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To: [Health and Community Services Committee](#)
Cc: [Peter Soyer](#)
Subject: Telehealth Inquiry - Submission
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Attachments: Store and forward telehealth in QLD.DOCX
2011 EMA Muir J Incorporating teledermatology.pdf
2013 JTT Biscak Audit of a state-wide store and forward teledermatologypdf

To whom it may concern,

We write to you in response to your call for submissions for an inquiry into telehealth services in Queensland.

The Dermatology Research Centre, part of the University of Queensland's School of Medicine has played a key role in store-and-forward Telehealth in Queensland. The department is headed by Professor H. Peter Soyer, a leading dermatologist who has initiated the use of teledermatology into the Princess Alexandra Hospital and has provided teledermatology consultation service throughout Queensland. He is also CIE of a recently awarded NHMRC Centre of Excellence grant on Telehealth lead by Professor Len Gray.

Prof Soyer has published two articles on store-and-forward telehealth, and these articles are attached for your reference. Also attached is a one page summary of store-and-forward telehealth and the studies covered in the articles.

We also like to draw attention to a current submission by the Australasian College of Dermatology on store-and-forward teledermatology to the Medical Services Advisory Committee (see also <http://www.msac.gov.au/> and search term teledermatology).

Please do not hesitate to contact me if you require any further information.

Kind regards,

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Store-and-forward Telehealth in Queensland

Skin conditions represent roughly 16% of visits to General Practice, however only a small amount of these cases are referred to a specialist dermatologist. Majority of skin presentations are not considered urgent and can be safely managed through an outpatient clinic. However skin emergencies do occur, and in some cases can even be life-threatening. Doctors working in the ED lack confidence in dealing with acute skin presentations partly due to limited dermatology training in their undergraduate courses. With majority of specialist dermatology services found in the capital cities, dermatology remains one of the most poorly supported medical services in rural areas, with many places relying on monthly or quarterly visits from specialists and long waiting lists

The use of teledermatology, where media (typically photos of skin conditions), is exchanged via telecommunication technologies to be evaluated by a dermatologists, has been highly beneficial in Australia and the world. Store-and-forward telehealth refers to the process where clinical information (data, images, video, sound etc.) is captured by a clinician, then forwarded to another site for clinical evaluation. Numerous studies have found telemedicine a reliable and accurate method of diagnosing skin disease.

The University of Queensland's Dermatology Research Centre conducted an observational pilot study between August 2008 to August 2009 of patients presenting with acute and subacute dermatology conditions in the ED of the Princess Alexandra Hospital (PAH) in Brisbane. Doctors completed a proforma on patient history, examination findings and lesions were photographed. This was sent as a case package to a secure email address and forwarded to a teledermatologists. In total, 60 patients participated in this study. The results found that 93% of cases received a dermatologist's opinion within 2 h and a face-to-face follow up occurred with 83% of the patients within 2 weeks. The level of observed agreement between tele-diagnostics and ED diagnosis was 72%, while the level of agreement between tele-diagnosis and the final clinical diagnosis was much higher at 98%. It was determined that the use of store-and-forward telehealth may provide significant improvements in the quality of care for dermatology emergencies. The results of this study is published in the journal of *Emergency Medicine Australasia* ([Muir et al, 2011](#))

Based on the encouraging results of this research project the Dermatology Department at the PAH started to provide a store-and-forward teledermatology service for Queensland. An audit on the state wide store-and-forward teledermatology service in Australia was carried out by researchers at University of Queensland's, Dermatology Research Centre and published in the journal of *Telemedicine and Telecare* ([Biscak et al, 2013](#)). The audit examined 167 cases of store-and forward telederm consultations during 2012, and included a clinician questionnaire. Results revealed that most referrals received a reply within 3 h (56%), majority of the referring clinicians were junior doctors (2nd-4th postgraduate year), and that 100% of the questionnaire respondents stated the service was useful with 97% said they would use it again in the future, with one respondent stating 'possibly'. The audit confirmed a clinical need for access to specialist dermatology consultation and the expediency of the telederm service provided by the PAH Dermatology Department for Queensland Health hospitals and other health centres throughout Queensland. It showed that such advice can be provided via store-and-forward telehealth and there was an overwhelming positive response from clinicians using this service.



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ORIGINAL RESEARCH



Incorporating teledermatology into emergency medicine

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Abstract

Objective: The aim of the present study was to investigate the feasibility of using a store-and-forward Skin Emergency Telemedicine Service (SETS) to provide rapid specialist diagnostic and management advice for dermatological cases in an ED.

Methods: This pilot study was conducted at the Princess Alexandra Hospital between August 2008 and August 2009. Study subjects were consenting patients over 18 years of age who presented with a dermatological condition to the ED. The ED doctor sent the patient's history, examination findings and the digital images of the skin conditions to a secure email address, which automatically forwarded this to the teledermatologist. The teledermatologist reviewed the cases and sent advice on diagnosis and management to the referring ED doctor via email and/or telephone. Face-to-face follow-up consultations with the patients were conducted within 2 weeks. The diagnostic and management concordance between ED doctors, teledermatologists and reviewing dermatologists were analysed.

Results: A total of 60 patients participated in the present study. SETS provided a rapid response with 56 (93%) of ED consultations receiving a dermatology opinion within 2 h. Face-to-face follow up occurred in 50 patients (83%). Statistical analysis showed significant levels of agreement between tele-diagnosis and ED diagnosis of 71.2% (Kappa 0.42) and tele-diagnosis and final clinical diagnosis of 98% (Kappa: 0.93). The clinical management concordance was 96% in complete agreement and 4% in relative agreement between the teledermatologists and reviewing dermatologists, based on chart review.

Conclusion: The present study has shown that SETS can provide rapid and accurate diagnostic and treatment advice from a specialist for dermatological presentations to the ED.

Key words: *dermatology, emergency medicine, skin emergency, teledermatology, telemedicine.*

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Introduction

Prevalence data on dermatological presentations to Australian EDs are not well documented. However, it is known that they make up about 25% of all visits to medical practitioners and approximately 4–12% of presentations to EDs in the USA.^{1,2} In Australia, dermatological diseases represent 17% of presentations in general practice.³

Skin presentations are usually not urgent and are safe to be managed at an outpatient clinic. However, exceptions do occur and patients can present with a skin emergency or with cutaneous signs of a serious, even life-threatening systemic disease.¹ Early diagnosis and treatment is crucial to optimizing outcomes for skin emergencies such as toxic epidermal necrolysis, staphylococcal scalded skin syndrome, exfoliative dermatitis, pustular psoriasis, pemphigus vulgaris, the various autoimmune blistering disorders and vasculitis. Many of these conditions require aggressive inpatient treatment, and must be immediately recognized to the treating physician.^{4–7}

The authors have identified a lack of confidence in dealing with acute presentations to EDs of patients with rashes as a result of a paucity of dermatology teaching in undergraduate courses and the difficulty of learning this subspecialty with limited clinical training. In the authors' experience, the lack of emergency dermatology on-call cover at most hospitals, public and private, can be a serious problem for EDs with patients potentially suffering as a consequence. Telemedicine has been increasingly utilized for delivery of a wide range of medical specialties in Australia and around the world.⁸ Teledermatology is one of the more useful telemedicine applications given the visual nature of skin disease presentations.^{9–12} Numerous studies have demonstrated adequate accuracy and reliability of telemedicine in diagnosing skin disease.^{13–17} It was reported that the diagnostic agreement rate between clinic-based dermatologists and store-and-forward teledermatologists ranged from 57% to 96% when both the diagnosis and differential diagnoses were considered.^{13–16} Clinical management concordance between teledermatology and conventional clinic has demonstrated similar agreement rates.¹⁵ Studies found that diagnostic accuracy rate is significantly higher by dermatologists compared with non-dermatologists across a whole spectrum of skin conditions.^{2,3,17}

There are 469 dermatologists and 101 trainees servicing 22 million Australians and most are based in private practice in capital cities or major metropolitan areas.^{18–20}

In Queensland, there are only five major teaching hospitals with visiting dermatologists. Rural services are mostly provided by visiting dermatologists on a monthly to quarterly basis. Consequently, many patients are required to travel a long distance by road or air to see a dermatologist and often remain on waiting lists for weeks or months. Since the mid-1990s, Australian dermatologists have utilized teledermatology as an adjunct for clinical education and to provide ready access to the underserved communities. These include Tele-Derm National established by the Australian College of Rural and Remote Medicine (ACRRM) in 2004,²¹ teledermatology services for urban and rural New South Wales^{13,22} and also in Perth, Western Australia.²³

There is little published work on teledermatology service specifically dealing with dermatological emergencies.²⁴ The aim of this Skin Emergency Telemedicine Service (SETS) study was to investigate the feasibility of using telemedicine to provide accurate and rapid management advice for dermatological cases in a hospital ED.

Methods

Study design

This was an observational pilot study of a non-consecutive convenience sample of ED patients presenting with acute and subacute dermatological conditions.

Setting

The Princess Alexandra Hospital (PAH) is one of three tertiary hospitals in Queensland. Its ED is a designated level 6 trauma centre with more than 46 000 annual attendances, approximately 35% of all presentations being admitted. In addition, the ED provides extensive clinical training for the medical house officers. Its Dermatology Department had 10 948 outpatient visits and 640 admissions in 2007/2008. The department provides dermatology specialty care, staff training and also houses non-invasive bio-imaging research.²⁵ The University of Queensland (UQ) Dermatology Research Centre was established in 2007 as a joint initiative with the Queensland Skin and Cancer Foundation to represent Queensland's first professorial research unit led by specialist dermatologists. The primary objectives are to initiate, conduct and promote international-standard translational and interdisciplinary research in skin disease.

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In August 2008, a teledermatology system was set up using store-and-forward technology linking ED of PAH and a secured UQ server based at the School of Medicine. A dedicated email router delivered the referral information simultaneously to the dermatologists who provided tele-consultations and to the SETS coordinator who also provided around the clock technical support to the service. The SETS directory was installed in the ED desktop computers with SETS referral proforma, instruction and patient information consent form.

Patient recruitment and study procedure

Patients were recruited over 1 year between August 2008 and August 2009. Study subjects were consenting patients over 18 years of age presenting with an acute or subacute dermatological condition to the PAH ED where it was felt by medical staff that specialist dermatology advice was warranted. Skin lesions caused by an accident or trauma were excluded. A total of 60 patients were enrolled. Appropriate ethics approval was obtained for the present study.

The ED treating doctor completed a SETS proforma documenting the patient's history and examination findings. The patient's skin lesions were photographed with a digital camera. The cameras included a Sony Cyber-shot (Model: DSC-P73), a Canon PowerShot (Model: G9), a Canon Digital IXUS (Model: 85 IS) and a Panasonic Lumix (Model: DMC-TZ3).

Both the completed SETS proforma and the digital images of the rash or skin lesions were sent to a secure SETS email address and automatically forwarded to the teledermatologist. The teledermatologist then reviewed the cases through their PC equipped with high resolution monitors and sent advice on diagnosis, further investigations required and management to be commenced back to the referring ED doctor via email and/or telephone. The ED doctor then executed investigation and management accordingly. Face-to-face (FTF) follow-up consultations with the patients were conducted either on the next ward round with a dermatologist or in the outpatient department (OPD) within 2 weeks. The reviewing dermatologists examined the patients and formulated an independent diagnosis and management plan. The diagnostic agreement and management concordance between teledermatologists and reviewing dermatologists (who might or might not have had access to histology results) were analysed.

Technical training and on-call support was provided to coordinate the tele-consultation process. These included a clinical tutorial session on Dermatological

Emergency cases presented by one of the teledermatologists. Brief training sessions were conducted at the ED to provide the emergency doctors with the essential information for the present study.

Data collection & analysis

Data were collected on referral request, digital images of the skin conditions, diagnoses and treatment recommendations from the ED doctors, teledermatologists and reviewing dermatologists (FTF consultations). The diagnoses were recorded following standard medical terminology, and coded as 'complete' or 'relative' or 'no' agreement based on text reading. Complete agreement was defined as full concordance between the diagnoses taking into consideration the protean dermatologic nomenclature. The relative agreement was defined if the final diagnosis was in the list of differential diagnoses. Semantic differences in the dermatologic terminology were taken into consideration.²⁶ Medical records (including diagnostic testing, histopathology results, recommendations of treatment and admission advice) were reviewed to allow analysis of diagnostic and management concordance between the teledermatologists and reviewing dermatologists. The data on response time (in minutes) of teledermatologists were recorded using time record of emails and telephone notes if telephone advice was provided.

Basic statistics on patient characteristics are presented by number (%), mean (SD) and median (interquartile range), as appropriate. The diagnostic agreement was presented by simple proportions and assessed by Kappa statistics.

Results

There were 60 patients referred from ED to the teledermatologists. The mean age was 47 (SD: 20) years old, and 21 (35%) of them were male. FTF follow up occurred with 50 patients (83%), 20 (33%) of the study patients being admitted to the hospital and 30 patients being reviewed in the dermatology OPD clinic. Ten patients (17%) did not attend to the follow-up clinics.

As assessed by the Australasian Triage Scale, most patients were triaged as Australasian Triage Scale Category 3–5 (98%). The median of the SETS response time was 27 (interquartile range: 17, 39) minutes. SETS provided a rapid response with 56 (94%) of ED consultations receiving a dermatology opinion within 2 h, including 49 cases (82%) within 1 h and 37 (62%) within

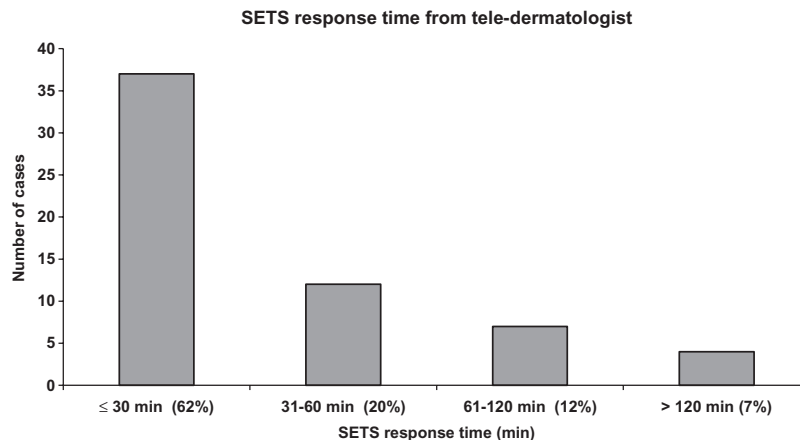


Figure 1. Skin Emergency Telemedicine Service (SETS) response time.

30 min (Fig. 1). Among these, 19 (32%) cases were submitted after-hours (18:00–08:00 and weekends). Comparing in-hours and out-of-hours SETS response times found no significant difference ($P = 0.087$).

Among the 60 study patients, ED doctors made correct diagnoses in 26 cases (43%), made differential diagnoses in 23 cases (38%) and made incorrect diagnoses in 3 cases (5%). ED did not provide diagnoses in eight referrals (13%). Table 1 lists the main dermatological conditions seen in SETS based on the clinical assessments confirmed with the laboratory tests and/or histopathology results. This includes the conditions that ED referral doctors provided initial diagnoses and the conditions that ED referral doctors had difficulty with diagnosis. All referrals to SETS requested diagnostic and management advice from teledermatologists.

The rates of diagnostic agreements and management concordance are presented in Table 2. The level of observed agreement between tele-diagnosis and ED diagnosis was 72%, with significant Kappa statistic of 0.42 (95% CI: 0.31–0.53). The level of agreement between tele-diagnosis and the final clinical diagnosis was much higher at 98% with Kappa statistic of 0.93 (95% CI: 0.90–0.95). The clinical management concordance between the teledermatologists and reviewing dermatologists was complete agreement in 48 cases (96%), and partial agreement in 2 cases (4%).

Relevant clinical tests ordered by the treating doctors in the ED were followed up in the wards and/or the dermatology OPD. These included blood, urine, swab, skin scraping and patch tests. Skin punch biopsies were requested for 23 patients (38%), 10 cases were performed by ED doctors during the initial ED presenta-

Table 1. Main dermatological conditions seen in SETS

Dermatological conditions	Number of cases	ED made wrong Dx	ED did not provide Dx
Dermatitis/eczema	9	1	
Urticaria	9		2
Allergic reaction/drug eruptions	8		
Psoriasis	6	1	
Arthropod bite reaction	5		2
Photocontact dermatitis†	4		
Erysipelas/cellulitis†	2		
Scabies	3		3
Impetigo	2	1	
Vasculitis†	2		
Darier disease	2		
Tinea	3		
Acute varicella/zoster†	2		
Bullous pemphigoid	1		1
Dermatomyositis	1		
Thrombocytopenic purpura	1		
Total	60	3 (5%)	8 (13%)

†These conditions are considered potential dermatological emergencies or severe conditions. SETS, Skin Emergency Telemedicine Service.

tion, directed by the SETS on-call teledermatologist. The other 13 punch biopsies were performed by dermatology OPD doctors during the follow-up consultations, or during the admissions on the wards. All specimens were collected adequately and examined by pathologists at the PAH.

Nearly half of the SETS patients (27 cases) were deemed to have acute or severe conditions (Table 1). A

J Muir *et al.***Table 2.** Level of diagnostic and management agreement with teledermatology

Teledermatology	ED diagnoses and management	Final diagnoses and management
Tele-diagnoses	71.2% Kappa: 0.42 ($P = 0.0001$) 95% CI: 0.31–0.53	98% Kappa: 0.93 ($P < 0.0001$) 95% CI: 0.90–0.95
Tele-management	N/A	96% complete agreement

The 'complete agreement' and 'relative agreement' on diagnoses were combined together for the estimation of Kappa.

total of 20 patients were admitted from the ED to the hospital inpatient wards following the tele-consultations, giving an admission rate of 33%. Ten patients (17%) did not attend the OPD follow-up appointments. Attempts were made to contact these patients by telephone to verify their reasons for non-attendance. Two patients indicated that their conditions had resolved and the remaining eight could not be contacted.

A total of 390 digital images were received in JPEG and Bitmap format from ED referrals, ranging from 1 to 20 images per patient (mean 6.5). Of these, 320 (82%) images were adequate and 70 (18%) were out of focus. Image resolution varied between 640×480 pixels and 4000×3000 pixels, with 24-bit colour resolution. The teledermatologists were able to make a diagnosis based on the digital images and history provided in every case.

Discussion

The diagnosis and management of dermatological conditions in the ED has until now, been problematic at times. Lack of experience and ongoing exposure, a relatively junior and transient medical work force has contributed to this. These patients are most commonly subacute in their presentations, and so, do not always receive the highest priority in the ED environment. Many hospitals do not have a dermatological service, and those that do have limited hours where that service is on site. Another very important factor has traditionally been the reliance on non-visual means of communication to a dermatology consultation service. Historically, these factors have combined to cause a long delay to diagnosis and effective definitive treatment for many patients who presented to ED with dermatological complaints.

In a specialty where the conditions and examination findings are predominantly visual in nature, a primarily visual form of communication has obvious attractions.

If that communication is simple, and makes use of existing technologies that most people are familiar with, then this could lead to better care of this population group. Teledermatology can be conducted using a variety of technologies with varying level of image quality.²⁷ The image resolution required for adequate diagnosis is under investigation. A previous study indicated that image resolutions of 1490×1000 pixels were not significantly better than 720×500 pixels in one study.^{28,29} In our study, the image resolution varied between 640×480 pixels and 4000×3000 pixels. The teledermatologists considered that these were adequate for diagnoses along with case histories.

The provision of SETS has enabled accurate and rapid diagnostic and treatment advice for emergencies. This trial provided an opportunity to evaluate emergency teledermatology service, which could improve outcome and community access for specialist dermatology care. This clinical study also provided further evidence to support the development of telemedicine services for remote communities.

The approach taken in the present study enabled participants to receive a diagnosis and treatment regime while waiting in the ED rather than having to wait days, weeks or even months for a face-to-face consultation to occur. The study suggests that the telemedicine application can provide a time-efficient solution to deliver specialist dermatology care to rural and remote communities.

This clinical trial was an observational study with no control group as a result of the urgent clinical presentations of the cases and the setting in the ED. However, the results suggest that SETS might provide significant improvements in quality of care for dermatology emergencies. There were a number of cases where important diagnoses were provided rapidly by dermatology specialists. In a number of cases ED staff found the confirmation of their provisional diagnosis as being correct and advice on investigation and management by teledermatology useful. The teledermatologists estimated

that the time to review and to make assessments of the referrals is about 5 min. This service rapidly facilitates specialist access and significantly improves the clinical management of patients with acute and subacute dermatological conditions.

Study limitations

As an observational study it suffers from potential selection bias. Current practice of dealing with dermatology cases in ED has not been studied. Our study probably underestimated the value of teledermatology to medical officers in ED because we only measured the broad diagnostic accuracy and did not measure their confidence in the diagnoses and accuracy of their proposed management. The intended management by ED doctors before the dermatologist advice were not recorded; therefore, adequacy could not be determined.

In the present study, the accuracy of ED diagnoses might have been artificially high as some of the patients already had established diagnoses. The teledermatologists estimated time to review and to make assessments of the referrals could have been better documented. We did not attempt to conduct cost analysis on standard referral or the cost of ED referrals.

Conclusion

The present SETS study in PAH has found that teledermatology provided accurate and rapid diagnostic and treatment advice for patients presenting with acute and subacute dermatological emergencies. This process has also enhanced medical training in emergency dermatology through direct consultations with teledermatologists. The implementation of this service could generate improved patient care and service outcomes in other EDs.

As technology advances rapidly, the technical platform and specialty applications of telemedicine are continually evolving. Based on this model, the implementation on a larger scale of the SETS in the State and National health-care systems will enable the access to specialist dermatology care for both urban and rural communities.

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Author contributions

JM, MS, CX, HPS, AS and IM were involved in the development and implementation of the study. SP provided statistical analysis and manuscript editing. PS and SD contributed to the data collection and analysis.

Competing interests

None declared.

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Audit of a State-wide store and forward teledermatology service in Australia

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Audit of a State-wide store and forward teledermatology service in Australia

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Summary

In 2008, the Skin Emergency Telemedicine Service was established at the Princess Alexandra Hospital (PAH) in Brisbane. We conducted an audit by evaluating all email communication during 2012, and administering a clinician questionnaire. A total of 167 cases were discussed via 685 email communications (46 being in-house PAH referrals). The highest number of external referrals came from Mt Isa (27%), located 1200 km from the nearest dermatology clinic, with a further 25% sent from centres located 50–600 km from a clinic. The main referring condition was rash (65%), followed by skin lesions (13%). The most commonly provided telemedicine diagnoses were dermatitis/eczema (23%), infection (20%) and drug eruption (17%). Most external referrals received a reply within 3 hours of the enquiry. Junior doctors (2nd–4th postgraduate year) represented the majority of referring clinicians (62% of questionnaire respondents). There were 111 potential questionnaire recipients. Responses were received from 34 clinicians, a response rate of 31%. Overall 100% of respondents stated that the service was useful to them and 97% said they would use it again in the future with one respondent stating ‘possibly’. It seems likely that teledermatology will serve an important role in the provision of healthcare to Queensland, and other remote Australian communities in the future.

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Introduction

Queensland is the second largest state in Australia, extending 2000 km from north to south and 1600 km east to west. It is home to approximately 5 million Australians.¹ The majority of Queensland’s population (90%) live in or near Brisbane, or along a narrow coastal zone. Only 5% of people live in the western 60% of the state and with one exception, no other town more than 150 km from the coast has a population in excess of 10,000 people.¹ The vast area, coupled with the widespread population, provides a challenge for equitable healthcare provision.

In 2012, 73 of the 411 active dermatologists in Australia were practising in Queensland,² with the majority located within the major metropolitan areas. The only public dermatology clinics are located in Brisbane (two clinics) and Cairns, and the provision of specialist dermatological advice to rural Queensland communities relies on quarterly outreach visits by dermatologists.

The Skin Emergency Telemedicine Service was established as a pilot study at the Princess Alexandra Hospital (PAH) Brisbane in 2008.³ It involved email referral from treating emergency department clinicians to two PAH-based dermatologists. The referral contained the relevant clinical history along with images of the skin condition in question. Once received, the case was reviewed by the on-call dermatology registrar who would liaise with the available dermatologist to provide diagnostic and

management advice to the referring clinician as required. The pilot study demonstrated that such a service was a feasible option for the provision of rapid specialist advice for dermatological cases in the emergency department.³ The service was very well received among the emergency department doctors and was therefore continued after the pilot phase ended in August 2009. Without any formal advertising or promotion, referrals continued to be received from Queensland Health clinicians across the state, suggesting a clinical need for consultant dermatologist advice from rural and remote locations.

The purpose of the present analysis was to assess the use of the teledermatology service, including the characteristics of clinicians using the service and their perceptions of it.

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Methods

The audit consisted of two parts. The first was an evaluation of all teledermatology consultations in the period 1 January to 31 December 2012. The second was a retrospective questionnaire to obtain feedback from the clinicians who used the service during the audit period. Ethics approval was obtained from the appropriate committees.

Results

During the study period, a total of 167 referrals were discussed via 685 email messages. There were 46 in-house PAH referrals and 121 external referrals. The highest number of external referrals (33 cases, 27%) came from Mt Isa (a mining town with a population of 22,000 located in the northwest of the state and 1250 km from the nearest public dermatology clinic in Cairns), 30 (25%) came from clinicians from various locations 50-600 km from a dermatology clinic in Cairns or Brisbane, 44 (36%) were from centres within 50 km of the PAH dermatology clinic and three referrals were from the neighbouring state of New South Wales (Table 1).

The most common referring presentation was rash, accounting for 108 (65%) of the total number of referrals. The next most common was skin lesions with 21 referrals (13%), see Table 2. The most commonly provided diagnoses were dermatitis/eczema (38 cases, 23%), infection (33 cases, 20%) and drug eruption (29 cases, 17%), see Table 3.

It was possible to calculate the response time for 107 of the 121 external referrals. The majority (60 referrals, 56%) received a reply within 3 hours, 13 referrals (12%) received a response in 3-6 hours, another 13 (12%) in 6-12 hours, 15 (14%) in 12-24 hours and only six (5%) referring clinicians waited more than 24 hours for an email reply.

Questionnaire

The referrals to the teledermatology service were received from 128 different email addresses and questionnaires were distributed to the referring clinicians via these email addresses in April 2013. Of these emails, 15 were rejected as no longer active and two responded as not applicable. Therefore there were 111 potential recipients. Responses were received from 34 clinicians, a response rate of 31%. Overall 100% of respondents stated that the service was useful to them and 97% said they would use it again in the future with one respondent stating 'possibly'.

The referring clinicians included 2nd-4th year post-graduate junior doctors (62% of respondents), general practitioners, trainee specialists, consultants and nurses. The majority of referring clinicians (53%) stated that they became aware of the service when they made a telephone call to the on-call registrar to obtain dermatological advice, 14% had been involved in the initial pilot study and another 14% were told by a colleague (Table 4).

Table 1. Referral location and distance from public clinic.

	Number	Distance to the nearest public dermatology clinic in Brisbane or Cairns (km)
Beaudesert	1	69
Bundell	1	76
Childers	1	312
Dalby	2	207
Dirranbandi	3	595
Gold Coast Hospital	4	80
Inverell Community Centre*	2	432
Ipswich	4	40
Kingaroy	2	214
Lismore*	1	199
Logan Hospital	15	47
Mater Hospital	2	0
Mt Isa	33	1257
Not stated/unsure	13	-
QEII	16	8
QID	1	3
Redland	4	50
Robina	3	82
Toowoomba	5	125
Townsville	4	355
Wacol Detention Centre	1	20
Warwick	2	156
Wynnum	1	20
<i>Subtotal</i>	<i>121</i>	
In-house	46	
<i>Total</i>	<i>167</i>	

*Indicates interstate.

Most of the referring clinicians (85%) stated that their main purpose in using the teledermatology service was to obtain a diagnosis, with 35% seeking confirmation of their provisional diagnosis. Thirty-eight percent stated that the inconvenience of distance for patients to obtain in-person dermatology review was a consideration while perceived urgency of the dermatological presentation contributed to 20% of respondent's referrals (Table 4).

Clinicians were able to provide comments in the questionnaire and the responses were unequivocally positive. 'It was fantastic support for a resident covering a rural hospital in the middle of nowhere!' and 'Thank you, the service is much appreciated especially given the expedient feedback' were two example comments. Additional comments included suggestions about the service request process. One clinician felt that a centralised website with a unique username and password with online forms and pre-set templates to complete and upload photographs would be more user friendly than the print and scan

Table 2. Referral complaint.

	Number
Acne	1
Blister	3
Cellulitis	4
Infection	2
Itch	3
Lesion	21
Other	12
Rash	108
Swelling	5
Ulceration	3
Information not available	5
<i>Total</i>	<i>167</i>

Table 3. Diagnosis.

	Number
Arthropod	3
Autoimmune	15
Bullous dermatoses	2
Dermatitis/eczema	38
Drug eruption	29
Diagnosis not stated in reply email	16
Infection	33
Other	22
Psoriasisiform	5
Skin cancer	4
<i>Total</i>	<i>167</i>

system employed. There was also a comment made suggesting that the follow up process could be improved.

Discussion

The diagnostic accuracy of store and forward teledermatology has been demonstrated⁴⁻⁷ and its value in providing second opinions has also been stated.⁸ The store and forward method of referral was found to be the most commonly used modality in a recent review of US teledermatology programmes.⁹ Australian studies published over the past 15 years demonstrate the use of teledermatology by general practitioners.¹⁰⁻¹² In addition to the reported clinical benefits of telemedicine in Australia, a review of the literature found increased opportunities for professional development for the health professionals involved and a potentially positive influence on the recruitment and retention of the rural medical workforce.¹³

The Skin Emergency Telemedicine Service, initially established for research purposes, has continued to operate in response to an obvious clinical need in the context

Table 4. Clinician questionnaire responses.

	Number	(%)
Level of employment		
PGY2	10	29
PGY3	9	26
PGY4	2	6
Other (see A below)	13	38
How found out about the service		
Telephone call	18	53
Worked on pilot	5	15
Other	11	32
Reason for contacting the service		
Diagnosis (more than one answer possible)	29	85
Confirmation	12	35
Urgency	7	21
Distance	13	38
Time to review	2	6
Other	1	3

A. Other levels Paediatrician, GP, SMO, ICU Director, RN, PGY8, Medical Registrar, Year 4 Registrar, Advanced ED Trainee, Clinical Nurse, Nurse Practitioner, Registrar Emergency Trainee

of a widely distributed state population and limited access to specialist dermatological care in more regional and remote areas. The service referrals came from clinicians in various locations throughout Queensland. However Mt Isa was by far the most frequent external referral source accounting for over 25% of cases. Mt Isa is a rural mining town which received visits from specialist dermatologists four times per year. The two teledermatologists involved in the service are also involved in these outreach clinics and therefore the community nurses were directly aware of the existence of the teledermatology service which may explain the large number of referrals.

In addition to the many remote referrals, a large number of referrals came from centres without in-house dermatology clinics but within 50 km of the Princess Alexandra Hospital. In these locations, face to face follow up appointments with dermatologists are possible. Thus, at these distances, teledermatology is mainly useful as a triage service for referrals to outpatient dermatology clinics, based on clinical need. Therefore, teledermatology may form an essential part of future clinical training programmes for dermatologists.

The main presentations for which referring clinicians required specialist input or second opinion advice were rashes. This may be attributed to a concern for missing the potentially life threatening dermatoses such as Stevens-Johnson syndrome (SJS) and toxic epidermal necrolysis (TEN) or perhaps also the varied clinical picture of the rashes presenting. The main diagnoses were dermatitis/eczema, infection and drug eruption which indicates that referring clinicians find challenges in both acute and more chronic patient presentations.

The short response times of the teledermatology service are noteworthy, especially since there were only two teledermatologists involved in the service at the time of audit. The instances where referring clinicians waited for 12 hours, and six clinicians waited more than 24 hours for reply do however suggest that a larger network of teledermatologists is required to guarantee round-the-clock access to specialist advice. Such recruitment of dermatologists, however, may provide its own challenges. A 2011 paper outlined concerns held by dermatologists in California (the US state with the most practising teledermatologists) regarding involvement in teledermatology programmes. The key problems were reimbursement for consultation, technology related difficulties and communication with referring providers.¹⁴ Concerns regarding the medicolegal risks and protection have also been expressed by dermatologists as being one of their main reasons for avoiding teledermatology consultations.¹⁵ The opinions of Australian dermatologists are not yet known.

Based on information provided via the questionnaires, the majority (62%) of referring clinicians were junior doctors in their 2nd-4th postgraduate years, which is the time at which doctors are required to begin rural posts under the Queensland Health system. The level of on-site support varies considerably on these rotations therefore having remote access to specialist advice may reduce the stress associated with being in an isolated community and provide increased opportunities for professional development.¹³

Suggestions for an online, pre-formatted web-based teledermatology form are legitimate. Such a framework is utilised in a project first established in 2002 (<http://www.telederm.org>) as a free, open access platform for teleconsultations in dermatology where clinicians and specialists share interesting or perplexing cases; many of which also include dermoscopic images for pigmented lesions (something not so commonly requested in our current service).¹⁶

The most obvious limitation of the teledermatology service is the lack of information regarding patient outcomes following implementation of management advice or treatment plans. On a few occasions the treating clinicians sent a follow up email to inform the teledermatologists of the patient outcome. However without a formal process in place, there is a risk that inadequate patient response or poor outcomes are overlooked. Such feedback systems should be implemented in future telemedicine services to optimise the framework for patient care.

Conclusion

An audit of the Skin Emergency Telemedicine Service demonstrated a clinical need for access to specialist dermatology consultation. It showed that such advice can be provided via store and forward modalities and there was an overwhelmingly positive response from

clinicians using the service. It seems likely that teledermatology will serve an important role in the provision of healthcare to Queensland, and other remote Australian communities in the future.

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