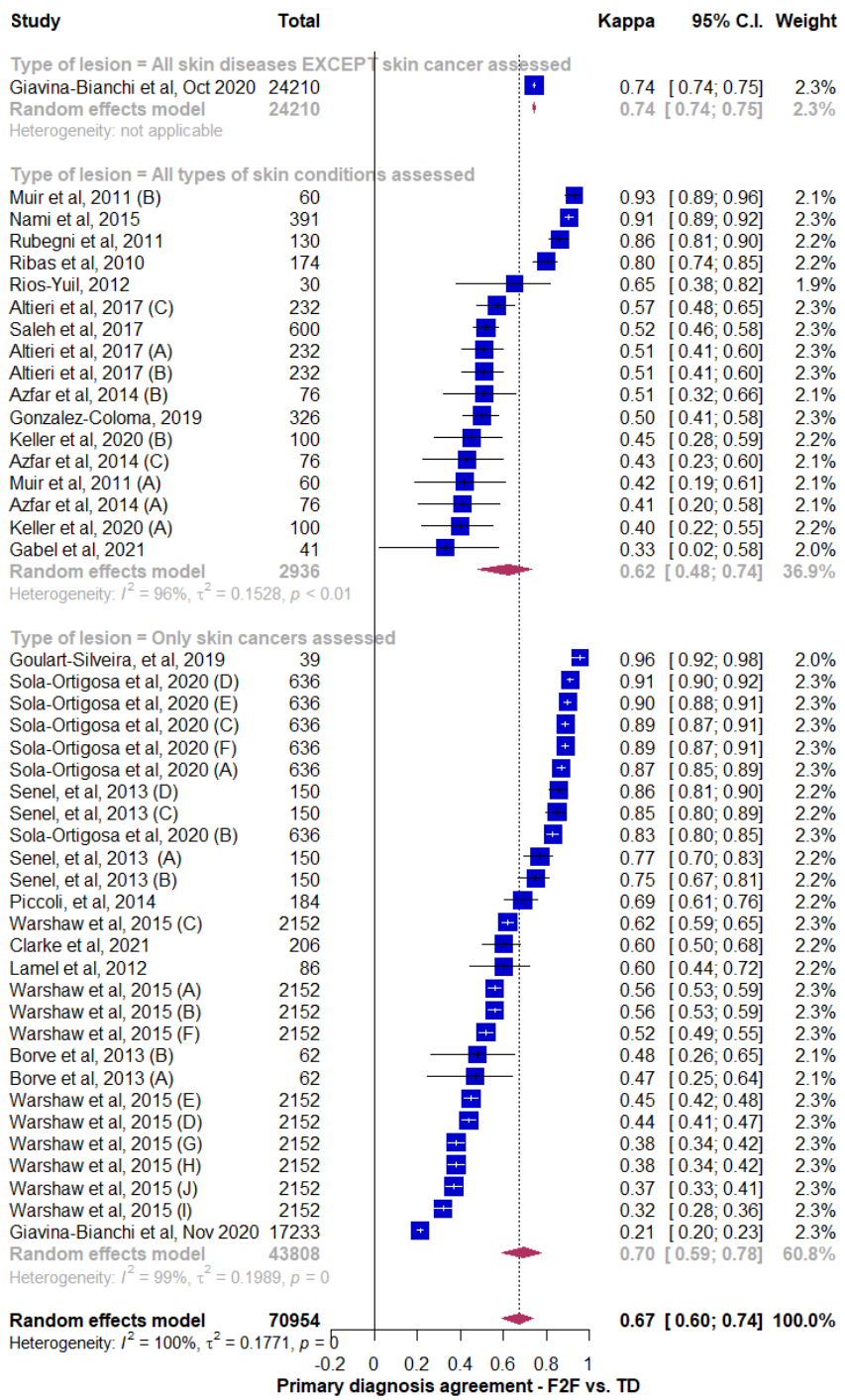


eFigure 4. Forest plot representing F2F and teledermatology primary diagnostic agreement by utilization of teledermoscopy. Studies were sorted into two groups, i) Did not use or did not report the use of teledermoscopy; ii) Used teledermoscopy. (A) Forest plot representing percentage agreement and 95% C.I. for overall concordance across 12 studies with a total of 22 unique number of comparisons, N of events and total included participants. (B) Forest plot representing kappa concordance and 95% C.I. for overall concordance across seven studies with a total of 16 unique number of comparisons, N of total included participants. Abbreviations: F2F (Face-to-Face), PCP (Primary Care Provider), TD (Teledermatology or Teledermatologist).

A



B



eFigure 5. Forest plot representing F2F and teledermatology primary diagnostic agreement by skin lesion category. Studies were sorted into three groups according to the type of lesions included, i) All skin conditions except likely malignant lesions; ii) All skin conditions; iii) Likely malignant lesions only. (A) Forest plot representing percentage agreement and 95% C.I. for overall concordance across 26 studies with a total of 39 unique number of comparisons, N of events and total included participants. (B) Forest plot representing kappa concordance and 95% C.I. for overall concordance across ten studies with a total of 27 unique number of comparisons, N of total included participants. Abbreviations: F2F (Face-to-Face), PCP (Primary Care Provider), TD (Teledermatology or Teledermatologist).

Author, Year	Study design	Country	Funding reported	Intervention	*Outcome	Patients (n)	Female (%)	Mean Age (y)	Lesions (N)
TD vs F2F Dermatologist									
Altieri, et al, 2017	Prospective Cohort	USA	Y	TD and F2F dermatologists via clinical images taken by digital photography	Diagnostic agreement rate, Concordance	232	N/A	NA	232
Azfar, et al, 2014	Prospective Cohort	USA, Botswana	N	TD and F2F dermatologists via smartphone images	Diagnostic agreement rate, Concordance	76	57	39	159
Barbieri, et al, 2014	Prospective Cohort	USA	N	TD and F2F dermatologists via smartphone images using the AccessDerm smartphone platform	Diagnostic agreement rate	50	64	55.2	50
Barcaui, et al, 2018	Prospective Cohort	Brazil	N	TD and F2F consult by the same dermatologist via digital photography and dermoscopy images stored in WhatsApp	Diagnostic agreement rate	31	71	56.5	41
Batalla, 2015	Retrospective Cohort	Spain	N	TD and F2F dermatologists by via clinical images	Diagnostic agreement rate	183	66	9	65
Borve, et al, 2012	Prospective Cohort	Sweden	Y	TD and F2F consults by the same dermatologist via smartphone images stored in Tele-Dermis	Diagnostic agreement rate	40	57.5	49	40
Gabel, et al, 2021	Prospective Cohort	USA	Y	TD and F2F dermatologists via clinical images taken by digital photography and tablets	Diagnostic agreement rate, Concordance	41	N/A	N/A	41
Gatica, et al, 2015	Prospective Cohort	Chile	N	TD and F2F dermatologists via clinical images taken by digital photography	Diagnostic agreement rate	125	57.6	37.7	125
Gerhardt, et al, 2021	Retrospective Cohort	USA	Y	TD and F2F dermatologists via clinical images	Diagnostic agreement rate	809	N/A	N/A	809
Keller, et al, 2020	Prospective Cohort	USA	Y	TD and F2F dermatologists or hospitalists on clinical images taken by smartphones and tablets	Diagnostic agreement rate, Concordance	100	43.2	N/A	100
Marchell, et al., 2017	Quasi RCT	USA	Y	TD and F2F dermatologists via digital photography, compressed and uncompressed video	Diagnostic agreement rate (SFTD, video)	216	N/A	N/A	216
Muir, et al, 2011	Prospective Cohort	Australia	N	TD and F2F emergency derms and non-specialists via clinical images taken by digital photography	Diagnostic agreement rate, Concordance	50	65	47	50
Nami, et al, 2015	Prospective Cohort	Italy and Austria	Y	TD and F2F dermatologists via smartphone images stored in MugDerma	Diagnostic agreement rate, Concordance	391	52.2	54	391
Okita, et al, 2016	Prospective Cohort	Brazil	N	TD and F2F dermatologists via smartphone images	Diagnostic agreement rate	100	N/A	N/A	100
Ribas, et al, 2010	Prospective Cohort	Brazil	Y	TD and F2F dermatologists via digital photography	Diagnostic agreement rate, Concordance	174	53.4	34.7	174
Rios-Yuil, 2011	RCT	Panama	N	TD and F2F dermatologists via clinical images taken by digital photography for case conferences	Diagnostic agreement rate, Concordance	30	63.3	N/A	30
Romero Aguilera, et al, 2014	Prospective Cohort	Spain	Y	TD and F2F dermatologists via clinical images taken by digital photography stored in DERMARED.Some patients were seen by the same derm for F2F and TD.	Diagnostic agreement rate	457	56%	36	170
Romero, et al, 2010	RCT	Spain	Y	TD and F2F consults by the same dermatologist via digital photography and videoconferences via DERMARED software	Diagnostic agreement rate	328	56%	36	510
Rubegni, et al, 2011	Prospective Cohort	Italy	N	TD and F2F dermatologists via digital photography and dermoscopy images stored in Dermo-image.	Diagnostic agreement rate, Concordance	130	53.9	80.6	130
Saleh, et al, 2017	Prospective Cohort	Egypt	Y	TD and F2F dermatologists via clinical images taken by digital photography stored in Dropbox	Diagnostic agreement rate, Concordance	600	50.7	N/A	600
Tran, et al, 2011	Prospective Cohort	Egypt	Y	TD and F2F dermatologists via smartphone images stored in ClickDoc	Diagnostic agreement rate	30	N/A	N/A	30
Vano-Galvan, et al, 2010	Retrospective, Cross-sectional	Spain	N	TD and F2F dermatologists via clinical images taken by digital photography for case conferences	Diagnostic agreement rate, 100 patients each analyzed by 20 observers	100	N/A	N/A	100
Zanini, 2013	Prospective Cohort	Brazil	N	TD and F2F dermatologists via clinical images taken by digital photography	Diagnostic agreement rate	100	N/A	N/A	100
Zink, et al, 2017, July	Prospective Cohort	Germany	Y	TD and F2F dermatologists via smartphone images stored in the KLARA app	Diagnostic agreement rate	195	20.5	N/A	195

All lesions

Borve, et al, 2013	Prospective Cohort	Sweden	Y	TD and F2F consults by the same dermatologist via smartphone and dermoscopy images stored in iDoc 24 app	Diagnostic agreement rate, Concordance	62	38.7	64	69	Skin cancers only
Carter, et al, 2017	Ambispective Cohort	USA	Y	TD and F2F dermatologists, as well as F2F PCP via clinical images stored using Epic EHR software	Diagnostic agreement rate	79	74	47	79	
Clarke, et al, 2021	Prospective Cohort	USA	Y	TD and F2F dermatologists via clinical images taken by digital photography stored in Research Electronic Data Capture	Diagnostic agreement rate, Concordance	206	49.5	56.9	308	
Giavina-Bianchi, et al, 2020 Nov	Retrospective Cohort	Brazil	N	TD and F2F dermatologists via smartphone images	Diagnostic agreement rate, Concordance	17,233	71.4	N/A	803	
Goulart-Silveira et al, 2019	Prospective Cohort	Brazil	N	TD and F2F dermatologists via smartphone images acquired and stored via Telederma app	Concordance	39	69	68	39	
Lamel, et al, 2012	Prospective Cohort	USA	N	TD and F2F dermatologists via smartphone images stored in ClickDerm	Diagnostic agreement rate, Concordance	86	58.1	45.2	107	
Senel, et al, 2013	Prospective Cohort	Turkey	N	TD and F2F dermatologists via digital photography and dermoscopy images	Concordance with and without dermoscopy	150	49	55	150	
Sola-Ortigosa, et al, 2020	Prospective Cohort	Spain	N	TD and F2F consults by the same dermatologist via dermoscopy and clinical images taken by digital photography and tablets	Diagnostic agreement rate, Concordance	636	43.2	72.8	1,000	
Tan, et al, 2010	Prospective Cohort	New Zealand	Y	TD and F2F consults by the same dermatologist via digital photography	Diagnostic agreement rate	200	63	N/A	491	
Vestergaard, et al, 2020	Prospective Cohort	Denmark	N	TD and F2F dermatologists via smartphone and dermoscopy images using FotoFinder Systems	Diagnostic agreement rate, Concordance	519	57	55	600	
Warshaw, et al, 2015	Prospective, Cross-sectional	USA	N	TD and F2F dermatologists via digital photography and dermoscopy images	Diagnostic agreement rate, Concordance	2,152	3.2	68	3,021	
Zink, et al, 2017, Sept	Prospective Cohort	Germany	Y	TD and F2F dermatologists via smartphone and dermoscopy images using Handyfotos	Diagnostic agreement rate	26	N/A	N/A	26	
Giavina-Bianchi, et al, 2020 Oct	Retrospective Cohort	Brazil	N	TD and F2F dermatologists via smartphone images	Diagnostic agreement rate, Concordance	24,210	70	N/A	739	B.

Author, Year	Study design	Country	Funding reported	Intervention	*Outcome	Patients (n)	Female (%)	Mean Age (y)	Lesions (N)	
TD vs F2F Non-specialist										
Costello, et al, 2019	Prospective, Cross-sectional	USA	Y	TD and F2F PCP via smartphone and dermoscopy images using the Photo Exam app	Diagnostic agreement rate	37	65	47.9	37	All skin lesions
Duong, et al, 2014	Prospective, Observational	France	Y	TD and F2F emergency physicians via smartphone images and videoconferences	Diagnostic agreement rate (SFTD, video)	194	N/A	N/A	178	
Gonzalez-Coloma, et al, 2019	Prospective, Cross-sectional	Chile	N	TD and F2F PCP via clinical images	Diagnostic concordance	326	59	35.8	326	
Keller, et al, 2020	Prospective Cohort	USA	Y	TD and F2F dermatologists or hospitalists on clinical images taken by smartphones and tablets	Diagnostic agreement rate, Concordance	100	43.2	N/A	100	
Muir, et al, 2011	Prospective Cohort	Australia	N	TD and F2F emergency physicians via clinical images taken by digital photography	Diagnostic agreement rate, Concordance	60	65	47	60	
Carter, et al, 2017	Ambispective Cohort	USA	Y	TD and F2F dermatologists, as well as F2F PCP via clinical images stored using Epic EHR software	Diagnostic agreement rate	79	74	47	79	Skin cancers only
Jones, et al, 2021	Retrospective Cohort	New Zealand	Y	TD and F2F PCP via digital photography and dermoscopy images	SSC matched for age, sex, and ethnicity. Diagnostic agreement rate	481	64	N/A	528	
Piccoli, et al, 2015	Retrospective, Cross-sectional	Brazil	Y	TD and F2F PCP via digital photography and dermoscopy images	Diagnostic concordance	184	73.4	54.7	184	
Chen, et al, 2010	Retrospective Cohort	USA	Y	TD and F2F PCP via clinical images stored in Second Opinion Software	Diagnostic agreement rate	405	50.6	5.9	405	B.
Patro, et al 2015	Prospective Cohort	India	Y	TD and F2F PCP via digital photography	Diagnostic agreement rate	206	58.7	N/A	206	

eTable 1. Study and patient characteristics for all included studies. The table is divided into two sections: one comparing teledermatology with Face-to-Face (F2F) dermatologists, and another comparing teledermatologists with F2F non-specialists. The studies are listed alphabetically and grouped by lesion type. *See supplementary **eTable 4** for agreement rates and concordance values. Abbreviations used in the table include B (Benign lesions only), ED (Emergency Department), EHR (Electronic Health Record), F2F (Face-to-Face), Histo

(Histopathology), ICD10 (International Classification of Diseases, 10th Edition), N (No), NA (Not available), PCP (Primary Care Provider), PLD (Polarized Light Dermoscopy), RCT (Randomized Controlled Trial), SFTD (Store-and-Forward Teledermatology), SSC (Specialized Skin Clinic), TD (Teledermatology or Teledermatologist), and Y (Yes). Patient characteristics for all 44 included studies are also provided, grouped by lesion type, with a column describing special inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
Primary articles assessing diagnostic agreement where store-and-forward technology or live video conference consults were compared with a control group who attend in-person visits.	Survey articles, feasibility studies, studies regarding other forms of telemedicine unrelated to dermatology, cost-effectiveness studies, editorials, and review articles.
Primarily comparing teledermatology to F2F, sometimes using histopathology as the reference standard.	Studies that clearly stated they used telermatologists as the gold- or reference standard. Studies that only compared dermatoscopic images in the absence of clinical images. Studies where patients captured their own photographs.

eTable 2. Inclusion and exclusion criteria for screening of literature search results.
F2F: Face-to-Face.

Study characteristics Author, year, title, study type, objective, country of publication. Patient characteristics: total number of participants included declaration of funding source, number of participants per study, mean age +/- SD, age range, gender, mean BMI and range, race/ethnicity, type of lesions evaluated, type of patients evaluated.
Methodology - teledermatology and F2F consults Method of correspondence, platform used for the teledermatology consult, training on teledermatology platform, length of teledermatology and F2F consult, experience of the teledermatologist and F2F physician, location of the teledermatologist, number of teledermatologists and F2F physicians who made a diagnosis for each patient, total number of telermatologists and F2F physicians in study, order of visits, wait time between teledermatology and F2F consult, whether same specialist conducted teledermatology and F2F visit, specialization of the F2F physician, number of reviews; qualifications of the individual who acquired the clinical photographs and whether they received additional training on taking clinical photographs.
Metrics and results Technology used for image acquisition and for viewing images with, distance between camera and lesion, number of images taken, use of teledermoscopy & dermoscopy, brand of dermatoscope, use of histopathology, referral content provided to teledermatologist, primary and differential diagnoses agreement and concordance rates, diagnostic accuracy values (if available) such as sensitivity, specificity, PPV and NPV.

eTable 3. Data extraction form with details of domains record.
F2F: Face-to-Face, PPV: Positive Predictive Value, NPV: Negative Predictive Value.

Author and Year	Unique Study Grouping	Participants (n)	Lesions (N)	Primary Diagnosis Agreement F2F vs F2F (%)	Diagnosis Agreement (N) / Total Diagnoses (N)	Primary Diagnosis Agreement TD vs TD (%)	Diagnosis Agreement (N) / Total Diagnoses (N)	Primary Diagnosis Agreement TD vs F2F (%)	Diagnosis Agreement (N) / Total Diagnoses (N)	Primary Diagnosis Agreement TD vs Histo (%)	Diagnosis Agreement (N) / Total Diagnoses (N)	Primary Diagnosis Kappa Value TD vs F2F	Primary Diagnosis Kappa Value TD vs Histo
Altieri et al, 2017 (A)	F2F Derm vs TD1	232	232					58	93/160			0.51	
Altieri et al, 2017 (B)	F2F Derm vs TD2	232	232					53	81/152			0.51	
Altieri et al, 2017 (C)	F2F Derm vs TD3	232	232					53	80/152			0.57	
Azfar et al, 2014 (A)	F2F Derm vs TD1	76	159					47	63/136			0.41	
Azfar et al, 2014 (B)	F2F Derm vs TD2	76	159					57	77/136			0.51	
Azfar et al, 2014 (C)	F2F Derm vs TD3	76	159					49	66/136			0.43	
Barbieri et al, 2014 (A)	F2F Derm vs TD1	50	50			58	29/50	64	32/50				
Barbieri et al, 2014 (B)	F2F Derm vs TD2	50	50					56	28/50				
Barcaui et al, 2018	F2F Derm vs TD	31	41					90	37/41				
Batalla, 2016	F2F Derm vs TD	183	183					55	36/65				
Borve et al, 2012 (A)	F2F Derm vs TD1	40	40	88	35/40	68	27/40	78	31/40				
Borve et al, 2012 (B)	F2F Derm vs TD2	40	40					78	31/40				

Borve et al, 2013 (A)	F2F Derm vs TD1	62	69	58	40/69	55	38/69			0.47	0.51
Borve et al, 2013 (B)	F2F Derm vs TD2	62	69			57	39/69			0.48	
Carter et al, 2017 (A)	F2F nonspecialist vs TD	79	79	38	30/79	14	11/79				
Carter et al, 2017 (B)	F2F Derm vs TD	79	79			38	30/79				
Chen et al, 2010	F2F nonspecialist vs TD	405	405			48	194/405				
Clarke et al, 2021	F2F Derm vs TD	206	308			67	205/308	65	40/62	0.6	
Costello et al, 2020	F2F nonspecialist vs TD	37	37			32	12/37				
Duong et al, 2014 (A)	F2F nonspecialist vs TD (Videoconference)	111	110			65	44/68				
Duong et al, 2014 (B)	F2F nonspecialist vs TD (SFTD)	111	110			31	34/110				
Gabel et al, 2021	F2F Derm vs TD	41	41			67	27/41			0.33	
Gatica, 2015	F2F Derm vs TD	125	125			82	103/125				
Gerhardt et al, 2021	F2F Derm vs TD	809	809			75	609809				
Giavina-Bianchi et al, Nov 2020	F2F Derm vs TD	17233	17233			61	490/803	54	156/289	0.21	0.09
Giavina-Bianchi et al, Oct 2020	F2F Derm vs TD	24210	27519			78	576/739			0.74	
Gonzalez-Coloma, 2019	F2F nonspecialist vs TD	326	326							0.5	
Goulart-Silveira, et al, 2019	F2F Derm vs TD	39	39							0.96	0.56
Jones et al, 2021	F2F nonspecialist vs TD (Suspicious Skin Cancer pathway)	NA	528			35	183/528	53	60/114		
Keller et al, 2020 (A)	F2F nonspecialist vs TD	100	100			45	24/53			0.4	
Keller et al, 2020 (B)	F2F Derm vs TD	100	100			53	28/53			0.45	
Lamel et al, 2012	F2F Derm vs TD	86	107			62	66/107			0.6	

Marchell et al, 2017	F2F Derm vs TD (SFTD)	216	216	91	122/134			76	162/213			
Marchell et al, 2017	F2F Derm vs TD (Uncompressed video)	216	216					76	77/101			
Marchell et al, 2017	F2F Derm vs TD (Compressed video)	216	216					72	81/112			
Muir et al, 2011 (A)	F2F nonspecialist vs TD	60	60					72	43/60			0.42
Muir et al, 2011 (B)	F2F Derm vs TD	60	60					98	49/50			0.93
Nami et al, 2015	F2F Derm vs TD	391	391					91	356/391			0.91
Okita et al, 2016	F2F Derm vs TD	100	100					54	54/100			
Patro et al, 2015	F2F nonspecialist vs TD	206	206					56	115/206			
Piccoli, et al, 2014	F2F nonspecialist vs TD	184	184									0.69
Ribas et al, 2010	F2F Derm vs TD	174	174	83	145/174	81	141/174	82	142/174			0.8
Rios-Yuil, 2012	F2F Derm vs TD	30	30					83	25/30	67		0.65
Romero Aguilera et al, 2014 (A)	F2F Derm vs TD1	457	192			69	118/170	73	124/170			
Romero Aguilera et al, 2014 (B)	F2F Derm vs TD2	457	192			73	124/170	72	123/170			
Romero Aguilera et al, 2014 (C)	F2F Derm vs TD3	457	192			67	114/170	88	150/170			
Romero et al, 2010 (A)	F2F Derm vs TD (SFTD)	457	192					88	325/368			
Romero et al, 2010 (B)	F2F Derm vs TD (SFTD and videoconferencing)	457	176					85	314/368			
Rubegni et al, 2011	F2F Derm vs TD	130	130					88	114/130			0.86
Saleh et al, 2017	F2F Derm vs TD	600	600			88	526/600	81	488/600			0.46-0.52
Senel, et al, 2013	F2F Derm vs TD1 (no dermoscopy)	150	150									0.77
Senel, et al, 2013	F2F Derm vs TD2 (no dermoscopy)	150	150									0.75

Senel, et al, 2013	F2F Derm vs TD1 (dermoscopy)	150	150									0.85
Senel, et al, 2013	F2F Derm vs TD2 (dermoscopy)	150	150									0.86
Sola-Ortigosa et al, 2020 (A)	F2F Derm vs TD1 (no dermoscopy)	636	1000			82	821/1000	88	875/1000			0.87
Sola-Ortigosa et al, 2020 (B)	F2F Derm vs TD2 (no dermoscopy)	636	1000			83	832/1000	84	835/1000			0.83
Sola-Ortigosa et al, 2020 (C)	F2F Derm vs TD3 (no dermoscopy)	636	1000			81	813/1000	88	884/1000			0.89
Sola-Ortigosa et al, 2020 (D)	F2F Derm vs TD1 (dermoscopy)	636	1000			92	915/1000	92	915/1000			0.91
Sola-Ortigosa et al, 2020 (E)	F2F Derm vs TD2 (dermoscopy)	636	1000			90	902100	91	912/1000			0.9
Sola-Ortigosa et al, 2020 (F)	F2F Derm vs TD3 (dermoscopy)	636	1000			90	899/1000	90	903/1000			0.89
Tan et al, 2010 (A)	F2F Derm vs TD1, F2F Derm 1 vs F2F Derm 2	200	491	82	157/191	72	355/491	74	283/385			
Tan et al, 2010 (B)	F2F Derm vs TD2, F2F Derm 2 vs F2F Derm 3	200	491	76	80/106			74	162/219			
Tan et al, 2010 (C)	F2F Derm 1 vs F2F Derm 3	200	491	76	147/194							
Tran et al, 2011	F2F Derm vs TD	30	30					75	23/30			
Vano-Galvan et al, 2011	F2F Derm vs TD	100	100					69	1381/2000			
Vestergaard et al, 2020 (A)	A F2F Derm vs TD1	519	600			62	370/600	62	372/600	58	170/292	
Vestergaard et al, 2020 (B)	F2F Derm vs TD2	519	600					60	361/600	54	157/292	
Warshaw et al, 2015 (A)	F2F Derm vs TD (non biopsied pigmented lesions, Macro)	2152	3021					76	570/753			0.56
Warshaw et al, 2015 (B)	F2F Derm vs TD (non biopsied pigmented lesions, Macro+PLD)	2152	3021					75	566/752			0.56
Warshaw et al, 2015 (C)	F2F Derm vs TD (non biopsied pigmented lesions, Macro+PLD)	2152	3021					80	548/684			0.62

Warshaw et al, 2015 (D)	F2F Derm vs TD (biopsied pigmented lesions, Macro)	2152	3021	53	344/651			0.44
Warshaw et al, 2015 (E)	F2F Derm vs TD (biopsied pigmented lesions, Macro+PLD)	2152	3021	53	348/652			0.45
Warshaw et al, 2015 (F)	F2F Derm vs TD (biopsied pigmented lesions, Macro+PLD)	2152	3021	60	357/595			0.52
Warshaw et al, 2015 (G)	F2F Derm vs TD (NONbiopsied NONpigmented lesions, Macro)	2152	3021	52	300/583			0.38
Warshaw et al, 2015 (H)	F2F Derm vs TD (NONbiopsied NONpigmented lesions, Macro+PLD)	2152	3021	50	291/579			0.38
Warshaw et al, 2015 (I)	F2F Derm vs TD (biopsied NONpigmented lesions, Macro)	2152	3021	46	473/1034			0.32
Warshaw et al, 2015 (J)	F2F Derm vs TD (biopsied NONpigmented lesions, Macro+PLD)	2152	3021	50	511/1020			0.37
Zanini, 2013	F2F Derm vs TD	100	100	76	76/100			
Zink et al, 2017, July (A)	F2F Derm vs TD	195	195	59	115/195	56	108/195	
Zink et al, 2017, Sept (B)	F2F Derm vs TD	26	26	92	24/26	67	17/26	

eTable 4. Included unique study groupings and letter codes for individual agreement rates and kappa concordance values. The abbreviations used in the text are as follows: TD (Teledermatology or Teledermatologist), Derm (Dermatologist), F2F (Face-to-Face), SFTD (Store and Forward Technology), PLD (Polarized Light Dermoscopy), and Macro (Macroscopic clinical images).

Study ID	Journal	Reason For Exclusion
NCT03034694, 2016	ClinicalTrials.gov	Wrong study design
Andersson et al, 2017	Lakartidningen	Wrong study design
Romero et al, 2018	Actas dermo-sifiliograficas	Wrong study design
Orruno et al, 2016	Health Technology Assessment Database	Wrong study design
Batalla et al, 2016	Piel	Wrong study design
Kroemer et al, 2011	British Journal of Dermatology	Wrong study design
Ernstberger et al, 2014	Zentralblatt fur Chirurgie	Wrong study design
Totty et al, 2018	Journal of wound care	Wrong study design
Wurm et al, 2013	Journal of Telemedicine and Telecare	Wrong study design
Wang et al, 2017	Telemedicine journal and e-health : the official journal of the American Telemedicine Association	Wrong study design
Singh et al, 2011	Australasian Journal of Dermatology	Wrong study design
Grey et al, 2017	Dermatitis	Wrong study design
Crompton et al, 2010	Journal of Visual Communication in Medicine	Wrong study design
Ali et al, 2021	JMIR formative research	Wrong study design
Boyce et al, 2011	Dermatology	Wrong study design
Berg et al, 2017	Sarcoidosis Vasculitis and Diffuse Lung Diseases	Wrong study design
Shin et al, 2014	Journal of telemedicine and telecare	Wrong study design
Gacto-Sanchez et al, 2020	Burns : journal of the International Society for Burn Injuries	Wrong study design
Tian et al, 2017	Journal of Cosmetic Dermatology	Wrong study design
Thind et al, 2011	Clinical and Experimental Dermatology	Wrong study design
Silveira et al, 2014	BMC Dermatology	Wrong study design
O'Connor et al, 2017	JAMA Dermatology	Wrong study design
Janda et al, 2020	The Lancet. Digital health	Wrong study design
Day et al, 2020	Military medicine	Wrong study design
Karlsson et al, 2015	Acta Dermato-Venereologica	Wrong study design
Seghers et al, 2015	Australasian Journal of Dermatology	Wrong study design
Hazenberg et al, 2010	Journal of Medical Engineering and Technology	Wrong study design
Borve et al, 2015	Acta Dermato-Venereologica	Wrong study design
Boissin et al, 2015	Burns	Wrong study design
Da Silva et al, 2018	Dermatology online journal	Wrong study design
Devrim et al, 2019	BMC pediatrics	Wrong study design
Danielsson et al, 2016	Health Technology Assessment Database	Wrong study design
Berglund et al, 2020	Journal of the European Academy of Dermatology and Venereology : JEADV	Wrong study design
Forsblom et al, 2013	Clinical Infectious Diseases	Wrong study design
G Bianchi et al, 2020	Journal of medical Internet research	Wrong study design
Congalton et al, 2015	Journal of the European Academy of Dermatology and Venereology	Wrong study design
Ferrandiz et al, 2012	Archives of Dermatology	Wrong study design
Ismail et al, 2018	International Journal of Women's Dermatology	Wrong study design
Gamus et al, 2019	International journal of medical informatics	Wrong study design
Paudel et al, 2020	Case reports in dermatological medicine	Wrong study design
Georgesen et al, 2020	Telemedicine journal and e-health : the official journal of the American Telemedicine Association	Wrong study design
Gagnon et al, 2015	Dermatology Times	Wrong study design
Philp et al, 2013	Pediatric Dermatology	Wrong study design
Mooney et al, 2011	Skin Research and Technology	Wrong study design
Do Khac et al, 2021	JMIR mHealth and uHealth	Wrong study design
Chambers et al, 2012	Journal of the American Academy of Dermatology	Wrong study design
Garcia-Romero et al, 2011	Telemedicine journal and e-health : the official journal of the American Telemedicine Association	Wrong study design
Ahmed et al, 2020	Annals of internal medicine	Wrong study design
Marwaha et al, 2019	Journal of the American Academy of Dermatology	Wrong study design
NCT02122432, 2014	ClinicalTrials.gov	Wrong study design
Lowe et al, 2021	Clinical and experimental dermatology	Wrong study design

Bowling et al, 2011	Wound Repair and Regeneration	Wrong study design
Marin-Gomez et al, 2020	Journal of primary care & community health	Wrong study design
Veronese et al, 2021	Diagnostics (Basel, Switzerland)	Wrong study design
Ismail et al, 2018	International journal of dermatology	Wrong study design
NCT02905851, 2016	ClinicalTrials.gov	Wrong study design
Trinidad et al, 2020	Journal of the American Academy of Dermatology	Wrong study design
Tensen et al, 2019	Studies in health technology and informatics	Wrong study design
Karavan et al, 2014	Journal of telemedicine and telecare	Wrong study design
Viola et al, 2011	Archives of Dermatology	Wrong study design
van Netten et al, 2017	Scientific reports	Wrong study design
Cai et al, 2016	Burns : journal of the International Society for Burn Injuries	Wrong study design
Hazenberg et al, 2010	Diabetes Technology and Therapeutics	Wrong study design
Jacoby et al, 2021	Journal of drugs in dermatology : JDD	Wrong study design
Pak et al, 2018	Wound repair and regeneration : official publication of the Wound Healing Society [and] the European Tissue Repair Society	Wrong study design
Kummerow Broman et al, 2019	JAMA surgery	Wrong study design
Munoz-Lopez et al, 2021	Journal of the European Academy of Dermatology and Venereology : JEADV	Wrong study design
Markun et al, 2017	Medicine	Wrong study design
Piette et al, 2017	Journal of telemedicine and telecare	Wrong study design
Tan et al, 2010	British Journal of Dermatology	Wrong study design
Watson et al, 2010	Archives of Dermatology	Wrong study design
Wiseman et al, 2016	Journal of vascular surgery. Venous and lymphatic disorders	Wrong study design
Wolf et al, 2013	JAMA dermatology	Wrong study design
Laggis et al, 2020	The American Journal of dermatopathology	Wrong study design
Kazi et al, 2021	Telemedicine journal and e-health : the official journal of the American Telemedicine Association	Wrong study design
Kanthraj et al, 2013	Indian Journal of Dermatology, Venereology and Leprology	Wrong study design
Shah et al, 2016	Journal of the American Academy of Dermatology	Wrong study design
Kim et al, 2018	Skin research and technology	Wrong study design
Nguyen et al, 2017	Journal of Clinical and Aesthetic Dermatology	Wrong study design
Rizvi et al, 2020	PloS one	Wrong study design
Mehrtens et al, 2019	Clinical and experimental dermatology	Wrong study design
Knudsen et al, 2012	Lakartidningen	Research letter or letter to the editor
Korman et al, 2020	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Mercer et al, 2014	Journal of Cutaneous Medicine and Surgery	Research letter or letter to the editor
Grunig et al, 2015	JAMA Dermatology	Research letter or letter to the editor
Cartron et al, 2020	Dermatologic therapy	Research letter or letter to the editor
McAfee et al, 2020	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Wong et al, 2021	JAMA dermatology	Research letter or letter to the editor
Baranowski et al, 2020	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Micheletti et al, 2014	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Osei-Tutu et al, 2013	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Nair et al, 2015	International Journal of Dermatology	Research letter or letter to the editor
Miller et al, 2021	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Keleshian et al, 2017	Journal of the American Academy of Dermatology	Research letter or letter to the editor
HAYES; Inc et al, 2016	Health Technology Assessment Database	Research letter or letter to the editor
Jacob et al, 2017	Journal of telemedicine and telecare	Research letter or letter to the editor
Perkins et al, 2020	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Halpern et al, 2010	British Journal of Dermatology	Research letter or letter to the editor
Newman et al, 2020	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Hunt et al, 2020	Clinical and experimental dermatology	Research letter or letter to the editor
2018	Nursing	Research letter or letter to the editor
Taneja et al, 2021	Indian journal of dermatology, venereology and leprology	Research letter or letter to the editor
Echeverria-Garcia et al, 2019	Actas dermo-sifiliograficas	Research letter or letter to the editor
Henning et al, 2010	Archives of Dermatology	Research letter or letter to the editor

Demo et al, 2019	Clinical and experimental dermatology	Research letter or letter to the editor
Byamba et al, 2015	British Journal of Dermatology	Research letter or letter to the editor
Gupta et al, 2020	Journal of the American Academy of Dermatology	Research letter or letter to the editor
De Giorgi et al, 2017	Journal of the European Academy of Dermatology and Venereology	Research letter or letter to the editor
Duong et al, 2016	Annales de Dermatologie et de Venereologie	Research letter or letter to the editor
Mortimer et al, 2021	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Gravely et al, 2010	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Choi et al, 2021	International journal of dermatology	Research letter or letter to the editor
Motley et al, 2012	BMJ: British Medical Journal (Clinical Research Edition)	Research letter or letter to the editor
Leavitt et al, 2016	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Cheng et al, 2020	Dermatitis : contact, atopic, occupational, drug	Research letter or letter to the editor
Clark et al, 2021	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Fuesl et al, 2010	MMW-Fortschritte der Medizin	Research letter or letter to the editor
English III et al, 2013	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Cotes et al, 2021	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Abi Rafeh et al, 2021	Journal of cutaneous medicine and surgery	Research letter or letter to the editor
Okeke et al, 2020	The Journal of dermatological treatment	Research letter or letter to the editor
Splete et al, 2014	Emergency Medicine (00136654)	Research letter or letter to the editor
Khosravi et al, 2021	Clinical and experimental dermatology	Research letter or letter to the editor
Sivesind et al, 2021	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Stoecker et al, 2013	JAMA dermatology	Research letter or letter to the editor
Skayem et al, 2020	Journal of the European Academy of Dermatology and Venereology : JEADV	Research letter or letter to the editor
Su et al, 2020	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Massone et al, 2021	Anais brasileiros de dermatologia	Research letter or letter to the editor
Li et al, 2021	The Journal of infection	Research letter or letter to the editor
Afanasiev et al, 2021	Journal of the American Academy of Dermatology	Research letter or letter to the editor
Varma et al, 2011	British Journal of Dermatology	Research letter or letter to the editor
Van Der Heijden et al, 2010	Journal of the European Academy of Dermatology and Venereology	Research letter or letter to the editor
Motley et al, 2012	BMJ (Online)	Research letter or letter to the editor
Villani et al, 2020	Dermatologic therapy	Research letter or letter to the editor
Portnoy et al, 2018	The journal of allergy and clinical immunology. In practice	Research letter or letter to the editor
Tschandl et al, 2018	British Journal of Dermatology	Research letter or letter to the editor
Poolworaluk et al, 2020	Future healthcare journal	Research letter or letter to the editor
Anonymous et al, 2020	Journal of drugs in dermatology : JDD	Research letter or letter to the editor
Tan et al, 2021	Annals of the Academy of Medicine, Singapore	Research letter or letter to the editor
Silva et al, 2021	Anais brasileiros de dermatologia	Research letter or letter to the editor
de Giorgi et al, 2016	International Journal of Dermatology	Wrong outcomes
Senel et al, 2014	Journal of telemedicine and telecare	Wrong outcomes
Goodier et al, 2021	Contact dermatitis	Wrong outcomes
Foolad et al, 2017	International Journal of Dermatology	Wrong outcomes
Wells et al, 2020	The Journal of clinical and aesthetic dermatology	Wrong outcomes
Arzberger et al, 2016	Acta Dermato-Venereologica	Wrong outcomes
Creighton-Smith et al, 2017	International Journal of Dermatology	Wrong outcomes
Marwaha et al, 2019	Journal of the American Academy of Dermatology	Wrong outcomes
Pasquali et al, 2021	Actas dermo-sifiliograficas	Wrong outcomes
Vestergaard et al, 2020	Family practice	Wrong outcomes
Kravets et al, 2018	Acta dermatovenerologica Alpina, Pannonica, et Adriatica	Wrong outcomes
Speiser et al, 2014	American Journal of Dermatopathology	Wrong outcomes
N/A	Journal of the American Academy of Dermatology	Wrong outcomes
Whited et al, 2013	Journal of Telemedicine and Telecare	Wrong outcomes

Abhishek et al, 2021	medRxiv	Wrong outcomes
Villa et al, 2020	Internal and emergency medicine	Wrong outcomes
Lubeek et al, 2016	Tijdschrift voor gerontologie en geriatrie	review
Ndegwa et al, 2016	Health Technology Assessment Database	review
Moreno-Ramirez et al, 2017	Acta dermato-venereologica	review
Moreno-Ramirez et al, 2017	Acta Dermato-Venereologica	review
Van Der Heijden et al, 2010	Huisarts en Wetenschap	review
Walocko et al, 2017	Dermatologic Clinics	review
Roman et al, 2014	Journal of the Dermatology Nurses' Association	review
Hart et al, 2011	Telemedicine journal and e-health : the official journal of the American Telemedicine Association	review
Elsner et al, 2020	Journal der Deutschen Dermatologischen Gesellschaft = Journal of the German Society of Dermatology : JDDG	review
Kaliyadan et al, 2020	Indian journal of dermatology	review
Burch et al,		review
Evans et al, 2017	Pharmazeutische Zeitung	Editorial
Anonymous. et al, 2016	Journal of AHIMA / American Health Information Management Association	Editorial
Luk et al, 2018	Hong Kong Journal of Dermatology and Venereology	Editorial
Queen et al, 2018	International wound journal	Editorial
Anguita et al, 2014	Nurse Prescribing	Editorial
Haworth et al, 2020	Clinical and experimental dermatology	Editorial
Romero-Aguilera et al, 2019	Actas dermo-sifiliograficas	Editorial
Barrio Garde et al, 2016	Piel	Editorial
Morand et al, 2010	Annales de dermatologie et de venereologie	Editorial
N/A	Journal of the American Academy of Dermatology	Abstract
N/A	Journal of the American Academy of Dermatology	Abstract
Bianchi et al, 2020	Journal of the American Academy of Dermatology	Abstract
Creadore et al, 2020	Journal of the American Academy of Dermatology	Abstract
N/A	Journal of the American Academy of Dermatology	Abstract
Tognetti L et al, 2020		Abstract
SPLETE et al, 2014	Emergency Medicine (00136654)	Abstract
N/A	Journal of the American Academy of Dermatology	Abstract
Dahlen Gyllencreutz et al, 2017	Journal of the European Academy of Dermatology and Venereology	Wrong intervention
Tandjung et al, 2015	Journal of Evaluation in Clinical Practice	Wrong intervention
Paradela-De-La-Morena et al, 2015	European Journal of Dermatology	Wrong intervention
Horsham et al, 2015	British Journal of Dermatology	Wrong intervention
Saenz et al, 2018	International Journal of Telemedicine and Applications	Wrong intervention
Kochmann et al, 2016	Telemedicine journal and e-health : the official journal of the American Telemedicine Association	Wrong comparator
Markun et al, 2017	Medicine (United States)	Wrong comparator
Feigenbaum et al, 2017	Pediatric Dermatology	Wrong comparator
Massone et al, 2014	Journal of the European Academy of Dermatology and Venereology	Wrong comparator
MacLellan et al, 2021	Journal of the American Academy of Dermatology	Wrong comparator
Koysombat et al, 2021	Journal of plastic, reconstructive & aesthetic surgery : JPRAS	Corrrespondence
Jakhar et al, 2020	Clinical and experimental dermatology	Corrrespondence
Alkmim et al, 2013	Journal of Telemedicine and Telecare	Corrrespondence
NCT02836665, 2016	ClinicalTrials.gov	Clinical trial - no associated manuscript
JPRN-UMIN000020873 et al, 2016		Clinical trial - no associated manuscript
Fogel et al, 2016	Journal of the American Academy of Dermatology	Commentary
Hoyer et al, 2020	Cutis	Commentary
Pasadyn et al, 2020	Journal of the American Academy of Dermatology	Duplicate

Moreno-Ramirez et al, 2017	American Journal of Clinical Dermatology	Erratum
Trovato et al, 2011	Eplasty	Wrong patient population
Bowns et al, 2016	Health Technology Assessment Database	Wrong publication date
Gemelas et al, 2019	Telemedicine journal and e-health : the official journal of the American Telemedicine Association	Wrong setting

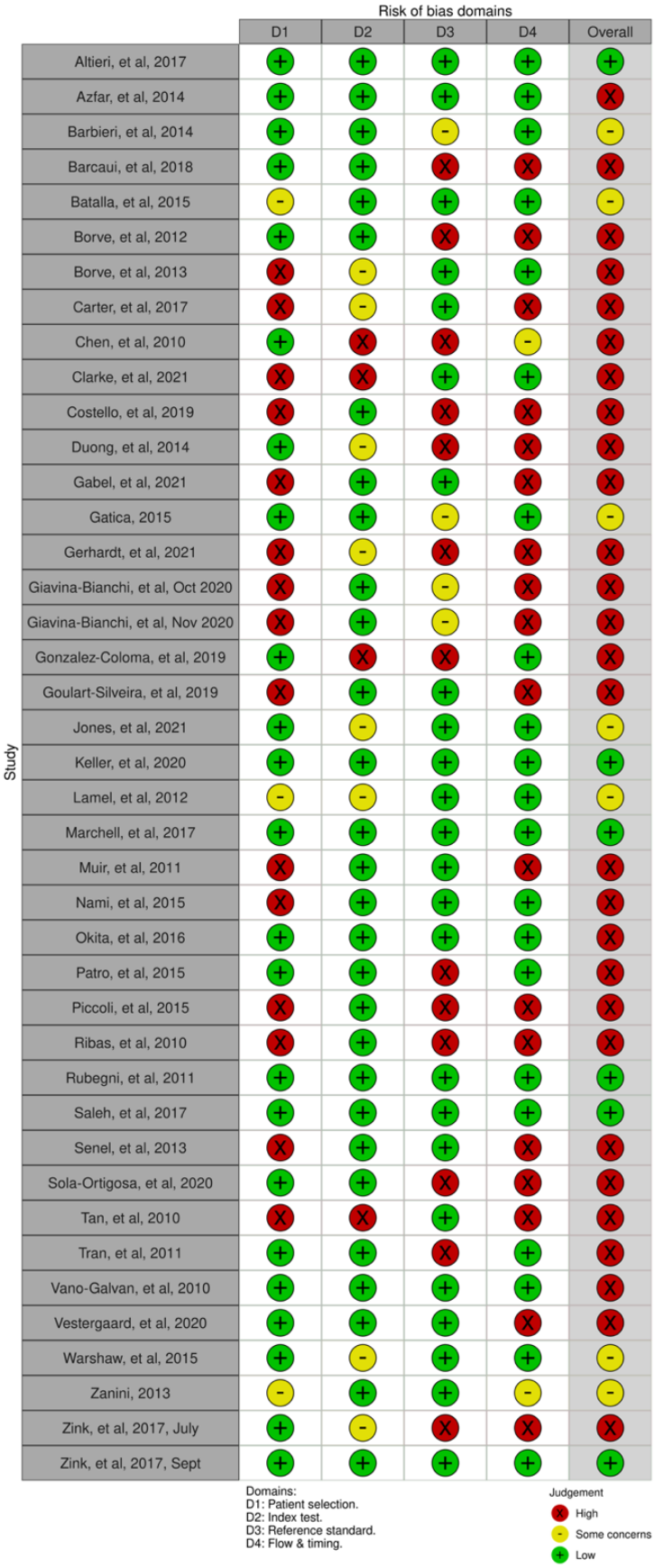
eTable 5. List of studies excluded at the full-text screening stage.

A

Domain 1: SAMPLE SELECTION		
Signalling Q1	Was a consecutive or random sample of patients enrolled? - In the study by Giavina-Bianchi et al., a consecutive sample of patients was enrolled, introducing less bias. Skewed patient demographics: e.g., over 70% female, select age groups, studies. that do not disclose age range and or sex/gender of the patients. - In the study by Carter et al., over 70% of the patients were female, which may introduce bias and reduce applicability.	Yes/No/Unclear
Signalling Q2	Was a case-control design avoided? - Gabel et al. avoided a case-control design, which reduces the risk of bias.	Yes/No/Unclear
Signalling Q3	Did the study avoid inappropriate exclusions? - In the study by Giavina-Bianchi et al., complex, and severe cases were excluded, which may introduce bias and affect applicability.	Yes/No/Unclear
Risk of bias	**Could the selection of patients have introduced bias?** - For example, Giavina-Bianchi removed the most complex/severe cases and then excluded any non-skin neoplasms, and then they further filtered to only include the 10 most common skin neoplasms.	RISK: LOW/HIGH/ UNCLEAR
Concerns regarding applicability	**Is there concern that the included patients do not match the review question?** - 'High' if the study only looked at a specific lesion category such as skin cancers only, or pigmented lesions only, or if they had a skewed patient demographics (e.g., 70% female, or geriatric population only). Our study is focuses on generalizability of teledermatology in all skin conditions.	RISK: LOW/HIGH/ UNCLEAR
Domain 2: INDEX TEST (Teledermatology consult)		
Signalling Q1	Were the derms/physicians making the index diagnoses unaware of the reference diagnosis? - Same dermatologist doing F2F and teledermatology consuls? Is there blinding of dermatologists to each other's diagnoses? In the study by Tan et al., the same dermatologist performed both the F2F and teledermatology consultations, which may introduce bias if they were not blinded to each other's diagnoses.	Yes/No/Unclear
Signalling Q2	Did the study require physicians to provide a specific primary diagnosis, or were they only required to provide a general grouping, e.g., inflammatory vs. skin neoplasm. Was analysis only performed for categories instead of complete primary diagnoses (such as skin neoplasm vs basal cell carcinoma)? Did physicians use standardized referral/consult sheet with set diagnoses? Did they group similar / synonymous diagnoses (e.g dermatitis / eczema together? Was a non-specialist in charge of comparing diagnoses and deciding if there was agreement? - In the study by Warshaw et al., physicians were required to provide a categorical or pooled diagnosis (e.g., skin neoplasm instead of basal cell carcinoma), which may introduce bias and reduce applicability.	Yes/No/Unclear
Risk of bias	**Could the conduct (technology used for taking images/viewing images) or interpretation (what constituted primary diagnosis/ complete agreement) of the index test have introduced bias?**	RISK: LOW/HIGH/ UNCLEAR
Concerns regarding applicability	Is there concern that the index test, its conduct, or interpretation differ from the review question?	RISK: LOW/HIGH/ UNCLEAR
Domain 3: REFERENCE TEST (F2F, in some cases histopathology)		
Signalling Q1	Describe the reference standard and how it was conducted and interpreted:	Yes/No/Unclear

	What was the order of visits? What was the experience level and specialization of the F2F physician? Did the same dermatologist do both teledermatology and F2F consult?	
Signalling Q2	Is the reference standard likely to correctly classify the target condition?	Yes/No/Unclear
Risk of bias	**Could the reference standard, its conduct, or its interpretation have introduced bias?** - In studies where the reference standard was a consultation with a non-specialist, such as Costello et al., there is a risk of introducing bias.	RISK: LOW/HIGH/ UNCLEAR
Concerns regarding applicability	**Could the reference standard, its conduct, or its interpretation have introduced bias?** - Applicability was impacted by physician specialization.	RISK: LOW/HIGH/ UNCLEAR
Domain 4: FLOW AND TIMING		
Signalling Q1	Was there an appropriate interval between index test(s) and reference standard? - Was the time interval greater than 2 weeks? In studies where the same dermatologist did F2F and teledermatology -> Say 'No' regardless of the time between teledermatology and F2F consult. - In the study by Gerhardt et al., there was a 30-day interval between teledermatology and F2F, which may introduce bias.	Yes/No/Unclear
Signalling Q2	Did all patients receive a reference standard?	
Signalling Q3	Did all patients receive the same reference standard? - In studies like Sola-Ortigosa et al., all patients received a reference standard, either histopathology or F2F consultation. Did a paper use histopathology as the reference standard for cancer lesions but F2F for non-cancer lesions? Were all patients evaluated by physicians with similar level of experience?	Yes/No/Unclear
Signalling Q4	Were all patients included in the analysis? - In studies like Gabel et al., all patients were included in the analysis, reducing the risk of bias.	Yes/No/Unclear
Risk of bias	Could the patient flow have introduced bias?	RISK: LOW/HIGH/UNCLEAR

B



eTable 6. Risk of Bias (ROB) results.
(A) QUADAS-2 summary sheet. **(B,C)** QUADAS-2 RoB analysis of 41 observational studies. **(D,E)** ROB-2 analysis of three randomized controlled trials.

eReferences.

1. Hoyer P, Ahatov R, Ross L. Utilization of telehealth services during the COVID-19 pandemic. Cutis. 2020;106(2):70-1.
2. Gomez Arias PJ, Arias Blanco MC, Redondo Sanchez J, et al. [Usefulness and efficiency of teledermoscopy in skin cancer management in primary care]. Semergen. 2020;46(8):553-9.
3. Jacoby T, Woolard A, Chamoun S, et al. Asynchronous Teledermatology Assessment of Young Adult Acne Likely Concordant With In-Person Evaluation. Journal of drugs in dermatology : JDD. 2021;20(4):432-5.
4. McHugh ML. Interrater reliability: the kappa statistic. Biochem Med (Zagreb). 2012;22(3):276-82.
5. Altieri L, Hu J, Nguyen A, et al. Interobserver reliability of teledermatology across all Fitzpatrick skin types. Journal of telemedicine and telecare. 2017;23(1):68-73.
6. Castelo-Soccio L, Kovarik CL, Azfar RS, et al. Reliability and validity of mobile teledermatology in human immunodeficiency virus-positive patients in botswana a pilot study. JAMA Dermatology. 2014;150(6):601-7.
7. Barbieri JS, Nelson CA, James WD, et al. The reliability of teledermatology to triage inpatient dermatology consultations. JAMA Dermatology. 2014;150(4):419-24.
8. Barcaui CB, Lima PMO. Application of teledermoscopy in the diagnosis of pigmented lesions. International Journal of Telemedicine and Applications. 2018;2018((Barcaui) Adjunct Professor of Dermatology, Faculty of Medical Sciences, State University of Rio de Janeiro, PhD in Medicine (Dermatology), University of Sao Paulo, Dermatology Department, Pedro Ernesto University Hospital, Rio de Janeiro State University):1624073.
9. Batalla A, Suh-Oh HJ, Abalde T, et al. Teledermatology in Paediatrics. Observations in daily clinical practice. Anales de pediatria (Barcelona, Spain : 2003). 2016;84(6):324-30.
10. Borve A, Holst A, Gente-Lidholm A, et al. Use of the mobile phone multimedia messaging service for teledermatology. Journal of Telemedicine and Telecare. 2012;18(5):292-6.
11. Borve A, Terstappen K, Sandberg C, et al. Mobile teledermoscopy-there's an app for that! Dermatology practical & conceptual. 2013;3(2):41-8.
12. Carter ZA, Li X, Goldman S, et al. Creation of an internal teledermatology store-and-forward system in an existing electronic health record: A pilot study in a safety-net public health and hospital system. JAMA Dermatology. 2017;153(7):644-50.
13. Chen TS, Goldyne ME, Mathes EFD, et al. Pediatric teledermatology: Observations based on 429 consults. Journal of the American Academy of Dermatology. 2010;62(1):61-6.
14. Clarke EL, Reichenberg JS, Ahmed AM, et al. The utility of teledermatology in the evaluation of skin lesions. Journal of telemedicine and telecare. 2021(9506702, cpj):1357633X20987423.
15. Costello CM, Cumsky HJL, Maly CJ, et al. Improving Access to Care Through the Establishment of a Local, Teledermatology Network. Telemedicine journal and e-health : the official journal of the American Telemedicine Association. 2020;26(7):935-40.
16. Duong TA, Cordoliani F, Julliard C, et al. Emergency department diagnosis and management of skin diseases with real-time teledermatologic expertise. JAMA Dermatology. 2014;150(7):743-7.
17. Gabel CK, Nguyen E, Karmouta R, et al. Use of teledermatology by dermatology hospitalists is effective in the diagnosis and management of inpatient disease. Journal of the American Academy of Dermatology. 2021;84(6):1547-53.
18. Gatica JL, Bertolo S, Morales E, et al. Store-and-forward teledermatogy in Chile: A contribution to primary health care. Piel. 2015;30(3):148-54.
19. Gerhardt CA, Foels R, Grewe S, et al. Assessing the Diagnostic Accuracy of Teledermatology Consultations at a Local Veterans Affairs Dermatology Clinic. Cureus. 2021;13(6):e15406.
20. Giavina-Bianchi M, Azevedo MFD, Sousa RM, et al. Part II: Accuracy of Teledermatology in Skin Neoplasms. Frontiers in medicine. 2020;7(101648047):598903.
21. Giavina-Bianchi M, Sousa R, Cordioli E. Part I: Accuracy of Teledermatology in Inflammatory Dermatoses. Frontiers in medicine. 2020;7(101648047):585792.
22. Keller JJ, Johnson JP, Latour E. Inpatient teledermatology: Diagnostic and therapeutic concordance among a hospitalist, dermatologist, and teledermatologist using store-and-forward teledermatology. Journal of the American Academy of Dermatology. 2020;82(5):1262-7.
23. Lamel SA, Haldeman KM, Ely H, et al. Application of mobile teledermatology for skin cancer screening. Journal of the American Academy of Dermatology. 2012;67(4):576-81.
24. Muir J, Xu C, Singh P, et al. Incorporating teledermatology into emergency medicine. EMA - Emergency Medicine Australasia. 2011;23(5):562-8.

25. Nami N, Rubegni P, Fimiani M, et al. Concordance and Time Estimation of Store-and-Forward Mobile Teledermatology Compared to Classical Face-to-Face Consultation. Acta Dermato-Venereologica. 2015;95(1):35-9.
26. Okita AL, Molina Tinoco LJ, Criado PR, et al. Use of Smartphones in Telemedicine: Comparative Study Between Standard and Teledermatological Evaluation of High-Complex Care Hospital Inpatients. Telemedicine journal and e-health : the official journal of the American Telemedicine Association. 2016;22(9):755-60.
27. Patro BK, Tripathy JP, De D, et al. Diagnostic agreement between a primary care physician and a teledermatologist for common dermatological conditions in North India. Indian dermatology online journal. 2015;6(1):21-6.
28. Ribas J, Schettini APM, Ribas CBDR, et al. Agreement between dermatological diagnoses made by live examination compared to analysis of digital images. Anais Brasileiros de Dermatologia. 2010;85(4):441-7.
29. Rios-Yuil JM. [Correlation between face-to-face assessment and telemedicine for the diagnosis of skin disease in case conferences]. Actas dermo-sifiliograficas. 2012;103(2):138-43.
30. Romero Aguilera G, Cortina De La Calle P, Vera Iglesias E, et al. Interobserver reliability of store-and-forward teledermatology in a clinical practice setting. Actas Dermo-Sifiliograficas. 2014;105(6):605-13.
31. Romero G, Sanchez P, Garcia M, et al. Randomized controlled trial comparing store-and-forward teledermatology alone and in combination with web-camera videoconferencing. Clinical and Experimental Dermatology. 2010;35(3):311-7.
32. Rubegni P, Nami N, Poggiali S, et al. Geriatric teledermatology: Store-and-forward vs. face-to-face examination. Journal of the European Academy of Dermatology and Venereology. 2011;25(11):1334-9.
33. Saleh N, Abdel Hay R, Hegazy R, et al. Can teledermatology be a useful diagnostic tool in dermatology practice in remote areas? An Egyptian experience with 600 patients. Journal of telemedicine and telecare. 2017;23(2):233-8.
34. Sola-Ortigosa J, Munoz-Santos C, Masat-Tico T, et al. The Role of Teledermatology and Teledermoscopy in the Diagnosis of Actinic Keratosis and Field Cancerization. The Journal of investigative dermatology. 2020;140(10):1976-84.e4.
35. Tan E, Yung A, Oakley A, et al. Successful triage of patients referred to a skin lesion clinic using teledermoscopy (IMAGE IT trial). British Journal of Dermatology. 2010;162(4):803-11.
36. Tran K, Ayad M, Monir S, et al. Mobile teledermatology in the developing world: Implications of a feasibility study on 30 Egyptian patients with common skin diseases. Journal of the American Academy of Dermatology. 2011;64(2):302-9.
37. Vano-Galvan S, Aguayo-Leiva I, Rios-Buceta L, et al. Store-and-forward teledermatology: Assessment of validity in a series of 2000 observations. Actas Dermo-Sifiliograficas. 2011;102(4):277-83.
38. Vestergaard T, Prasad SC, Schuster A, et al. Diagnostic accuracy and interobserver concordance: teledermoscopy of 600 suspicious skin lesions in Southern Denmark. Journal of the European Academy of Dermatology and Venereology : JEADV. 2020;34(7):1601-8.
39. Gravely AA, Warshaw EM, Nelson DB. Reliability of store and forward teledermatology for skin neoplasms. Journal of the American Academy of Dermatology. 2015;72(3):426-35.
40. Zanini M. Analyze of diagnostic concordance between face-to-face and teledermatology diagnosis. Medicina Cutanea Ibero-Latino-Americana. 2013;41(2):60-2.
41. Zink A, Kolbinger A, Leibl M, et al. The value of teledermatology using a mobile app compared to conventional dermatology. European Journal of Dermatology. 2017;27(4):429-31.
42. Zink A, Kolbinger A, Leibl M, et al. Teledermoscopy by mobile phones: Reliable help in the diagnosis of skin lesions? Hautarzt. 2017;68(11):890-5.
43. Marchell R, Locatis C, Liu W-L, et al. Comparing High Definition Live Interactive and Store-and-Forward Consultations to In-Person Examinations. Telemedicine journal and e-health : the official journal of the American Telemedicine Association. 2017;23(3):213-8.
44. Jones L, Jameson M, Oakley A. Remote Skin Cancer Diagnosis: Adding Images to Electronic Referrals Is More Efficient Than Wait-Listing for a Nurse-Led Imaging Clinic. Cancers (Basel). 2021;13(22).
45. Gonzalez Coloma F, Sandoval Garces M, Gedda Quiroga V, et al. Teledermatology in Remote Parts of Chile: Experience in 4 Isolated Rural Areas. Actas dermo-sifiliograficas. 2019;110(8):653-8.
46. Goulart Silveira CE, Carcano C, Mauad EC, et al. Call phone usefulness to improve the skin cancer screening: preliminary results and critical analysis of mobile app development. Rural & Remote Health. 2019;19(1):1-7.
47. Piccoli MF, Amorim BDB, Wagner HM, et al. Teledermatology protocol for screening of Skin cancer. Anais Brasileiros de Dermatologia. 2015;90(2):202-10.

48. Senel E, Baba M, Durdu M. The contribution of teledermatoscopy to the diagnosis and management of non-melanocytic skin tumours. Journal of Telemedicine and Telecare. 2013;19(1):60-3.
49. Gravely AA, Nelson DB, Warshaw EM. Accuracy of teledermatology/teledermoscopy and clinic-based dermatology for specific categories of skin neoplasms. Journal of the American Academy of Dermatology. 2010;63(2):348-52.

MOOSE Checklist for Meta-analyses of Observational Studies

Item No	Recommendation	Reported on Page No
Reporting of background should include		
1	Problem definition	4
2	Hypothesis statement	4
3	Description of study outcome(s)	4-5
4	Type of exposure or intervention used	6-8
5	Type of study designs used	6-8
6	Study population	6-8
Reporting of search strategy should include		
7	Qualifications of searchers (eg, librarians and investigators)	6
8	Search strategy, including time period included in the synthesis and key words	6-8
9	Effort to include all available studies, including contact with authors	6-8
10	Databases and registries searched	6-8
11	Search software used, name and version, including special features used (eg, explosion)	6-8
12	Use of hand searching (eg, reference lists of obtained articles)	6-8
13	List of citations located and those excluded, including justification	Supplement
14	Method of addressing articles published in languages other than English	6-8
15	Method of handling abstracts and unpublished studies	6-8, Supplement
16	Description of any contact with authors	6-8, Supplement
Reporting of methods should include		
17	Description of relevance or appropriateness of studies assembled for assessing the hypothesis to be tested	9-12
18	Rationale for the selection and coding of data (eg, sound clinical principles or convenience)	9-12
19	Documentation of how data were classified and coded (eg, multiple raters, blinding and interrater reliability)	9-12
20	Assessment of confounding (eg, comparability of cases and controls in studies where appropriate)	9-12
21	Assessment of study quality, including blinding of quality assessors, stratification or regression on possible predictors of study results	9-12
22	Assessment of heterogeneity	9-12
23	Description of statistical methods (eg, complete description of fixed or random effects models, justification of whether the chosen models account for predictors of study results, dose-response models, or cumulative meta-analysis) in sufficient detail to be replicated	9-12
24	Provision of appropriate tables and graphics	9-12, Supplement
Reporting of results should include		
25	Graphic summarizing individual study estimates and overall estimate	Fig 1-3, Supplement
26	Table giving descriptive information for each study included	Tables 1, 2, Supplement
27	Results of sensitivity testing (eg, subgroup analysis)	9-12
28	Indication of statistical uncertainty of findings	9-12

Item No	Recommendation	Reported on Page No
Reporting of discussion should include		
29	Quantitative assessment of bias (eg, publication bias)	9-12
30	Justification for exclusion (eg, exclusion of non-English language citations)	9-12
31	Assessment of quality of included studies	9-12
Reporting of conclusions should include		
32	Consideration of alternative explanations for observed results	13-17
33	Generalization of the conclusions (ie, appropriate for the data presented and within the domain of the literature review)	13-17
34	Guidelines for future research	13-17
35	Disclosure of funding source	18

From: Stroup DF, Berlin JA, Morton SC, et al, for the Meta-analysis Of Observational Studies in Epidemiology (MOOSE) Group. Meta-analysis of Observational Studies in Epidemiology. A Proposal for Reporting. *JAMA*. 2000;283(15):2008-2012. doi: 10.1001/jama.283.15.2008.

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	p1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	p3-4
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	p5-6
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	p5-6
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	p8, Supplementary p15
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	p7
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Supplementary p2
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	p8
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	p8
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Supplementary p15
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	p8 and Supplementary p15
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	p9
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	p8-9
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	p8-9
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	p 8-9 Supplementary p2
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	p 8-9 Supplementary p2
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	p 8-9 Supplementary p2
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	p 8-9 Supplementary p2
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	NA
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	p9
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	NA

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Figure 1, p10
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Supplementary p23-3
Study characteristics	17	Cite each included study and present its characteristics.	p10-11, Table 1, 2
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	p15, Supplementary eTable 5
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	p15, Supplementary eTable 5
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Figure 2, 3, Supplementary eFigure 1-5
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	p 11-13 Supplementary p3
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	p 11-13 Supplementary p3
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	NA
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Supplementary eTable 5
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	p 11-13 Supplementary p3
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	p14
	23b	Discuss any limitations of the evidence included in the review.	p15-16
	23c	Discuss any limitations of the review processes used.	p16
	23d	Discuss implications of the results for practice, policy, and future research.	p17
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	p7
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	p7
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	NA
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	p18
Competing interests	26	Declare any competing interests of review authors.	p18
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71