Title Page

Title:
The cost-effectiveness of store-and-forward teledermatology: a systematic review.

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Abstract

Importance: Teledermatology is a topical clinical approach being trialled in Australia and overseas (1). With a majority of dermatologists residing in metropolitan areas, teledermatology provides an apparent low cost and convenient means of access for individuals living outside these areas (1, 2). It is important that any proposed new addition to a healthcare system is assessed on the ground of economic cost and effectiveness.

Objective: To summarise and evaluate the current economic evidence comparing store-and-forward teledermatology (S&FTD) with conventional face-to-face (FTF) care.

Evidence Review: Search terms with appropriate amendments were used to return S&FTD articles that included economic analysis. Six databases were searched; title, abstract and full text reviews were conducted by two researchers. References of all unique returned articles were searched by hand.

Findings: Eleven articles were selected for inclusion; consisting of once cost-analysis, five cost-minimisation analyses, three cost-effectiveness analyses and two cost-utility analyses. The Consolidated Health Economic Evaluation Reporting Standards checklist was used to evaluate quality, scores ranged from 7 to 21 out of a possible 24 points, with a median score of 17.

Conclusions and Relevance: Current evidence is sparse, but suggests that S&FTD can be cost-effective. It appears to be cost-effective when it is used as a triage mechanism to reduce FTF appointment requirements. The cost-effectiveness of S&FTD increases when patients are required to travel further distances to access dermatology services. Further economic research is required for the emerging S&FTD which uses dermatoscopes in combination with smartphone applications, and around the possibility and consequences of patients self-capturing and transmitting images.

Background

Teledermatology is an area of healthcare described by the fusion of dermatological care and telehealth. It is attractive because it optimises current processes and results in a more efficient use of resources (4). It uses either video conference or store-and-forward technology to increase population access to dermatologist specialists (2, 5). Store-and-forward teledermatology (S&FTD) involves images of lesions or skin sections being captured and transmitted electronically to a dermatologist, generally accompanied by a relevant patient history. The dermatologist reviews the images and relevant history and replies with a diagnostic opinion and suggested action plan. There are many models of care for S&FTD involving different individuals collecting the images and health information such as nurses, general practitioners (GPs), or patients (6). One of the primary uses being explored is using S&FTD as a method of referral between GPs and dermatologists instead of the conventional written referral method (7). Teledermatology enables dermatologists to triage cases more effectively, or refer patients back to the GPs for management. It is widely accepted that dermatologists are more effective at diagnosing dermatological conditions than GPs, therefore it follows that GPs prefer to refer dermatological cases that they are hesitant or suspicious about (4, 8). The teledermatology feedback or refer-back process has the potential to shorten the waiting lists for specialists, and increase convenience for patients whilst ensuring that patients are receiving optimal care (9-11).

Teledermatology is an ever expanding area in Australia and overseas (1). With a large majority of dermatologists residing in metropolitan areas, teledermatology provides an apparent low cost and convenient means of access for individuals living outside these areas (1, 2). It is important that any proposed new addition to a healthcare system is assessed on the ground of economic cost and effectiveness. The economic effectiveness of interventions is calculated by applying an economic value to each intervention and an effectiveness or utility

measure to quantify the outcome. The economic cost is then weighted based on the efficacy or utility value of the outcome. There are four types of economic evaluation relevant to this review; cost-analysis (CA), cost-minimisation analysis (CMA), cost-effectiveness analysis (CEA), and cost-utility analysis (CUA). CA and CMA provide findings in terms of difference in costs. CA presents only financial values, while a well-designed CMA addresses the equivalent efficacy between the interventions to justify presenting results in cost terms only. If this is not justified appropriately it is possible that CMA may miss key comparator information between interventions (3). CEA and CUA weight the cost findings in terms of the intervention outcome (either in terms of clinical effectiveness or a pre-defined utility measure such as the quality-adjusted life year, QALY) (3, 12). Each of these methods is only as accurate as the information used to estimate the cost, efficacy, or utility outcomes (3). This review aims to synthesise their results and assess the current level of evidence for teledermatology cost-effectiveness.

Objectives

To summarise and evaluate the current economic evidence comparing store-and-forward teledermatology (S&FTD) with conventional face-to-face (FTF) care.

Method

Search strategy

This review follows the methods described in a published protocol (PROSPERO 2015:CRD42015014295). Studies were included if (i) they related to any population requiring dermatological care; (ii) they included a store-and-forward teledermatology intervention, regardless of the device or individual used to capture the images; (iii) the intervention was compared to conventional care defined as a FTF consultation; and (iv) the outcome is expressed in terms of any kind of economic analysis. No limits were put on publication date, but only full-text journal articles available in English were included.

Search terms with appropriate amendments (dependent on MESH terms) used to search EMBASE, EconLit, PubMed, MedLine, Cochrane, and CINAHL were (cost or economic) AND (teledermatology or teledermoscopy or telederm*), AND store-and-forward. Google and Google Scholar were also searched to identify any other unique literature not returned through the above databases, and the references of all returned articles were searched by hand.

Article selection

After duplicates were removed, titles and abstracts were screened for eligibility. The remaining articles were then read in full text to confirm eligibility. Eligible articles were those that described any cost analysis performed that compared conventional care and teledermatology as per the inclusion criteria stated previously. The primary search was conducted by one researcher (CS). Abstracts were reviewed by two researchers (CS and JW), with any disagreement discussed to reach consensus. During the final stage of full text

review a third researcher (RM) read the articles that met the criteria to confirm their inclusion.

Data extraction and analysis

Data including study design, economic content and S&FTD methods used, were extracted using a standard form based on the CASP (Critical Appraisal Skills Programme) for economic evaluation and the Consolidated Health Economics Evaluation Reporting Standards (CHEERS) checklist (3, 13). As few restrictions were placed on the economic or S&FTD aspects of the literature included the identified studies varied widely, therefore numerous data points were extracted in order to effectively contrast the studies. The CHEERS checklist was used to assess the quality of each article by assigning them a value out of 24, with higher scores indicating more complete reporting against the 24-items (3). Economic principles such as currency, discounting, time horizon, effectiveness measures, choice of outcome, assumptions, and model choice are all included (3). The checklist also includes items that would be applicable to other study types such as population information, and characterisation of uncertainty, analytical methods, parameters and heterogeneity (3). Meta-analysis was not completed on the selected studies due to the inappropriateness of directly comparing economic outcomes between varying countries and health systems, and the lack of sufficient studies within one system.

Results

Study Selection

The study extraction and selected results are listed in Figure 1. Eleven of the 59 full-text articles screened according to the PRISMA guidelines remained for inclusion (14).

Study characteristics

All included studies examined teledermatology as a means of optimising referrals to dermatologists. Ten of the eleven studies involved GPs identifying patients as requiring a dermatologist referral (4, 7-11, 15-18). Teledermatology was compared to the conventional model of written referral to a dermatologist where all patients attend a FTF appointment, the urgency of which was determined by the referral letter written by the GP (4, 7-11, 15-18). Dermatologists reviewed the images and responded by either scheduling a face-to-face appointment, giving guidance for GP management of the condition, or concluding that no action was required (1, 4, 7-11, 15-18). The remaining study involved psoriasis patients sending information directly to their dermatologist to decide if a FTF appointment was required (1). Six studies showed that teledermatology was able to reduce the number of patients required to attend FTF consultations with a dermatologist by 39-88% (Table 1) (9-11, 17, 18). This in turn reduced the waiting time for those patients who did require an appointment (8-11, 17, 18).

Study quality

. Overall evidence quality was appraised for each article by using an abridged version of the rating system published by the Oxford Centre (Table 2). The CHEERS checklist was used to evaluate the adherence to best practice reporting, quality scores ranged from 7 to 21 out of a

possible 24 points, with a median score of 17 (Table 1) (3). The CHEERS score represents how well the authors adhered to best practice when reporting their study. Two studies (Datta and Eminovic) outlined a time horizon, and only one (Eminovic) discussed a discounting method for their study (4, 15). The lower scores were due to a failure to report or discuss relevant economic principles or justify the choice of analysis (3). For S&FTD the most relevant principles that were not included were time horizons (study lengths and appropriate financial conversions), financial referencing (all figures should be cited), and the choice of analysis should always be justified whether with efficacy or economic data explaining all assumptions. It is reasonable to expect a high quality analysis to address each of the 24 points in the checklist, even if only to explain why that item was not included or calculated (3).

Economic Findings

The majority of the studies (82%), with the exception of Eminović and Datta concluded that teledermatology using store-and-forward technology was cost-effective (1, 7-11, 16-18). These conclusions are presented in Table 2. Three of the eleven studies used CEA and expressed their outcome effect in terms of days to "initial intervention", where "initial intervention" was categorised as either initial FTF appointment (for patients requiring a FTF consult), or diagnostic feedback being received by GP from dermatologist (if patient not required to attend FTF) (Table 2) (7, 9, 16). Two papers applied a CUA and measured QALYs and cost in their studies, and outcomes were expressed as incremental cost per QALY gained (1, 4). QALYs are a robust preference-based measure for utility that is commonly used to value health interventions (19). QALYs were calculated using the time trade-off method by Datta, and the Dermatology Life Quality Index (DLQI) based on the QALY model score by Parsi (1, 4). Datta found no difference between the QALY outcome for S&FTD and written referral, as a result the findings were described as a CMA (4).

The countries in which the studies were conducted varied broadly, with the highest number of studies (36%) conducted in the United States of America (USA) (Table 1). Of the eleven studies, eight (73%) reported results from the perspective of their national health system (NHS) or, the national department for defence or Department of Veteran Affairs (DVA) who service a smaller subset of the population (Table 2) (4, 7, 8, 10, 11, 16-18). NHS systems and DVA systems differ between country in terms of delivery, governance, and what is covered. Eminovic, Datta, and Parsi described their analyses as being from a societal perspective (1, 4, 15). Parsi characterised societal perspective as the cumulative costs incurred by the health institutions, the patient (including productivity, travel and time) and the government (1). Datta and Eminovic also included travel costs, out-of-pocket expenses, and productivity losses (4, 15).

There were three outcomes used to describe the difference between teledermatology and conventional care. Outcomes were expressed by the number of referrals, time in days to the "initial intervention" (as defined previously), or in QALYs (1, 4, 7, 9, 10, 16). Sensitivity analysis was performed in four studies, although calculation approaches varied (1, 7, 9, 15). The variable that was tested for sensitivity varied (Table 2). Parsi calculated the sensitivity of the reported travel time by specifying a plausible range from the literature and performing a one-way analysis (1). Whited, Eminovic, and Moreno-Ramirez performed one-way sensitivity analysis to assess the effect of a variation in travel requirements or the number of avoided face-to-face appointments on the cost-effectiveness of teledermatology, the findings were statistically significant (Table 2) (7, 9, 15). It was also demonstrated that a decrease in patient time requirements while undertaking teledermatology, or an increased travel requirements, increased the cost-effectiveness of S&FTD (1, 15, 16). Cost-effectiveness was

still maintained in the study by Moreno-Ramirez and colleagues even when the percentage of avoided FTF appointments observed in the study was assumed to reduce by half (9).

Clinical characteristics

The teledermatology methods and types of technology utilised in the studies varied. Differences included the skin condition, type of camera (digital camera or dermatoscope), forwarding method, who captured the image, and whether or not the system was costed in the analysis (see Table 3). The individual capturing the images, device, and transfer method were not standardised between studies. All studies used either proprietary software (websites, encrypted email, and server) or their NHS intranet to transfer the images. All teledermatology images were reviewed by a dermatologist together with the relevant clinical information. The industry gold standard for confirmation of dermatology diagnosis is histopathology (carried out by two studies) (9, 16). However two other studies acquired confirmation by having a second dermatologist review either all referrals or a subset of the referrals (1 in 10 for Livingstone) (10, 18).

Discussion

This review has identified a small but growing body of evidence evaluating the cost-effectiveness of S&FTD. By maintaining broad inclusion criteria, the review provides a comprehensive summary of the economic literature. Majority of the articles identified S&FTD as a clinically and economically effective model for referring patients to dermatologists (4, 7-11, 15-18), although the quality of this evidence is limited. The inconsistent results depending on the study context, and limitations in methodological quality of several studies mean that currently, only a weak recommendation for the cost-effectiveness of Teledermatology can be made (recommendation level 2A) (20). The final reported outcome depended on a range of factors, including the economic analysis method, the analysis perspective, and the sensitivity analysis performed. Effectiveness was primarily demonstrated by quantifying the number of unnecessary FTF dermatologist appointments prevented (8-11, 17, 18). Three articles recognised that cost savings were greater for patients located a further distance from a dermatology service due to the cost of travel (1, 15, 16).

Analysis Perspective

The studies retrieved present a narrow perspective of the cost of S&FTD due to the fact that most of them are from an NHS perspective. The NHS perspective (demonstrated by 73% of studies) only includes costs which would be incurred by the NHS (7-11, 16, 17). It does not take into account costs that may be incurred or spared for the patient or other parties such as travel time, productivity or wage loss, accommodation costs, or co-payments (3). While this information is good for policy makers it does not provide a full picture of the overall costs or cost savings of implementing S&FTD. Three of the studies considered additional societal costs in their analysis which gives a broader cost estimation by taking into account financial

costs for the NHS, and the patient (both direct costs and productivity/wage loss) (1, 4, 15). Similar to the other studies which performed their analysis from the perspective of the health system, two out of the three found S&FTD to be cost-effective (1, 4). However, in contrast, the third provided circumstances under which their analysis would show cost-effectiveness (15). Given that S&FTD offers the potential for reduced travel and increased convenience to the patient it may be more appropriate to present findings from a societal perspective in order to capture these gains more holistically.

Sensitivity Analysis

The extent to which findings were sensitive to assumptions made in the analyses were tested during analyses by most studies, generally only using one-way sensitivity analyses rather than more technically robust approaches such as probabilistic sensitivity analysis. Nevertheless, overall it can be concluded that while most studies show S&FTD to be cost-effective, the extent of cost-effectiveness is affected by the travel requirements of patients and the number of FTF consultations it prevents. These two factors will be of particular relevance in areas where large geographical distances have to be overcome such as Australia. Thus, S&FTD may provide particularly good value for money, as well as benefits in terms of equity of access, in areas challenged by geographical remoteness.

Analysis Method

This review has shown that there is currently very limited economic evidence relating to the cost-effectiveness of S&FTD. The evidence available is derived primarily from CMA. This is due to the fact that economic analysis of the S&FTD services have been carried out after services were initialised through the NHS or DVA. It may also be due to challenges in collecting meaningful clinical indicators of effectiveness that are sensitive to change,

especially where the aim of S&FTD may relate to the identification or management of low-incidence conditions (such as melanoma). One study evaluated outcomes and concluded no significant change in QALYs between teledermatology and the conventional referral model, the authors chose to present their results in a CMA format based on the statistical significance (4). This change of method from a CUA to a CMA was argued by the authors to be appropriate given that the use of a CMA was justified. However, there is an economic literature arguing that even when outcomes are not statistically different, it is still relevant to perform a full cost-effectiveness or cost-utility analysis, since it is the ratio of incremental costs to benefits we are interested in, and this ratio can be significant, even if the outcomes alone are not (12).

S&FTD in ten of the eleven studies was trialled as an addition to the current model of care, rather than a potential replacement for (4, 7-11, 15-18). Most studies posed that S&FTD be incorporated into the current model of care to optimise referrals and associated waiting lists to see dermatologists (8-11, 17, 18). In many countries, including but not limited to those included in this review, dermatologists are a scarce resource and waiting lists for consultations are long (11, 17). Although conventional care models attempt to triage high risk patients, this is hard to do from written referrals (8). S&FTD enables this triage to be done more effectively, therefore reducing waiting times for physical appointments for cases that require them (4, 7-11, 15-18).

Teledermatology characteristics

The S&FTD technology employed varied between studies (1, 4, 7-11, 15-18). Each system had different set up and maintenance cost. These costs were accounted for by six studies (1, 7, 9, 10, 15, 16). The studies that did not include the set-up and maintenance cost either did

not address it at all, explained it as irrelevant (systems were already installed and in use by the NHS or DVA), or said the relatively low cost made it irrelevant. The studies that failed to address this cost may represent less robust findings than those that did. There is a large body of research emerging about using smart phone applications for S&FTD. The lack of current evidence around economic viability of smartphone applications for S&FTD means that there is currently inadequate literature assessing new S&FTD model of care and technology, reducing the generalisability of this review's findings. Additionally a number of these studies (due to the year of the research and/or the implementation cost) utilised digital cameras to capture images. Dermatoscopes have become a standard instrument in dermatology, they are part of a routine FTF consultation, and have become inexpensive enough to incorporate into systems (10, 11, 17). The fast pace with which technology used for S&FTD progresses makes the contemporary evaluation of cost-effectiveness challenging. The lack of economic evaluation related to dermatoscopes and smartphones suggests an important avenue for further research.

Limitations

This review was comprehensive in its approach to identifying and summarising the economic literature on S&FTD, suggesting the approach generally provides good value for money. Nevertheless, the articles meeting criteria for inclusion had limitations. The CHEERS scores (Table 1) indicated that articles could have improved their studies by addressing more economic principles. The participant numbers varied in the identified studies (see Table 1), from 64 in Parsi to 37207 in Van der Heijden (9, 18). The reliability of the results is greater for the studies with greater sample sizes (see Pak and Lim), due to the increased likelihood that their conclusions are directly transferrable to a national population (11, 18). None of the articles utilised the smart phone application technology for image capture or transfer, which

is an area of emerging teledermatology research. This means that these articles have not assessed the current technology within the field of teledermatology (21). Two of the economic analyses (18%) were conducted on S&FTD services post-implementation (10, 16). This post-implementation method of evaluating cost means that researchers had reduced ability to randomise effectively and have adequate control populations. This study design, although pragmatic, makes the reported cost evaluations less rigorous. Finally, the resources identified for cost analysis differed between studies reducing their comparability. Some of the differences were driven by their economic perspectives and national funding bodies, and by the data collection methods (patient self-reporting costs) (18).

Further research

Further research is required in the area of S&FTD economic evaluation. Studies should focus on applying the most appropriate economic analysis methods, include a consideration of effectiveness measures, and consult the CHEERS checklist when writing to ensure all elements are addressed (12). There should also be a focus on emerging technologies such as smart phone applications that utilise dermatoscope attachments (teledermoscopy) where appropriate. Analysis should be informed primarily by RCTs or where necessary pragmatic study designs. Economic analysis models should be designed that include as many relevant outcomes and cost factors as possible (this is easily achieved by using a tool like CHEERS) and can be applied to screening and diagnosis for standard and high risk populations.

Conclusion

Current evidence suggests that S&FTD can be cost-effective. It appears to be cost-effective when it is used as a triage mechanism to reduce FTF appointment requirements. The cost-effectiveness of S&FTD increases when patients are required to travel further distances to access dermatology services. Further economic research is required for the emerging S&FTD which uses dermatoscopes in combination with smartphone applications, and around the possibility and consequences of patients self-capturing and transmitting images.

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Figure Legends:

Figure 1

Title: Article selection process

Legend: Figure 1 demonstrates the article selection process and lists the exclusion criteria. It is modelled according to the PRISMA protocol.

Tables:

Table 1. Study characteristics (columns continued to next page)

Author/s	Year	Country	n	Analysis Type* (**/***)	CHEERS quality score (out of 24)
Datta et al. (4)	2015	USA	392	CUA** /CMA**	18
Eminović et al. (15)	2010	Netherlands	631	CMA**	21
Ferrandiz et al. (16)	2008	Spain	134	CEA**	18
Lim et al. (11)	2012	New Zealand	300	CMA***	13
Livingstone et al. (10)	2015	UK	248	CEA** /CMA***	7
Moreno-Ramirez et al. (9)	2009	Spain	2009	CEA**	16
Morton et al. (17)	2011	Scotland/UK	477	CA***	18
Pak et al. (18)	2009	USA	698	CMA**	17
Parsi et al. (1)	2012	USA	64	CUA**	21
Van der Heijden et al. (8)	2011	Netherlands	37207	CMA***	14
Whited et al. (7)	2003	USA	275	CEA**	15

***Cost-analysis (CA), cost-minimisation analysis (CMA), cost-effectiveness analysis (CEA), cost-utility analysis (CUA)**
****Analysis type as determined by the author**
*****Analysis type not stated by author, determined by reviewer**

Table 1. Study characteristics (columns continued from previous page)

Cost of S&FTD per patient	S&FTD concluded to be cost effective?	FTF avoided via S&FTD screening
USD$30 saved (VA) USD$82 saved (societal)	Equivalent (VA perspective) Yes (societal perspective)	Unspecified
€ 32.50 saved	Equivalent	Unspecified
€ 122.02 saved	Yes	Unspecified
NZ$42 saved	Yes	88%
£12460 saved (total for all participants)	Yes	41%
€ 49.59 saved	Yes	50%
£1.70 saved	Yes	72%
USD$32 saved	Yes	39%
USD$261 saved	Yes	N/A
€ 34.94 saved	Yes	74%
USD$15 extra	Yes	Unspecified

***Cost-analysis (CA), cost-minimisation analysis (CMA), cost-effectiveness analysis (CEA), cost-utility analysis (CUA)**
****Analysis type as determined by the author**
*****Analysis type not stated by author, determined by reviewer**

Table 2. Economic analysis characteristics (columns continue on next page)

Author, Year	Analysis Type* (**/***)	Economic evaluation informed by****	Quality rating of informing studies *****	Outcome
Datta et al. (4)	CUA** /CMA**	RCT	1	▪ Utility was not found to be influenced by the intervention, therefore analysis was reduced to CMA. ▪ Two perspectives were examined and only the savings from a societal perspective were found to be statistically significant. ▪ USD$30 saved per patient (VA) USD$82 saved per patient (societal)
Eminović et al. (15)	CMA**	RCT	1	▪ S&FTD has a 0.11 probability of being cost effective
Ferrandiz et al. (16)	CEA**	POS	2	▪ €3.10/patient /day saved for patients with no impediments to travel ▪ €4.87/patient /day saved for patients who had impediments to travel
Lim et al. (11)	CMA***	RCT	1	▪ NZ$42 saved per patient
Livingstone et al. (10)	CEA** /CMA***	ROS	3	▪ £12460 saved (total for all participants)
Moreno-Ramirez et al. (9)	CEA**	POS	2	▪ €0.65/patient /day saved
Morton et al. (17)	CA***	POS	2	▪ £1.70 saved per patient
Pak et al. (18)	CMA**	RCT	1	▪ USD$32 saved per patient
Parsi et al. (1)	CUA**	RCT	1	▪ Mean improvement in QALYs was not significant between groups, however S&FTD saved $539.58/QALY.
Van der Heijden et al. (8)	CMA***	POS	2	▪ Cost reduction estimated at 18% (average weighted costs)
Whited et al. (7)	CEA**	RCT	1	▪ USD$0.12-0.17/patient/day saved

***Cost-analysis (CA), cost-minimisation analysis (CMA), cost-effectiveness analysis (CEA), cost-utility analysis (CUA)**
****Analysis type as determined by the author**
*****Analysis type not stated by author, determined by reviewer**
******Randomised control trial (RCT), Retrospective observational study (ROS), Prospective observational study (POS)**
*******Evidence quality rating: 1 (Properly powered and conducted randomized clinical trial; systematic review with meta-analysis), 2 (Well-designed controlled trial without randomization; prospective), comparative cohort trial, 3 (Case-control studies; retrospective cohort study), 4 (Case series with or without intervention; cross-sectional study), 5 (Opinion of respected authorities; case reports)**

Table 2. Economic analysis characteristics (columns continued from previous page)

Perspective	Was effectiveness evaluated?	Sensitivity testing
Department of Veterans Affairs, USA & Societal (individual costs only)	Yes, in terms of QALYs	No
Societal (individual costs only)	Yes, in terms of unnecessary referrals. Effectiveness was not considered jointly alongside cost.	Yes (showed that coat-effectiveness is dependent on the travel requirements on the patient or greater FTF avoided)
NHS, Spain	Yes, in terms of time to initial intervention	No
NHS, New Zealand	Yes, in terms of time to initial intervention and other measures	No
NHS, United Kingdom	Yes, in terms of referral time. Effectiveness was not considered jointly alongside cost.	No
Unspecified	Yes, in terms of time to initial intervention	Yes (Showed that S&FTD is still cost effective if avoided FTF appointments are reduced by a further 25%)
NHS, United Kingdom	Yes. Effectiveness was not considered jointly alongside cost.	No
Department of defence, USA	Yes, comparable outcomes previously demonstrated and described.	No
Societal (institutional, individual, and governmental costs)	Yes, in terms of QALYs	Yes (travel time to attend a FTF was varied between 30-180min)
NHS, Netherlands	Yes, in terms of prevented referrals. Effectiveness was used to calculate a weighted change in cost.	No
Department of Veterans Affairs, USA	Yes, in terms of time to initial intervention	Yes (showed that cost-effectiveness is dependent on the number of appointments avoided)

***Cost-analysis (CA), cost-minimisation analysis (CMA), cost-effectiveness analysis (CEA), cost-utility analysis (CUA)**
****Analysis type as determined by the author**
*****Analysis type not stated by author, determined by reviewer**
******Randomised control trial (RCT), Retrospective observational study (ROS), Prospective observational study (POS)**
*******Evidence quality rating: 1 (Properly powered and conducted randomized clinical trial; systematic review with meta-analysis), 2 (Well-designed controlled trial without randomization; prospective), comparative cohort trial, 3 (Case-control studies; retrospective cohort study), 4 (Case series with or without intervention; cross-sectional study), 5 (Opinion of respected authorities; case reports)**

Table 3. Store and forward methodology

Author, Year	Condition	S&F camera	S&F transfer method	Image captured by	S&F system cost taken into account? (Yes/No)
Datta et al. (4)	Any (ambulatory skin conditions)	Digital camera	Unspecified	Unspecified	No
Eminović et al. (15)	Unspecified	Digital camera	Website /Server	GP	Yes
Ferrandiz et al. (16)	Either non-melanoma skin cancer or fast-growth vascular tumour suitable for surgery under local anaesthesia	Digital camera	Intranet	GP	Yes
Lim et al. (11)	Any (except specified physical area)	Dermatoscope	Website /Server	Melanographer	No
Livingstone et al. (10)	Unspecified	Dermatoscope	Secure e-mail	Trained staff member	Yes
Moreno-Ramirez et al. (9)	Suspected cancer	Unspecified	Intranet	GP	Yes
Morton et al. (17)	Suspected cancer	Dermatoscope	Server	Melanographer	No
Pak et al. (18)	Any (except emergent or complicated cases)	Digital camera	Website/Server	Unspecified	No
Parsi et al. (1)	Psoriasis	Digital camera	Website/Server	Patient	Yes
Van der Heijden et al. (8)	Unspecified	Digital camera	Website/Server	GP	No
Whited et al. (7)	Unspecified	Digital camera	Unspecified	Unspecified	Yes

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Study concept and design: Snoswell, Whitty, Finnane, Mujcic, Soyer, and Janda.

Acquisition, analysis, and interpretation of data: Snoswell, Whitty, Finnane, Mujcic.

Drafting of the manuscript: Snoswell.

Critical revision of the manuscript for important intellectual content: Snoswell, Whitty, Finnane, Janda, Soyer and Mujcic.

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