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REVIEW ARTICLE

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Store-and-forward (asynchronous) doctor-to-dermatologist non-skin cancer specific teledermatology services in Australia: A scoping review

Celine Jessica Lee MBBS (Hons)[1] | **Dr Aaron Boyce FACD, MBBS (Hons), MBA**[2] | **Julia Chequer de Souza MBBS (Hons)**[1] | **Dr Rebecca Evans PhD**[1]

[1]College of Medicine and Dentistry, James Cook University, Queensland, Townsville, Australia

[2]Department of Dermatology, Townsville University Hospital, Douglas, Queensland, Australia

Correspondence
Celine Jessica Lee, James Cook University, Townsville, Qld, Australia.
Email: celine.lee@my.jcu.edu.au

Abstract

Store-and-forward teledermatology (SAFT) has become increasingly popular as a means to increase access to specialist care and address healthcare disparities such as those experienced by rural communities. A contemporary systematic overview of the Australian SAFT services and outcomes for all dermatological conditions is missing. This scoping review provides an overview of Australian SAFT models. Twelve studies were identified through web databases, grey literature sites and reference lists of eligible articles. Eligibility criteria included studies evaluating doctor-to-dermatologist Australian SAFT services provided to Australians for all skin conditions but excluded the studies that solely focused on skin cancers. Data on study design, setting, population, SAFT model, referral characteristics, patient, and general practitioner perspectives, diagnostic concordance, and measured outcomes such as follow up, investigation and waiting time were extracted. Quality of the included studies was assessed using CASP tools. Synthesis reveals that SAFT can be used for patients with any dermatological condition, provides more accurate diagnostics compared to cases without dermatologist input, may reduce waiting times for dermatological expertise, and users generally had positive experiences with SAFT. Although results are positive, this review reveals the heterogenous nature of the literature on SAFT in Australia and a need to establish a uniform approach to assessing the outcomes and impacts of such services.

KEYWORDS

Australia, dermatologists, dermatology, skin, telemedicine

INTRODUCTION

Dermatological presentations constitute up to one sixth of general practice consultations,[1] and over 4.5% of the population suffer from chronic skin conditions.[2] Access to a dermatologist improves patient outcomes,[3] and increases healthcare efficiencies.[4–6] However, Australia suffers from a maldistribution of its dermatology

workforce with the majority (92.5%)[4] of dermatologists practicing in a major city (Modified Monash Model 1),[7] influencing equitable access to care for regional, rural and remote populations.

Teledermatology is the use of telemedicine in the field of dermatology with the purpose of overcoming barriers to accessing specialist medical care.[6,8,9] Dermatology is well-suited to telehealth models of care as most dermatological conditions are diagnosed visually.[9,10] Teledermatology models exist throughout the world,[6,11] and provides accurate diagnostic and management services with similar patient outcomes when compared to face-to-face dermatology consults.[12] The benefits of teledermatology include cost-effectiveness,[13,14] reduction in waiting time,[15] increased management of skin conditions in primary care thereby fostering continuity of care,[9] and reducing the impact of geographical isolation for rural patients and doctors.[8,9] The recent global surge of interest in telemedicine models such as teledermatology has also been further driven by the COVID-19 pandemic.[16]

There are three major models of teledermatology: (i) synchronous, (ii) asynchronous, and (iii) hybrid. Synchronous models use live telecommunication methods, such as videoconferencing, between the dermatologist and patient with or without their primary care provider. Asynchronous teledermatology (also known as store-and-forward, SAF) involves electronic transmission of a patient's case along with relevant clinical images of the patient's skin condition to a dermatologist who responds to the requested advice at a later time. The combination of synchronous and asynchronous models in one service is known as hybrid teledermatology.[6,17,18]

Store-and-forward teledermatology (SAFT), in particular, has a number of advantages over synchronous teledermatology: (i) appointment times and doctor-patient co-availability are not necessary,[19] (ii) internet speed is less critical, and (iii) usually allows provision of higher resolution images of skin lesions, and therefore may increase diagnostic proficiency.[20,21] This service model may increase the efficiency of out-patient dermatology care by reducing unnecessary in-person referrals, and decrease healthcare costs.[13,22] Furthermore, hybrid teledermatology has not been shown to add any clinical benefit compared to SAFT alone.[23]

Although the potential benefits associated with SAFT are apparent, there remain barriers to using SAFT models of care. This includes difficulty conducting surgical procedures if required,[24] poor patient follow up after SAFT use,[25] and patients needing to travel to their local provider's clinic.[9] Furthermore, adequate reimbursement for teledermatology services is challenging. Since the outbreak of COVID-19, the Australian government has established reimbursement for synchronous forms of teledermatology, but the Medical Services Advisory Committee (MSAC) suggests more research is needed to justify funding for SAFT services.[26]

The Australian perspective of SAFT is important as Australia is unique due to its vast geography and dispersed population,[27] population demographics, and universal approach to health care.[28] There is no literature synthesising the SAFT experience in Australia.[29] Developing an understanding of SAFT characteristics, patient outcomes can help guide future research and justify appropriate funding.

This scoping review aims to summarise and evaluate the current literature surrounding SAFT in Australia and identify areas that may require additional research. The question guiding this scoping review was: what is the current literature available for SAFT models and clinical outcomes for Australians? The question was guided by the PICO framework[30] to assess studies that focused on (i) Australian patient populations with dermatological conditions, (ii) SAFT model interventions, and (iii) outcomes of SAFT models. This review will inform clinicians who consider a SAFT service by understanding Australian SAFT models, outcomes, and perceptions of such services.

METHODOLOGY

A scoping review was the most appropriate approach for this review question given the heterogeneity of literature associated with SAFT. There is no standard method of reporting or analysing teledermatology services. The PRISMA extension for Scoping Reviews was used to inform the conduct and reporting of this scoping review.[31] A protocol for this review is made public through the Open Science Framework (https://osf.io/r7k3h/).[32]

Information sources and searches

Medline, CINHAL, Emcare, Embase and Scopus databases were searched for the terms teledermatology AND store-and-forward AND Australia, and their synonyms, inclusive of dates prior to the date last searched: April 25, 2023 (detailed search strategy Appendix S1). Google Scholar, TROVE, Base-search Net, Open DOAR, Monash Health Centre for Clinical Effectiveness, Australian Government Department of Health and Ageing, and MSAC were searched for grey literature related to the search term 'teledermatology' and published before June 1, 2023 (date last searched). There was no limit on the date of the publications to yield the highest number of articles. Reference lists of included studies and relevant SAFT systematic reviews were also searched for additional articles that may be relevant to this review.

The search strategies (Appendix S1) were drafted and refined through team discussion with an experienced librarian. Search results were exported into EndNote where duplicates were removed.

Study selection and eligibility

There were several inclusion and exclusion criteria applied in this review. Included articles researched Australian hybrid or SAFT services (i.e. services involving asynchronous communication) between a doctor and dermatologist. Doctors include general practitioners (GPs), junior doctors, specialists and trainees. The SAFT models may have any field of application (e.g. educational, triage, consultative, follow up) and in relation to any skin condition. Teledermatology focused on skin cancers, teledermoscopy, telepathology, telecytology, telehistology were excluded as recent reviews of teledermatology for skin cancer have previously been published.[33] Studies that utilised artificial intelligence, a provider who was not a dermatologist, direct-to-consumer models (i.e. patients are able to refer themselves into the service), or mobile health applications were excluded. This is justified by variable outcomes of these services (e.g. some services have higher risk of medical errors).[6,34] Publications in the form of editorials, letters, research notes, case studies, conference abstracts, presentations, reviews or published in languages other than English were excluded.

Two reviewers (CL and JD) independently screened all articles by title and abstract, completed full text review and critical appraisal. When the two reviewers disagreed, a third independent reviewer (RE) reviewed the relevant article for inclusion.

Data extraction and synthesis of results

A data-charting table was created and tested using two studies before use by one reviewer (CL) to determine which variables to extract from articles. Two reviewers (CL and JD) independently charted the data then compared, discussed, and combined tables to ensure comprehensive data collection. Data was extracted on study characteristics (e.g. author, year, participants, methodology, and outcomes), SAFT characteristics (e.g. service model, technology characteristics, referral characteristics, and diagnostic and management concordance), user perspectives, and outcomes of the service (e.g. dermatologist advice, additional investigations, waiting time, follow up). By analysing the main findings of included studies, common themes were identified.

Risk of bias assessment tool

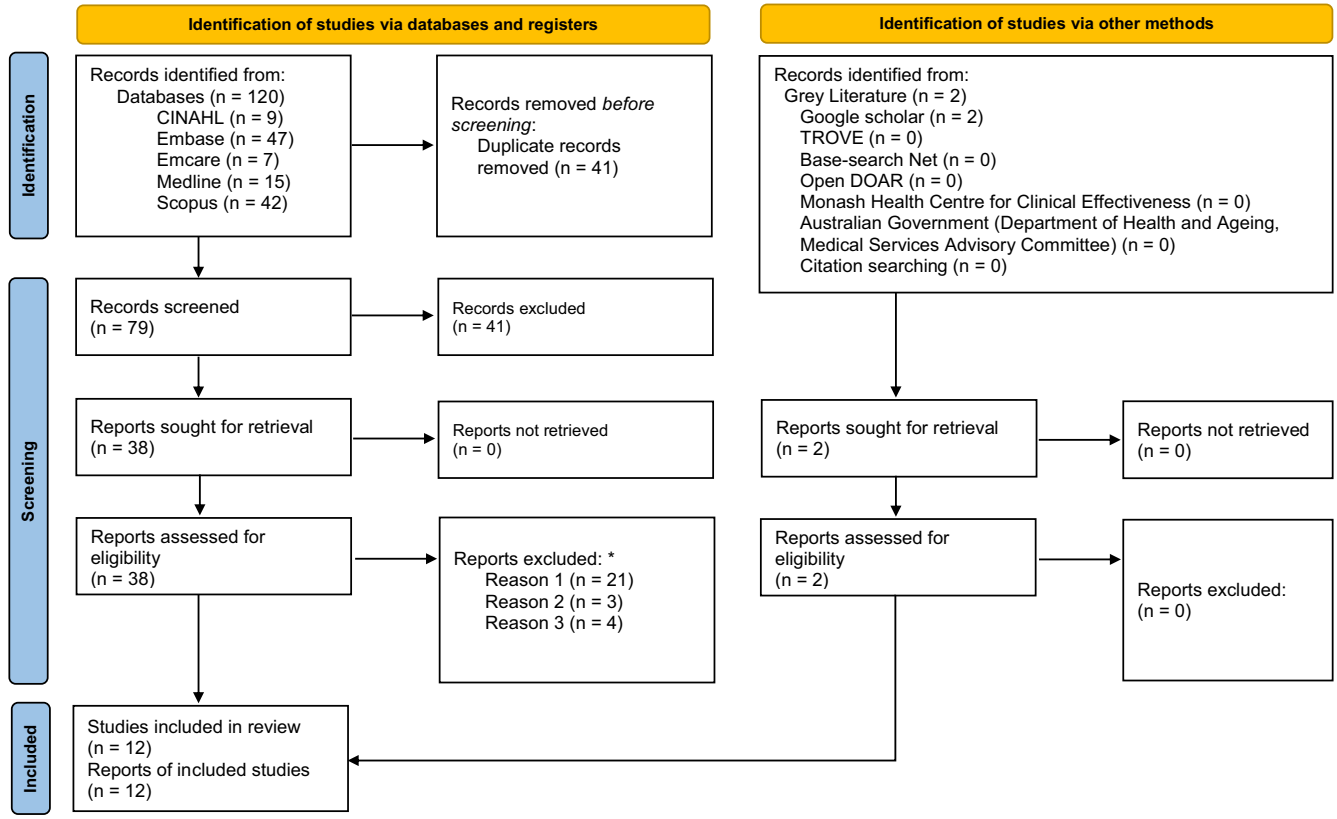
The Critical Appraisal Skills Programme (CASP) checklists aim to critically appraise the literature, but without scoring, to guide decision-making about the risk of bias and quality of evidence in literature. Two reviewers (CL and JD) used CASP checklists to assess the risk of bias for all studies independently. A third independent reviewer (RE) was consulted when discrepancies between two independent reviewers were present to establish a mutual agreement. The risk of bias evaluation aids in data synthesis by grouping similar studies and assessing the reliability of the evidence available. The diagnostic,[35] qualitative,[36] and cohort[37] study checklists were used in this review. Where relevant, diagnostic study then qualitative studies took precedence over cohort study as there were more specific and targeted questions in those appraisal tools and the cohort study checklist was less aligned with the design of included SAFT studies.

RESULTS

The electronic database search identified 120 articles. After removing duplicates, 81 records remained. Of those, 41 articles were excluded based on title and abstract, and another 41 excluded after full-text review. Grey literature search and citation searching yielded two additional studies. A total of 12 publications were included in the final analysis of this review. Figure 1 shows the reasons of exclusion.

Summary of study characteristics

A summary of the included studies is illustrated in Table 1. Nine different SAFT models operated by four hospitals,[27,39,42–47,49] one skin cancer centre[40,48] and one by the Australian College of Rural and Remote Medicine (ACRRM)[9] were reported from included studies. Six out of nine of the teledermatology models were based in Queensland,[9,27,39,42,43,45–47] two from Western Australia,[44,49] and one from New South Wales.[40,48] Models targeted a range of geographic areas covering patient populations: metropolitan and rural,[27,39,42,46,47,49] predominantly rural,[9,40,43,44] and predominantly metropolitan populations.[45,48] There was a total of 1818 patient cases across these studies, with a range of 12–685 patients per study. The St George Teledermatology Trial had two studies,[40,48] and the Skin Emergency Telemedicine Service (SETS) had three studies evaluating their service.[27,39,42] All other models had one associated article published. The earliest published study was in 1999,[49]



*Reason 1: not a primary peer-reviewed study with measured SAFT outcomes
Reason 2: not an Australian study
Reason 3: not related to store-and-forward teledermatology or specific for skin lesions and skin cancers

FIGURE 1 PRISMA flow diagram.[38]

and latest in 2021.[47] Seven studies were prospective interventional studies[27,40,43–45,48,49] and the remaining five were retrospective studies or audits.[9,39,42,46,47] Data extraction led to consideration of findings in three key areas: description of methodology or SAFT models, impact on patient care, and users' experiences. These are also summarised in tables in the Appendices S2–S4.

The SAFT model

There are some notable differences in the application of SAFT models, communication modes, reporting of technology utilised, and condition foci. All models utilised some form of SAF transmission in their service. One service also utilised synchronous communication (phone consultations between the dermatologist and patient), classifying it as a hybrid service.[47] Two SAFT models utilised an online case-based reasoning system where GPs can learn from cases to aid them in reaching their own diagnosis, or a dermatologist can be contacted for advice.[9,44]

Different types of communication methods between the dermatologist and the patients' referring doctor exist. The earliest SAFT model used a graphic user interface computer program.[49] Five of the more recent SAFT models used emailing as the modality for communication.[27,40,43,47,48] The mode of communication was not detailed in one study.[45] Five studies reported standard digital cameras were used to capture images of skin lesions.[27,40,43,48,49] (Appendix S2 includes details of photography training, image resolution, file sizes, and quality).

Although most services provided for patients with any skin condition, three services targeted populations with specific skin conditions. These studies were designed for adult patients with acute and subacute skin conditions,[27] patients with psoriasis,[45] and patients experiencing adverse drug reactions in hepatitis C.[46] Categories of diagnoses made by dermatologists via telehealth were characterised in eight studies.[27,39,40,42,43,46,48,49] Among the included studies, the most commonly diagnosed dermatoses were dermatitis, as well as other common conditions being fungal infections, skin cancers, acne, and drug reactions (Appendix S2).

Impact on patient care

The SAFT models included in this review were assessed for their influence on health care provision and quality of

patient care in a variety of ways (see Appendix S3) and included waiting time to specialist advice,[9,27,39,40,42,43,46] investigations or follow up conducted,[9,27,40,46,48] and accuracy of the service.[27,45,48,49] The average waiting time for specialist advice was 2.7 h,[46] 3 h,[20–22] 5.5 h,[9] and 46 h.[43]

Where reported, recommendations from the dermatologist included face-to-face appointments (in 6.4%,[9] 7%,[46] and 25%[40] of the cases), biopsies,[27] referral to another specialist,[9] and admitting the patient into the hospital.[9,27] Additionally, dermatologists in two studies were found to request additional images due to poor image quality in the first SAFT referral.[9,43]

Diagnostic concordance between SAFT referrals and gold-standard face-to-face consults was assessed in four studies and found to be relatively good.[27,48,49] The percentage concordance of the preferred diagnosis was reported as 79%,[48] 83%,[49] and 98%.[27] The kappa score was reported as 0.83 and 0.6 (interpreted as very good agreement and moderate agreement) at 6 and 14 weeks after face-to-face assessment respectively for the Tele-assessment of Psoriasis Area and Severity Index (PASI) scores.[45] One of the studies also reported management concordance as 96% of SAFT diagnoses in complete agreement with face-to-face diagnoses, and the remainder 4% in relative agreement.[27]

Understanding the user and user experiences

In this review, users of the SAFT service were understood to include both the referring clinicians and patients (see Appendix S4). Clinician perspectives prior to using SAFT were generally positive.[40,44,46] Reported clinicians' perceived benefits after using the SAFT services included prompt responses and increased access to specialist care in rural Australia.[46] However, one study showed a divide in clinician perspectives. Most GPs believed the system was easy to use, and a majority indicated that they would likely use the system again, but another assessment the following year revealed out of the two options given, 60% of GP respondents believed the service was beneficial to them and the other 40% thought it was not. Similarly, in the same study, opinions differed on whether the system would help to reduce consultation time.[44] No reasons were given for these responses.

Patients perceived benefits of SAFT as time-saving,[40] improved access to healthcare services, and ease of use.[47] Patients are generally reported being confident and comfortable using SAFT. However, a minority of patients (particularly the elderly) using the hybrid service who were responsible for sending clinical images expressed difficulties doing so. There was also concern for using telemedicine due to their perceptions regarding the primacy of visual examinations which is crucial for dermatology diagnoses.[47]

Risk of bias assessment

Generally, the papers presented evidence in which there was moderate confidence, for reasons that include clear aims addressed with a statement of findings. Limitations exist in diagnostic studies 'methodology and results confidence and the qualitative studies' analysis methods. The results of the quality assessment and the associated risk of bias are displayed in Table 2. The quality of the studies were reviewed using the qualitative checklist[36] for five, cohort checklist[37] for three, and diagnostic checklist[35] for four of the studies.

All studies had clear aims or research questions, appropriate recruitment of participants, and clear findings that provide value in this review of Australian SAFT models. Additionally, common strengths of qualitative articles include appropriate research design, methodology and data collection. Weaknesses observed in the qualitative studies included: not clearly stating the author's own role in the study and missing statements regarding analysis methods.

Criteria regarding confounding factors, follow up and precision of results were found to be less relevant for included studies evaluated using the cohort study checklist.[37] Interventions used in these studies reflect the real-world SAFT services. Although follow up of patients is important for patient care, it was not relevant to the results of these studies that mainly evaluated referral characteristics. The results of the cohort studies are most likely reliable as simple descriptive statistics are used to audit their services.

Aside from the general strengths mentioned above, diagnostic studies used appropriate reference standards (i.e. face-to-face dermatology consults). However, limitations include skewed higher degree of diagnostic accuracy as some patients already had established dermatological diagnoses.[27] Confidence intervals were not reported resulting in lower confidence of results.[45,48,49] Confirmation bias is an important consideration of the diagnostic studies and impacts the plausibility of the results. Confirmation bias could exist in the studies that utilised the same dermatologist in both teledermatology and face-to-face review of patients as there may be identifying features in the referral information or images.[27,45,49] It is also possible that publication bias may exist as findings were positive, overall.

DISCUSSION

This review identified 12 primary studies evaluating an Australian SAFT service for any skin condition (excluding studies specifically for skin cancers) to aid understanding of Australian SAFT models, outcomes, and user perspectives. Studies encompass descriptions of nine service models (including method of communication, technology utilised, condition foci, and populations serviced), and outcomes (diagnostic and

TABLE 1 Study characteristics.[a]

Service	Setting (R/M)[b]	First author	Year	CASP: Design
Telederm Australia	Royal Perth Hospital, Perth, WA (M + R)	Tait[39]	1999	Diagnostic: Pilot prospective non-randomised interventional study
St George Teledermatology Trial	St George Dermatology and Skin Cancer Centre, Kogarah, NSW (M)	Lim[40]	2001	Diagnostic: Prospective diagnostic concordance study
	Broken Hill, NSW (R)	See[41]	2005	Qualitative: Pilot prospective non-randomised interventional study
Skin Emergency Telemedicine Service	PAH, Woollo-ongabba, QLD (M + R)	Muir[27]	2011	Diagnostic: Pilot prospective diagnostic concordance study
		Biscak[42]	2013	Qualitative: Retrospective analysis – clinical audit
		Finnane[43]	2016	Cohort: Retrospective analysis – clinical audit
Pilot study in Mackay	Royal Children's Hospital, Brisbane, QLD (R)	Hockey[44]	2004	Cohort: Pilot prospective non-randomised interventional study
TELEDERM	Royal Perth Hospital, Perth, WA (R)	Ou[45]	2006	Qualitative: Prospective Qualitative study
Tele-assessment of PASI	PAH, Woolloongabba, QLD (M)	Singh[46]	2011	Diagnostic: prospective diagnostic concordance study
Tele-derm National (ACRRM)	Brisbane, QLD (R)	Byrom[9]	2016	Cohort: Retrospective analysis – clinical audit
Tele-dermatologist expert skin advice	Royal Brisbane Women's Hospital, Herston, QLD (M + R)	Charlston[47]	2018	Qualitative: Retrospective analysis – clinical audit
PAH Dermatology Outpatient Appointments	PAH, Woollo-ongabba, QLD (M + R)	Edwards[48]	2021	Qualitative: Retrospective analysis

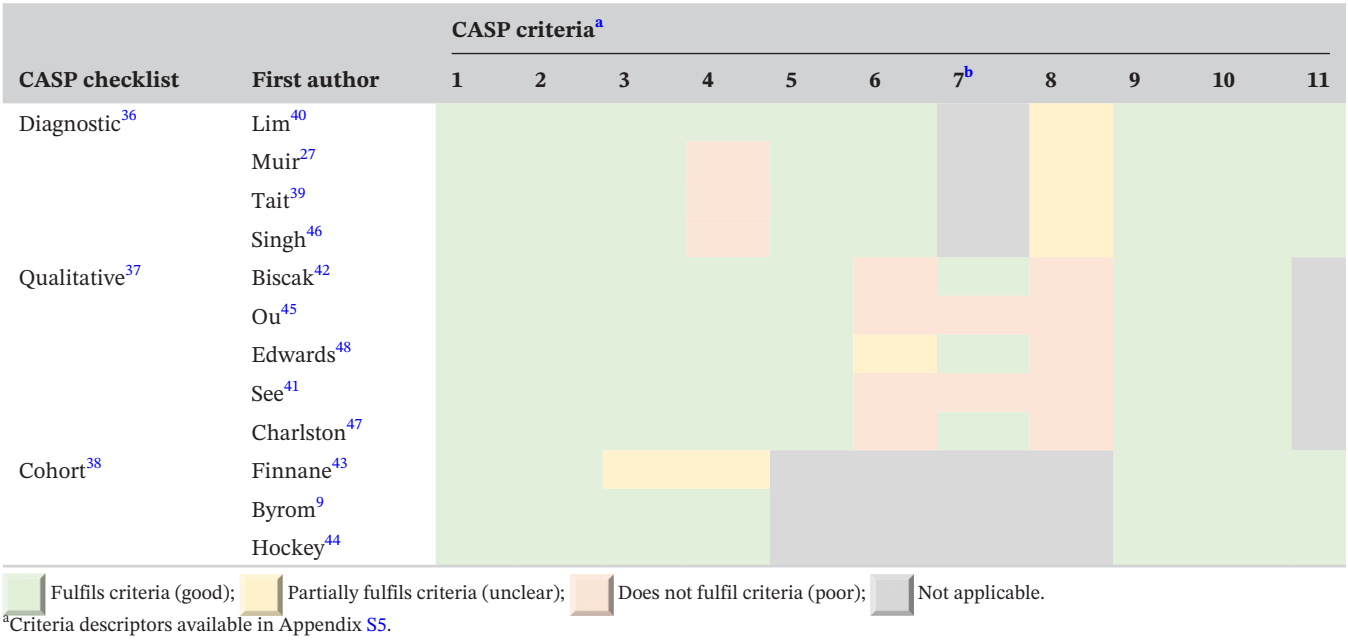
Abbreviations: ACRRM, Australian College of Rural and Remote Medicine; F2F, face-to-face; GP, general practitioner; NSW, New South Wales; PAH, Princess Alexandra Hospital; PASI, Psoriasis Area and Severity Index; QLD, Queensland; SAF, store-and-forward; SAFT, store-and-forward teledermatology.

[a]Case characteristics may include, and is not limited to, the reason for referral, skin conditions referred, if additional information is requested, and response time.

[b]Indicating the setting of the population M = metropolitan, R = rural (specific regions if detailed in the study are described in Appendix S3).

Aims	General outcomes	Participants
To determine the concurrence rate between dermatological diagnoses made following telemedicine consultations compared with F2F contact	25 out of 30 had the same preferred diagnosis	30 cases
To investigate the accuracy of SAFT diagnoses by evaluating concordance of diagnosis using 5 different dermatologists (interobserver variability) and concordance between a dermatologist using SAFT and a GP	Case characteristics given. Intraobserver variability: 88%. Concordance of preferred diagnosis between one reference dermatologist and four other dermatologists: 79%. Concordance with GP's primary diagnosis: 48%	53 cases, 49 patients, 4 dermatologists, 11 GPs
(Follow up of Lim et al. study). To investigate the use of information technology within dermatology, particularly in education and service delivery to remote areas	Case characteristics. Pre-project GP survey reveals most GPs had a positive expectation of the teledermatology service although most disagree that it will be fast/efficient. Patients revealed high acceptance of teledermatology	48 cases, 46 patients, over 1 year. 14 GP responses
To investigate the feasibility of using a SAF Skin Emergency Telemedicine Service to provide rapid specialist diagnostic and management advice for dermatological cases in an emergency department	Case characteristics, response time quick – majority 2 h, diagnostic concordance 98% and 96% management concordance	60 patients over 1 year
Assess the use of the teledermatology service, including the characteristics of clinicians using the service and their perceptions of it	Case characteristics, most responses within 3 h, majority referrers: junior doctors, most requested advice: regarding diagnosis, state-wide service with most referral from Mount Isa	685 cases, 167 patients, over 1 year. 34 clinician responses
To determine whether there has been any change in the number, type and location of referrals in 2014 in the emergency setting in comparison to 2008	Case characteristics, most responses within 3 h, just under one-third of referrals were internal	318 cases over 1 year
To provide advice to rural GPs within one working day and investigate the feasibility of a low-cost SAFT service for GPs	Case characteristics, average response time: 46 h, GPs felt more confident after undergoing training to use the service and rate of referrals increase with time	63 cases, 15 medical practices
To assess GP's perception of usefulness and usability of the Web-based decision support system (TELEDERM)	Clinician pre-trial questionnaire: high expectations of the service (important to rural remote GPs, useful in assisting decision making process), post-trial questionnaire: majority of GPs believed the system was easy to use, and a majority indicate that they would likely use the system again. 60% believed TELEDERM beneficial, 40% not beneficial	2005 trial 13 GPs responded to questionnaire A, and 9 to B. 2006 survey 25 GPs responded
To investigate the feasibility of tele-PASI by comparing the results to F2F assessments	Good overall agreement of PASI scores	12 cases, 3 dermatologists
To identify the current scope of Tele-Derm, the types of dermatological complaints experienced in the rural primary care setting, and to assess the quality of patient clinical information provided to the dermatologist	Case characteristics, most referrals from QLD, majority referrals requested both diagnostic and management advice, short response times	406 cases over 1 year
To conduct an audit to determine its effectiveness and user satisfaction in managing cutaneous adverse drug reactions in patients with hepatitis C, and to demonstrate a unique collaborative model of care for patients receiving specialised drug therapy	A large majority of cases from regional and remote areas, very high reported clinician satisfaction	43 cases, 29 referring sites, 18 clinicians over 2 years
To investigate the clinical efficacy and tolerability of telephone consultation and patient experience of a new remote consultation system	Large reduction in in-person clinic attendance, patients reported difficulty taking and emailing photos, patients enjoyed eliminating travel time and reducing interruption to their day	100 patient surveys

TABLE 2 CASP summary.



[a]Criteria descriptors available in Appendix S5.

[b]7 = Criteria for diagnostic and cohort checklists relates to the results of the articles presented in the results section of this article and not relevant to the critical appraisal.

management concordance, management advice, waiting time, follow up, and user perspectives). A majority (10 of 12) of the studies serviced rural populations which reflect the higher demand of teledermatology in this population.[41]

Diagnostic concordance

Diagnostic concordance of SAFT with face-to-face consults is an important aspect to consider when evaluating the efficacy and appropriateness of new models of care such as SAFT. This review reveals acceptable diagnostic concordance. Similarly, a previous systematic review determined diagnosis and management concordance of SAFT to be good and acceptable.[50] Although the diagnostic accuracy is not as high as standard face-to-face consults, Lim et al.[48] suggests that dermatology advice via SAFT is more accurate than a GP's diagnosis alone. This is not surprising as diagnostic accuracy of dermatologists has been shown to be higher than GPs.[3,51,52] On the other hand, Finanne et al.[33] suggest that management is more important than diagnosis as the treatment may be the same for the differential diagnoses resulting in the same outcomes. In one of the included studies, management concordance was reported as high,[27] reflecting previous results.[50] Concordance rates specific for individual dermatological conditions or categories were not investigated, except for in one study investigating the utility of SAFT for psoriasis assessments.[45] Therefore it is hard to ascertain whether certain skin conditions are more suited to management via SAFT. Previous literature indicates that high concordance rates were found in the broad categories: infections, tumours, and paediatric inflammatory dermatoses.[53]

Waiting times and face-to-face appointments

One of the goals of SAFT services is to reduce waiting times and prevent face-to-face appointments where patients need to travel long-distances to see a specialist dermatologist. Although waiting time was reported in half of the studies, no comparisons were made to the local conventional dermatology consults. Without comparisons, the results cannot be contextualised, and no conclusions can be drawn on whether time to dermatologist advice has overall decreased or increased for the studies' population. However, the average time to specialist advice reported in the studies utilising a SAFT service was faster compared to the average time required for patients referred to a large public dermatology clinic to be seen face-to-face.[54]

Only a small proportion of SAFT patients were recommended a subsequent face-to-face appointment thereby allowing more patients to be adequately managed in primary practice ultimately reducing the burden of the dermatology outpatient setting and preventing patients the need to travel to metropolitan centres for care. Furthermore, triaging dermatological patients, and determining which patients need subsequent face-to-face review, could increase efficiency of health-care systems.[55] However, none of the studies included in this review discussed the utility of SAFT for triaging.

The impact of SAFT on conventional care was shown to reduce referrals to one outpatient hospital dermatology department,[40] and a hybrid teledermatology model was able to replace most outpatient appointments that would have otherwise have been limited by COVID-19 social distancing rules.[47] More research regarding impact of SAFT services on conventional dermatology may aid in increasing efficiencies in current traditional models of care.

User perspectives

Where reported, GPs had a positive outlook of SAFT services, particularly prior to use, indicating remote access to dermatological advice is appreciated and can ease geographical professional isolation. However, in one study by See et al.,[40] the number of SAFT referrals did not reflect the demand of the service. Possibly GPs' expectations of the service were not met or there were limitations such as time-consuming nature of referrals, increased workload,[25,56] technological complications experienced,[10,25] or inadequate reimbursement.[57] High intention to use with low reported actual use has also been identified in other telemedicine platforms.[58] Empowering GPs self-efficacy towards use of telemedicine platforms, may increase uptake of newer innovative services.[58]

Patient perspectives revealed general acceptance of SAFT as a way to access dermatological care. Patient concerns regarding difficulties using technology can be addressed by avoiding the need to handle technology through a dedicated skin photographer or the patient's GP. Concerns from patients using other SAFT services reported in international literature with regards to imaging included feeling embarrassed having photos taken, social or religious issues with photography, and privacy issues regarding images.[59] Patient concerns not identified in this review, but in international literature, include inadequate doctor-patient relationship, long-wait times and inconsistencies in follow up, and lack of explanation of the dermatological advice provided.[25] Most qualitative studies included in this study used surveys rather than interviews which may have limited the patients' responses and therefore, the insights to patient concerns and acceptance of models. Future studies analysing associations between patient characteristics and perspectives may provide insight into SAFT service usage. Patients' perspectives need to be thoroughly assessed to improve patient outcomes and satisfaction of SAFT services.

Limitations

There are a few limitations of the literature to consider. There is no standardised way to evaluate a SAFT service as evidenced by the heterogeneity of study designs. Therefore, a narrative approach was used to discuss the results in this review. Critical appraisal of the articles highlighted qualitative studies would benefit from discussing methods used to analyse the data and the limitations of the study due to investigators' potential bias. Rigour of diagnostic concordance scores can be improved from minimising recall bias and assessing kappa scores and confidence intervals of results. Additionally, there is a potential for publication bias in this review as there are likely many motivations for not reporting negative outcomes such as model remuneration. Therefore, the findings in this review may be skewed towards positive outcomes. Moreover, not all SAFT services in Australia may be captured if no studies regarding the service have been published, and possible informal use of SAFT may not be recognised as a service.

This review identifies a paucity of Australian research in SAFT. Internationally, the greatest number of published studies regarding teledermatology was from the United States followed by the United Kingdom.[11] The lack of research is particularly evident in the areas of SAFT cost-effectiveness, appropriate follow up procedures, long-term consequences such as impact on patients' quality of life, and the utility of SAFT for triaging patients and educating GPs, trainees or medical students. Future research should include these aspects to better understand SAFT utility that have been described internationally.[11,17] Moreover, many studies reported GP perspectives of SAFT services, but less studies reported patient perspectives, and none reported dermatologists' perspectives of delivering the service. All of these are key stakeholders in SAFT models so it is important to assess their experiences and perspectives on how SAFT may contribute to good health care outcomes.

Furthermore, nine of the 12 studies were over a decade old involving outdated technology that no longer represents the current state of SAFT. Difficulties with internet and technology experienced in some of the studies may not present the same challenge today with the advancement of technology, for example, availability of faster internet, higher quality imaging. With time, particularly in the COVID-19 era, increased familiarity with technology and telehealth may also aid in patients' and clinicians' confidence in utilising SAFT services. Emerging technologies may have an important role in future SAFT models. This includes imaging modalities such as 3D total-body imaging, confocal microscopy, and use of artificial intelligence for diagnosis that may be paired with SAFT to deliver care to patients remotely. The technology is rapidly being assessed for skin cancer diagnosis, and in the future may advance to help diagnose dermatological conditions with more complex and heterogenous presentations such as inflammatory dermatoses.

Future practices and research

Teledermatology services have increased during, and following, the outbreak of COVID-19. According to a recent international survey, most teledermatology programs were found in North and South America, and Europe. There survey found a mix of teledermatology methods used, and a mix of reimbursement sources (National health care system 59%, private insurance 85%, self-pay 73%, unpaid volunteer 36%). There are no recognised international practice guidelines and variable teledermatology formats within countries.[60]

Practice guidelines for teledermatology services in Australia have recently been developed to support best practice and increase uptake of teledermatology.[61] These guidelines aid standardisation and safe use of SAFT in Australia. Research regarding whether patients are happy to pay out-of-pocket for SAFT has not been elicited in this review and would be beneficial to understand in the current context where SAFT services are not publicly funded. Although high patient satisfaction may reflect patients' willingness to pay for accessing SAFT services.[33] The Australasian College of Dermatologists (ACD) has applied twice (in 2014 and 2017) for government reimbursement for teledermatologists and clinicians involved in using this service.[26] The COVID-19 pandemic has encouraged reimbursement for live video-conferencing models of teledermatology, and reimbursement for SAFT models may be imminent. Additional published evidence-based research of SAFT services, with recommended improvements in minimising bias identified in the studies of this review, may support such changes to reimbursement policy. Current research is being conducted to investigate the utility of SAFT for the purpose of education and training.[29]

CONCLUSION

Teledermatology delivered via SAFT models is a promising solution addressing healthcare inequalities and the underservicing of patients living in regional and rural areas of Australia. Such models may allow patients to get timely specialist opinion without the need to travel long distances. Findings suggest that multi-faceted SAFT models can be used for patients with all skin conditions. The SAFT services improve diagnostic accuracy for patients when compared to no specialist input at all. It is important to research SAFT outcomes to assess the individual service models which will aid in continuous quality improvement, a collaborative approach to developing successful SAFT services, and facilitating informed decisions for patients wishing to access the service. More research into Australian SAFT service outcomes may aid in the development of reimbursement policies for teledermatologists and referrers which may result in more populations accessing timely care and improved patient outcomes.

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CONFLICT OF INTEREST STATEMENT

No conflicts of interest are noted.

ORCID

Celine Jessica Lee https://orcid.org/0000-0002-8233-1510
Julia Chequer de Souza https://orcid.org/0000-0001-6266-138X
Rebecca Evans https://orcid.org/0000-0001-6393-2903

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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