Does the use of store-and-forward telehealth systems improve outcomes for clinicians managing diabetic foot ulcers? A pilot study

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Abstract

Diabetic foot ulcers are one of the most hospitalised diabetes complications and contribute to many leg amputations. Trained diabetic foot teams and specialists managing diabetic foot ulcers have demonstrated reductions in amputations and hospitalisation by up to 90%. Few such teams exist in Australia. Thus, access is limited for all geographical populations and may somewhat explain the high rates of hospitalisation.

Aim: This pilot study aims to analyse if local clinicians managing diabetic foot complications report improved access to diabetic foot specialists and outcomes with the introduction of a telehealth store-and-forward system.

Method: A store-and-forward telehealth system was implemented in six different Queensland locations between August 2009 and February 2010. Sites were offered ad hoc and/or fortnightly telehealth access to a diabetic foot speciality service. A survey was sent six months following commencement of the trial to the 14 eligible clinicians involved in the trial to gauge clinical perception of the telehealth system.

Results: Eight participants returned the surveys. The majority of responding clinicians reported that the telehealth system was easy to use (100%), improved their access to diabetic foot speciality services (75%), improved upskilling of local diabetes service staff (100%), and improved patient outcomes (100%).

Conclusion: This pilot study suggests that clinicians found the use of a telehealth store-and-forward system very useful in improving access to speciality services, clinical skills and patient outcomes. This study supports the recommendation that telehealth systems should be made available for diabetic foot ulcer management.

Keywords: Diabetic foot, telehealth, foot ulcer, clinicians, survey.

Introduction

Diabetic foot ulcers are one of the leading causes of diabetic-related hospitalisation and lower extremity amputation[1]. In 2004, diabetic foot ulcers resulted in the use of 130,000 hospital beds, 3,400 amputations and contributed to over 1,000 deaths in Australia[2]. Of the 1 million Australians diagnosed with diabetes mellitus[3], approximately 15% will develop a foot ulcer in their lifetime[4].

Multifaceted strategies to improve diabetic foot ulcer outcomes include access to specialist diabetic foot teams, clinical pathways and clinical training[5-12]. Benefits of such strategies include reductions of amputations (85%) and hospitalisation (90%)[5-12]. In Australia, access to diabetic foot specialist teams appears to be limited. It is estimated that 20 specialist diabetic foot teams exist: five in Queensland (personal communication, P Wraight, Chair Australian Diabetes Foot Network, Melbourne, Australia 2010). This limitation may be a factor in the high rate of Australian diabetic foot hospitalisation. This may particularly be the case in rural populations, where rates of diabetic foot ulcer hospitalisation in Australia are fourfold that of metropolitan populations[2].

A recent release of Australian diabetic foot guidelines has recommended remote expert consultation with digital imaging for diabetic foot ulcer management should be made available in remote areas[13]. This recommendation has contributed to the need to further investigate telehealth's use in diabetic foot management.

Background

Telehealth is defined as the use of telecommunications technology for diagnosis and patient care[14]. Types of telehealth technologies include the use of telephone, email, videoconference and store-and-forward applications of clinical images[14]. Telehealth applications are now readily found in dermatology, radiology, accident and emergency, and clinical education with a range of outcomes[14]. For example, teledermatology has demonstrated improved access to dermatology specialists, with comparable clinical efficacy and cost, to that of conventional face-to-face clinical care[15].

Accelerating telecommunications advances, increasingly ageing populations and limited availability of skilled clinicians has meant telehealth is becoming regarded as a valid option in providing increased and equitable healthcare. In Australia, Medicare Benefits have been available for telepsychiatry consultations for many years[16]. Significantly, recent Australian Government election pledges have surrounded the extended use of telehealth to provide more Medicare-funded telehealthcare consultations, particularly in rural and remote health[17].

The use of telehealth in chronic wound care is a more recent phenomenon and has demonstrated encouraging results. Studies in a telewound pressure ulcer program using a store-and-forward system and remote plastic surgeon demonstrated fewer hospitalisations as compared to a standard care group[18]. Other studies in store-and-forward telemedicine for wound care have demonstrated clinical diagnosis accuracy is comparable with in-person assessment[19,20]. One of the more significant telewound studies was an Australian randomised controlled trial of people with general lower leg ulcers, including approximately 40% that were diabetic foot ulcers[21]. This trial demonstrated that by providing a store-and-forward system with a remote wound care consultant that healing rates, amputation rates and cost-effectiveness improved in comparison to usual care in remote Australia[21].

However, there are limited studies into the use of telehealth, specifically in the management of diabetic foot complications. One of the original investigations in this area was an Australian study which outlined the development, use and anecdotal results of a simple, inexpensive, store-and-forward system for diabetic foot management[22]. An American study has since gone on to specifically investigate the healing rates of diabetic neuropathic foot ulcers using telehealth[23]. This study demonstrated that healing rates using a model of interactive videoconference consultations between a nurse managing foot ulcers and a remote specialist was no different to a model of face-to-face diabetic foot specialist team[23].

The Queensland Health AUSCARE® Diabetic Foot Store-and-forward Project commenced following a recommendation from the Queensland Health Diabetic Foot Innovation Project (DFIP). Access to speciality services, not readily available at pilot sites and particularly rural sites, had initially been highlighted by the DFIP as an important issue that may be rectified with the use of telehealth[24]. The DFIP trialled a videoconference system that enabled pilot site clinical staff weekly case conference access to a diabetic foot speciality service that included an endocrinologist, physician and senior podiatrist. The telehealth service was one aspect of a suite of DFIP strategies that together demonstrated significant improvements in diabetic foot clinical management[25].

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Clinicians were generally satisfied with videoconference as a service delivery tool, indicating that it reduced patient and clinician travel[24]. However, the necessity for an effective, user-friendly clinical image store-and-forward system to be made available for diabetic foot clinicians in conjunction with the videoconferencing facilities was identified[24].

The aim of the AUSCARE® diabetic foot store-and-forward project was to investigate diabetic foot clinicians' perceptions of the impact of using a store-and-forward telehealth system in regard to:

- Ease of use and satisfaction.
- Access to speciality services.
- Ability to upskill local clinical staff.
- Patient outcomes.

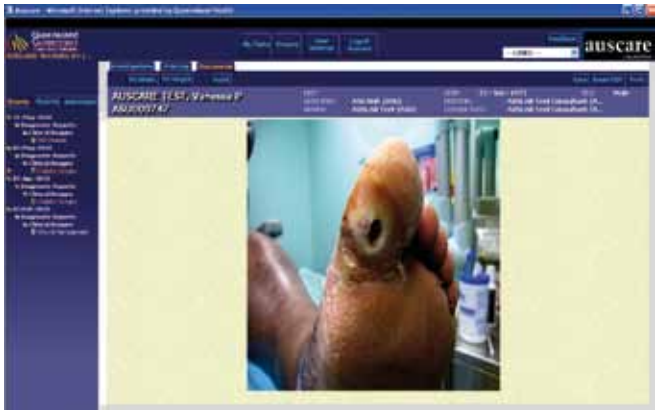

Figure 1. AUSCARE® system screen shot of a diabetic foot ulcer clinical image example.

Note: This image is from a mock patient to ensure de-identification of all patients. Normal clinical images would have measurement grid attached adjacent to the wound.

Methods

Setting and participants

The AUSCARE® diabetic foot store-and-forward project was implemented between August 2009 and February 2010 across six Queensland Health sites. These included The Prince Charles Hospital (Metro North), Princess Alexandra Hospital (Metro South), Inala Chronic Disease Management Service (Metro South), Mount Isa Hospital, Townsville Hospital and Cairns Diabetes Centre. Fourteen Queensland Health clinicians who routinely managed people with diabetic foot complications (podiatrists, diabetes educators, orthotists, physician and endocrinologist) volunteered to participate in the project. The Human Research Ethics Committee at The Prince Charles Hospital provided ethical approval for this study.

Procedure

The AUSCARE® system is a web-based clinical information system. The AUSCARE® system was chosen as it was identified as unique in the Australian context due to it its flexibility to upload, store and simultaneously view clinical images, documents and pathology from a Queensland Health-wide repository. The AUSCARE® system has the ability to configure stored images and documents into an electronic filing system based on Australian standard, paper-based healthcare records. A variety of file types was able to be viewed and/or uploaded including diabetic foot ulcer clinical images, taken using a diverse range of digital cameras and mobile phones, diabetic foot assessment forms[25], pathology results and any other appropriate clinical documents or images. All participants received training in the use and application of the AUSCARE® system in their local clinical environment. After completion of the training, participants had direct password-protected access to the AUSCARE® system to upload and/or view appropriate clinical images, pathology and documents as they required. Below is an example of clinical images uploaded during the trail (Figure 1).

All clinicians had some prior experience in digital photography for patient images. However, clinicians were encouraged to take their images from between 30 and 90 centimetres away from the wound or complication, perpendicular to the foot surface and incorporate a millimetre grid legend in the image adjacent to the wound with the patient's identification number for quality assurance purposes. Clinicians were asked to take images of diabetic foot complications that they felt they needed specialist clinical advice. Participants uploaded images directly to AUSCARE® at their convenience along with the patient's Diabetic Foot Form (Figure 2) that acted as a diabetic foot referral history.

Following the uploading of files, participants were offered access to either 1) request ad hoc emailed advice or telephone advice from specialists or other sites and/or 2) participate in a fortnightly videoconference case conference with diabetic foot speciality service (senior podiatrists, physician and/or endocrinologist) to gain specialist advice. Clinical images or documents were then able to be viewed simultaneously by the local and specialist clinicians from their own computer/s or videoconference location/s to discuss appropriate management.

Measures

A survey was developed to evaluate the impact of the system at the completion of the six-month project. The survey

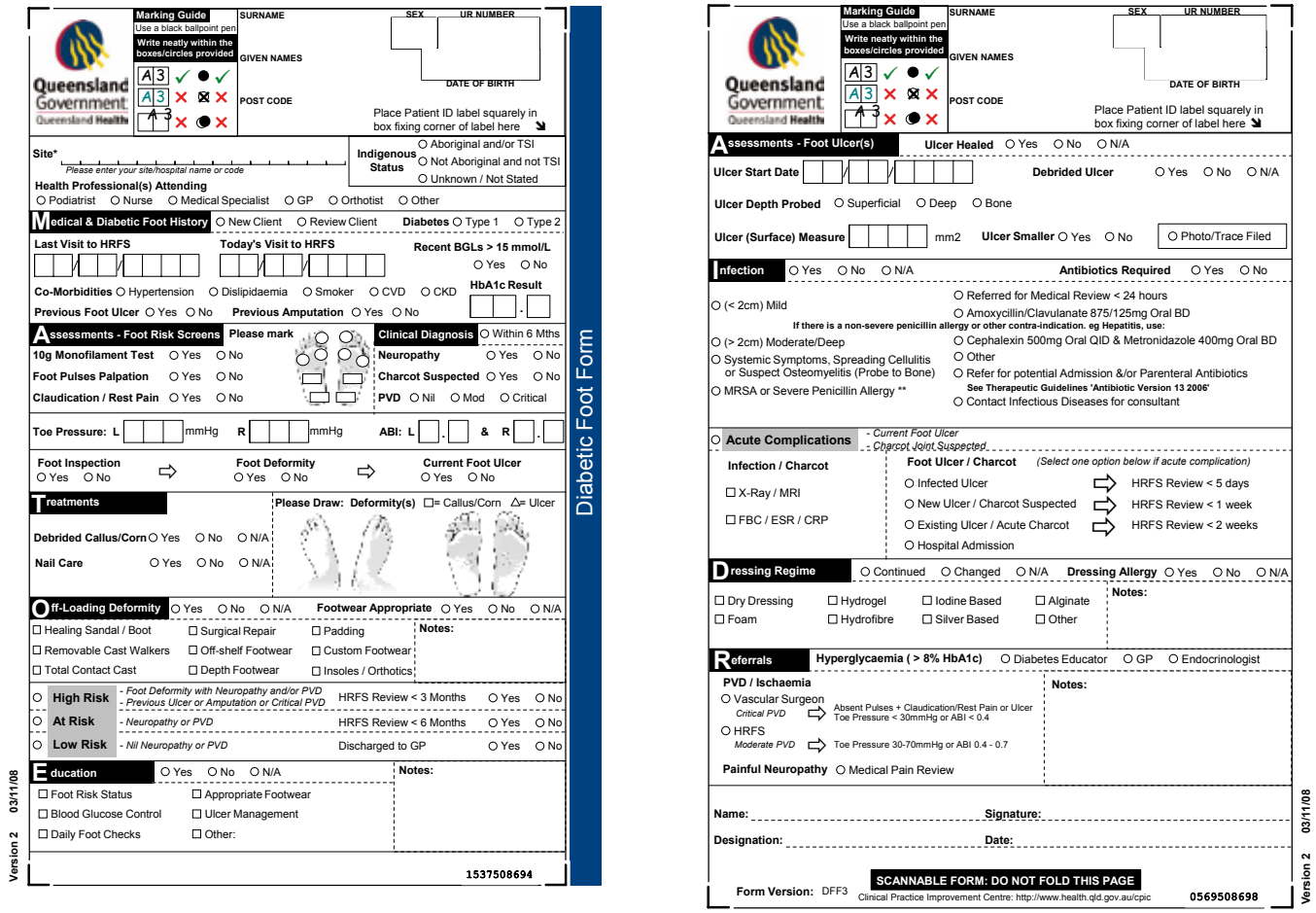

Figure 2. Queensland Health Diabetic Foot Form (Version 2.0).

was sent to all 14 eligible participants. Survey questions were based on key performance indicators developed after a literature review and discussions with clinicians. The questions either used a dichotomous (yes/no) or five-point Likert scale system and included items on ease of use and satisfaction, access to diabetic foot speciality services, use in upskilling local clinical staff and patient outcomes.

Statistical analysis

Descriptive statistics were conducted on survey responses with frequency of responses reported for each question. Responses are reported as numbers or percentage agreement, disagreement or not applicable for each question.

Results

During the six-month trial, 303 clinical images were uploaded. A total of eight (57%) surveys were returned; at least one survey response was received from each of the six participating sites. All responders identified themselves as existing users of the AUSCARE® system.

Overall, the AUSCARE® system was positively rated by clinicians in regard to use and satisfaction of the system. All respondents who answered the questions, rated the AUSCARE® system easy to use (n=6); were able to upload their images into AUSCARE® (n=7); and used AUSCARE® for viewing images (n=7). All respondents agreed (75% strongly agreed, 25% agreed) that AUSCARE® provided a secure storage location for their clinical images (n=8). The frequency of use by most respondents was at least fortnightly (57% fortnightly, 29% weekly; n=7). One respondent stated they had not used the system.

Tables 1a and 1b present other responses regarding use and satisfaction of the AUSCARE® system.

The AUSCARE® system was also positively rated by clinicians in relation to access to diabetic foot speciality services. Table 2 presents main responses to access to diabetic foot speciality services with the AUSCARE® system. All respondents who answered the question reported they received speciality advice within a suitable time frame (40% always, 60% most of the time; n=5).

Table 1a. Ease of access and problems with AUSCARE®.

	Always	Most of the time	Sometimes	Rarely	Not at all	NR
Was AUSCARE® easy to access from your desktop?	4	2	0	1	0	1
Have you experienced any problems searching for patient images in AUSCARE®?	0	0	1	2	4	1

NR. No response

Table 1b. Future recommendations for AUSCARE®.

	Definitely	Probably	Maybe	Probably not	Definitely not	NR
Will you continue to use the software for storing & accessing clinical images?	5	1	2	0	0	0
Would you recommend the AUSCARE® imaging system to other health professions managing different health conditions (e.g. ENT, dermatology, ophthalmology)?	6	1	1	0	0	0

NR. No response

Tables 3 and 4 report survey results on the AUSCARE® system's ability to upskill local clinical staff and the overall impact on patient outcomes respectively.

Discussion

The integration of a store-and-forward telehealth system into diabetic foot service delivery appears to be a useful method for improving diabetic foot management and, in particular, access to speciality services. The findings of this pilot study generally support those of other diabetic foot telehealth studies that indicate positive impacts for the clinician, service delivery and patient outcomes[21-23].

This pilot study appears to be unique in that it directly surveyed clinicians using a store-and-forward telehealth system to determine their perceptions of the impact that a telehealth system had on their management of patients with diabetic foot complications. The findings of these surveys seem to support our original hypothesis that by providing telehealth access to diabetic foot speciality services, local clinicians reported improved levels of access to, and support by, speciality services and that, in turn, their own clinical skills and patient outcomes improved.

Previous studies have focused on the positive impacts that telehealth applications have in regional and remote areas[21,23]. In the current study, 50% of included sites were metropolitan. All sites seemed to indicate that the same positive impacts associated with regional and remote areas may also be appreciated in metropolitan areas.

Table 2. Access to diabetic foot speciality services using AUSCARE®.

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	NR
Do you think the use of AUSCARE® has improved access to speciality services?	3	3	1	1	0	0
Was the quality of the image clear and suitable for diagnosis?	1	5	1	0	0	1

NR. No response

Table 3. Ability to upskill local clinical staff.

	Definitely	Probably	Maybe	Probably not	Definitely not	NR
Has the AUSCARE® & case conferencing helped to improve the upskilling of diabetic clinical staff?	4	3	0	0	0	1
Has AUSCARE® helped to improve the quality of the video diabetic case conferences?	6	1	0	0	0	1

NR. No response

Table 4. Impact on patient outcomes.

	Definitely	Probably	Maybe	Probably not	Definitely not	NR
Has the videoconferencing case conferences helped to improve the outcomes of patients?	1	5	0	0	0	2
Has the use of AUSCARE® reduced patient travel & minimised hospitalisation?	2	2	2	1	0	1

NR. No response

Enhanced telehealth access to specialist clinicians has been shown to have a direct effect on improved patient outcomes[15,21,23]. It is likely that such improvements depend on or at least are related to the quality of the available images. The AUSCARE® system seemed to enable clinicians and specialists to view an accurate picture on which to base their diagnosis or advice. This was rated positively by study participants and again supported current literature on the importance of this aspect of telehealth systems[20,22]. Even though this study did not directly evaluate patients, it is likely that with this study's demonstrated improvements in specialist access, this should lead to actual improvement in patients' diabetic foot outcomes. This is further supported by clinicians' perceptions that they felt their patients' outcomes had improved since using the telehealth system.

Clinicians in this study also perceived that patient travel to receive specialist care had been reduced as per other studies[21]. Reduction in patient travel should not be underestimated with regard to the effect this has on the patients' overall quality of life and service costs. The ability for patients to remain in their community to receive comparable treatment, particularly for remote and/or Indigenous patients, seems to have a positive effect on the patients' quality of life[26]. These findings also support other similar studies demonstrating a cost saving via the direct reduction on travel demands of patients and clinicians[15,21].

An important benefit of telehealth systems often overlooked is the complementary effect of upskilling the local clinicians at the forefront of patient care due to increased access and dialogue with specialists. Clinicians in this study reported improved levels of upskilling with the use of the telehealth systems. Previous telehealth studies have mentioned this effect as providing a larger benefit than perhaps would be assumed[21,23]. In fact, upskilling clinical staff may have a beneficial effect on service delivery, with a reduction in specialist advice necessary due to the satisfactory upskilling of local staff. This outcome is further supported in this study as clinicians felt they only needed a fortnightly case conference after experiencing a weekly case conference in the preceding Diabetic Foot Innovation Project telehealth service.

One factor which may have contributed to our positive findings regarding the use of this telehealth system was the fact that most participants had worked in their healthcare settings for at least two years. High staff turnover rates are commonly reported in rural and remote areas[21]. However it is possible that the routine telehealth access to a speciality service may provide enough support, upskilling and 'virtual' stability to local staff to partially stem the flow of turnover

in these areas. We also support the notion of other studies that telehealth services may provide the stability necessary to maintain quality services even with higher staff turnover by decreasing the length of transition required for new staff to upskill to the level of skill and service delivery required[21].

Finally, most respondents indicated that the system was overall easy to use and they were satisfied enough to continue to use the system after the completion of the trial and/or recommend its use for other health professional groups or conditions. These findings supported those of other studies using either simple or comprehensive store-and-forward systems[20,22].

Although the findings are generally positive for this pilot study, there were a number of limitations. The main methodological limitations were the limited sample size, subsequent lack of any statistical power for significance of results, absence of a matched control group, and lack of direct patient outcome measures. These limitations suggest the findings of this study should be accepted with caution.

However, this study does indicate a positive trend for the role of store-and-forward telehealth systems in the management of diabetic foot complications and supports other small diabetic foot studies in the area. The general positive trends of all these studies suggests a need for larger and more scientifically rigorous studies to determine the impacts that using telehealth systems have on the diabetic foot clinician, patient and cost outcomes.

One significant future barrier to wide-scale implementation of telehealth services in diabetic foot management noted by this study is the current lack of reimbursement for the specialist clinicians providing the advice. Our study was fortunate enough to have specialist podiatrists, physician and endocrinologist providing pro bono specialist advice at no extra cost to the local service. The Australian Government has recently considered expanding the Medicare Benefit Schedule (MBS) to include many more telehealth consults and services[17]. This study would seem to support the expansion of MBS items to include reimbursement for telehealth services provided by specialist multidisciplinary clinicians in the management of diabetic foot complications.

Conclusion

Considering the large economical and societal savings resulting from best practice diabetic foot management, interventions that improve access to speciality services, whether via face-to-face or telehealth services, should have a significant positive impact on healthcare services and the outcomes of patients.

This study adds positive weight to the findings of other diabetic foot studies and recent Australian diabetic foot guideline recommendations that the use of store-and-forward telehealth services should be encouraged for diabetic foot management in remote areas. This pilot study also suggests larger studies, and/or Medicare rebates, would be justified to investigate the advantages of telehealth in all geographical populations for diabetic foot management due to the existing limitations of diabetic foot specialist clinicians in Australia.

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Competing interests

None of the authors holds a financial interest in the AUSCARE® system.

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