Teledermatology by videoconference: Experience of a pilot project

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Abstract

Background: There is a shortage of medical specialists within the provincial departments of health in South Africa. Telemedicine is a potential way of providing specialist services, at a distance, to rural areas. This study assesses patient and staff satisfaction and issues, technological and operational, associated with the establishment of a videoconference-based teledermatology service.

Methods: An ISDN-based videoconference link was established between Port Shepstone Hospital and the Nelson R Mandela School of Medicine in Durban. Patients with a dermatological problem that would have necessitated transfer to the academic hospital for diagnosis and/or management were entered into a prospective study which evaluated the ability to make a diagnosis and prescribe a management plan by videoconference and the patients' and doctors' satisfaction with the consultations.

Results: A total of 69 patients were seen during 12 videoconferenced consultation sessions. Seventeen patients (24.6%) were subsequently referred to the academic hospital: nine patients were sent because a definitive diagnosis could not be made; and eight patients were transferred for specialist management based on the diagnosis made. The patients' and referring doctors' satisfaction with the consultation was 80.3% and 82.1% respectively, while the dermatologist was satisfied 67.6% of the time. The dermatologist was dissatisfied with ten (14.7%) of the consultations and this was related to difficulties in making a definitive diagnosis. The referring doctors found 59 (85.9%) of the consultations to be of educational value. No problems were noted in diagnosing lesions in dark-skinned patients.

Conclusion: Videoconferenced teledermatology between district hospitals and regional hospitals is possible and can improve services to rural areas. Further studies on widespread implementation and sustainability are warranted.

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Introduction

As in the rest of sub-Saharan Africa, South Africa faces a shortage of medical practitioners. This is especially so in the government sector. KwaZulu-Natal has a population of 9.4 million people, 53% of whom live in rural areas. A large number of medical specialist posts are unfilled with only 6.3 specialists, across all disciplines, per 100 000 uninsured people in the province.[1] The dilemma is how to provide an acceptable specialist clinical service to all the people.

Dermatology is a typical example of a speciality with limited resources both internationally[2] and in the provincial health care sectors in South Africa. Currently there are five full-time and three part-time dermatologists employed by the KwaZulu-Natal Provincial Health Department, all of whom are based in urban areas. Rural, and in some instances urban patients requiring dermatology diagnosis and clinical management are presently attended to by primary health providers in clinics and district hospitals, from where they may be referred to regional and tertiary centres. Referral is costly. The patient has to take time away from work and family and transport costs have to be borne by the patient or the Provincial Department of Health, which transports patients to the major centres by ambulance.

As part of an outreach programme in KwaZulu-Natal, dermatologists fly to rural hospitals using the Red Cross Air Mercy Service every two to three months. While of great benefit to the patients and the district hospital doctors, this is a very ineffective way of utilising scarce human resources, as it takes a dermatologist out of hospital clinic practice for a day to see between 10 to 20 patients in the district.

With the rapid advances and falling costs of information communication technology, telemedicine is a possible solution to some aspects of the problem. Teledermatology refers to the use of information and communication technology, such as the use of videoconferencing or the electronic transmission of digital images to enable the practice of diagnostic[3] and clinical dermatology[4] between participants separated by geographical distance. Telemedicine is not new, and many practitioners have unknowingly practised telemedicine when seeking or giving advice over the telephone or when faxing information to a colleague. Teledermatology is and has been practised in many parts of the world, including Norway, Finland, the USA, Canada, Australia, New Zealand, Northern Ireland, the Marshall Islands and the Greek island of Tilos.[4,5,6,7,8,9]

Telemedicine services have broadly evolved into two categories: store and forward telemedicine, and synchronous or real-time telemedicine. Store and forward telemedicine, as its name implies, involves forwarding information which has already been saved in an electronic format to a consultant who reviews the case in his or her own time. For dermatology, this involves sending an e-mail or posting to a website the patient's history and clinical information, with digital photographs of the lesions as an attachment. Synchronous or real-time telemedicine involves a live consultation with the consultant able to see and discuss the problem with the patient and the referrer. This usually involves some form of videoconference connection, to which can be added visual input from specialised instruments such as a dermascope, video camera or a document camera.

Real-time videoconference teledermatology began in 1989 in Norway and was first reported in 1993.[10] Subsequent literature has addressed issues of accuracy, reliability,[11] confidence of diagnosis and management at a distance,[12] patient[13] and doctor satisfaction with teledermatology,[14] image quality and the types of pathology best suited to teledermatology.[4] The American Academy of Dermatologists has developed a position statement on the practice of teledermatology.

To date there have been no reports of the practice of videoconferenced teledermatology in South Africa and no mention has been made in the international telemedicine literature of the potential difficulties associated with the practice of teledermatology in dark-skinned patients. The aim of this study was to initiate the use of integrated services digital network (ISDN) line-based videoconferencing for real-time teledermatology in a South African setting, identify technological and operational issues and to assess patient and staff satisfaction and acceptance of the service.

Methods

Patients were drawn from outpatients attending Port Shepstone Hospital in the months that the sessions were planned. The four selection criteria were i) that the patients had a dermatological problem; ii) the clinic doctor was uncertain of the diagnosis and management of the condition; iii) the patient would normally be transferred to Durban for a dermatological consultation; and iv) the patient was willing to take part in a teleconsultation. Patients were asked to return to Port Shepstone Hospital on the day of the consultation.

Videoconferenced teledermatology sessions were held between Port Shepstone Hospital and the Nelson R Mandela School of Medicine in Durban, between 2003 and 2005. For the first nine consultation sessions, a Polycom 128 videoconference unit was used at the send site and a Polycom 383 unit at the receive site. At both sites, 80 cm colour monitors were used and communication was made using dial-up ISDN telephone lines at 128 kbs^{-1}. For the last two consultation sessions the videoconference unit at Port Shepstone was upgraded to a Sony 1P multi-send unit and for the final consultation the number of ISDN lines was increased to provide a bandwidth of 384 kbs^{-1}.

The receiving site conformed to accepted standards for lighting and room colour for telemedicine.[15] The physical setting of the send site at Port Shepstone was substandard and the lighting was improved for the final three sessions. An auxiliary light was used at the send site to improve illumination of the lesion.

The referring doctor explained the procedure of the teleconsultation to the patient and obtained consent. The referring doctor was present during the teleconsultation and presented the patient to the dermatologist who asked additional questions as necessary. The dermatological condition was then shown to the dermatologist. No peripheral devices were used. The video camera of the videoconference unit was used to show both the patient and the referring doctor at the beginning of the consultation, and the camera was then directed to and focussed on the areas of dermatological interest. The camera was fixed to the videoconference unit, but was able to incline within a vertical range of 45° and sweep up to 180° horizontally. In some cases this relative lack of freedom of camera movement necessitated positioning the patient so as to be able to see the lesion more easily. For the last three sessions, still images were captured by freezing the image on the screen when the dermatologist felt it was warranted. This provided an image free of possible motion artefacts. The dermatologist then offered a diagnosis, or differential diagnosis and management plan, which was implemented at the

referring hospital. In the event that the diagnosis was not obvious, or management necessitated admission to an academic hospital, the patient was transferred to King Edward Hospital in Durban for a face to face consultation.

A datasheet was completed for each consultation. The patient's demographics, pertinent history, the referring doctor's diagnosis or differential diagnosis, the dermatologist's diagnosis or differential diagnosis, the management plan, and the duration of the consultation were recorded. In addition the patients', referring doctors' and dermatologist's satisfaction with the teleconsultation were scored on a five-point scale. The referring doctor was also asked to rank the educational benefit of participating in the consultation with the dermatologist.

Data are expressed as the mean and one standard deviation with the 95% confidence interval. Between group comparison of means was by one-way analysis of variance with post hoc testing using the Tukey-Kramer multiple comparisons test. Comparison of concordance of diagnoses was performed using a contingency table and the Chi-squared test and comparison of the transfer of patients was performed using Fisher's exact test. Alpha was set at 5%. Statistical analysis was performed using GraphPad InStat software, Graphpad, San Diego, California.

Results

Twelve teledermatology consultations were held, four in 2003, one in 2004 and seven in 2005. There were two medical officers who had a particular interest in dermatology who referred patients and one dermatologist was consulted. On two occasions a second junior dermatologist sat in as an observer. No patient declined teleconsultation. Sixty-nine patients participated in teleconsultations. Their average age was 40.5 ± 19.1 years (95% CI: 35.9–45.0), range 4 months to 80 years. There was a significant difference in ages between groups (ANOVA, $p = 0.0003$). The average age of the 34 black patients, 32.0 ± 17.7 years (95% CI: 26.0–38.1), was not different to that of the four coloured patients, namely 27.8 ± 21.3 years (95% CI: 6.9–48.6), but was significantly younger than the 14 Indian patients, namely 48 ± 15.6 years (95% CI: 39.8–56.2), $p < 0.05$, and the 17 white patients, namely 53.6 ± 14.2 years (95% CI: 46.9–60.4), $p < 0.001$. The coloured patients were also younger than the white patients ($p < 0.05$). Eight black and one coloured patient were under the age of 13 years. The average consultation time was 9 ± 3 minutes, with a range of 3–20 minutes. There was no difference between patient groups.

The outcome of the teleconsultations was that 12 patients (17.4%) were given either advice or treatment and were discharged after the consultation. Forty patients (58%) were prescribed treatment and were followed up at Port Shepstone Hospital, and 17 patients (24.6%) were transferred to Durban for further evaluation and management. Significantly more white patients warranted transfer to Durban than the other groups combined (Fishers's exact test, $p = 0.03$, relative risk = 1.562 (95% CI: 0.981–2.487)) (see Table I).

Table I: The outcome of the teleconsultations

	Black	Coloured	Indian	White
Treat + discharge	6 (17.6%)	1 (25.0%)	4 (28.6%)	1 (5.9%)
Follow up at PS	21 (61.8%)	2 (50.0%)	9 (64.3%)	8 (47.1%)
Transferred	7 (20.6%)	1 (25.0%)	1 (7.1%)	8 (47.1%)

(PS = Port Shepstone).

Based on the dermatologist's diagnosis, the pathology was considered to be benign in 61 patients (88.4%), malignant in 6 (8.7%) and undetermined in 2 patients (2.9%). The referring doctor's diagnosis or differential diagnosis was compared with that of the dermatologist. Overall there was concordance in the primary diagnosis in 47 cases (68.1%), in 2 cases the dermatologist confirmed one of the referring doctor's differential diagnoses (2.9%), and in 11 cases (15.9%) the dermatologist made a definitive diagnosis that was different to any presented by the referring doctor. In eight instances (11.6%) the dermatologist could not make a definitive diagnosis and offered a differential diagnosis and in a further case (1.4%) there was agreement in that neither the referring doctor nor the dermatologist was able to make the diagnosis. The dermatologist was therefore unable to make a diagnosis in nine cases (13.0%). This occurred in three black (8.8%), one coloured (25%), two Indian (14.3%) and three white (17.6%) patients, and the inability to make a diagnosis was not significantly different between patient groups. For the nine patients under the age of 13 years, there was 100% concordance between the diagnoses of the referring and consulting doctors.

For the purpose of analysis, and to determine which conditions might not be suitable for teledermatology, the conditions seen were categorised into groups (see Table II). In four of the eight cases that the dermatologist offered a differential diagnosis (two black, one coloured and one Indian patient) there was uncertainty between groups 1 and 2. In three instances the differential diagnosis was that of seborrhoeic dermatitis or psoriasis and in the fourth case psoriasis or eczema. One white patient had a differential diagnosis of prurigo or solar keratosis from groups 2 and 8, and an Indian patient either polymorphic eruption, drug-induced solar dermatitis or SLE from groups 6, 7 and 8. Two white patients required skin biopsies to differentiate between a tumour and a connective tissue disease (groups 4 and 6) and between a melanoma and seborrhoeic dermatitis (groups 2 and 4).

Table II: Range of conditions seen and grouped based on the dermatologist's diagnosis

Group	Conditions	Total	Concordance
1	Psoriasis, pityriasis rubra pilaris	11	10
2	Eczema (atopic eczema, seborrhoeic dermatitis, contact dermatitis)	14	12
3	Infections (viral, deep fungal infections, dermatophytes)	3	2
4	Tumours	4	3
5	Naevi	3	2
6	Connective tissue diseases	6	6
7	Drug reactions	2	1
8	Other (solar lentigo, seborrhoeic keratosis, vitiligo, macular amyloid, polymorphic eruption, pruritus, keratoderma, acne, skin nodules, ulcer, post-inflammatory hyperpigmentation, pityriasis rosea)	9	5
9	Autoimmume bullous diseases	2	1
10	Lichen planus	4	3
11	Unknown	3	3

The patients', referring doctors' and dermatologist's level of satisfaction with the teleconsultation was scored on a five-point scale, where 1 represented "very dissatisfied" and 5 represented "very satisfied". The median scores for the patients, referring doctors and dermatologist was 4. To further assess satisfaction the number of times a score of 4 ("satisfied") or 5 ("very satisfied") was given were added together

and expressed as a percentage. In total, 80.3% of the patients were satisfied with their consultation, the referring doctors rated 82.1% of the consultations as satisfactory, with the dermatologist satisfied 67.6% of the time. The differences were not statistically significant. Combining the scores of 1 ("very dissatisfied") and 2 ("dissatisfied"), one patient was dissatisfied (1.5%) as was the referring doctor in the same case (1.5%). The dermatologist was dissatisfied 14.7% of the time. The referring doctor rated the educational value of the teleconsultation as good (40.6%) and very good (45.3% of the time).

Of the 17 patients who were referred to Durban for a face to face consultation, the median score for patients and the referring doctor was 4 and for the dermatologist 3. Eleven patients (64.7%) were satisfied and none were dissatisfied. The referring doctor was satisfied on nine occasions (52.9%) and was not dissatisfied with any consultation. The dermatologist was satisfied with only six consultations (35.3%) and was dissatisfied 25% of the time. The difference was not significant. For the eight patients for whom a differential diagnosis was offered, the median satisfaction score of the dermatologist was 2.5, with zero satisfaction and 50% dissatisfaction.

Discussion

This study reports on the experience of our attempt to introduce a videoconference-based, synchronous, teledermatology service. The main findings of this audit of the pilot sessions are that 52 of the 69 patients (75.4%) were saved a 240 km round-trip to see the specialist dermatologist. In only one instance (1.4%) was the dermatologist not confident enough to make a diagnosis and in eight cases (11.6%) a differential rather than a definitive diagnosis was made. Patients were accepting of this approach to their management as were the referring doctors who also found the majority of sessions to be educational.

There are several obvious shortcomings to the study. The first is that the teledermatology diagnosis made by the dermatologist is taken as being correct. The accuracy of diagnosis in telemedicine is defined as the degree of concordance between the telemedicine diagnosis and the diagnosis made in a face to face consultation.[11] Accuracy in videoconferenced teledermatology ranges from 57 to 99%.[16] There is, however, a degree of inter-observer variability among dermatologists in face to face consultations and Krupinsky suggests that the 85% agreement between face to face and teledermatology consultations parallels agreement rates for dermatologists using in-person examination methods.[17] The second shortcoming is that there are no patient follow-up data to determine whether the diagnosis and management plan was correct. The technology was improved during the course of the study and the effect of this has not been studied separately. There are as yet no outcome studies in teledermatology.[11,17]

The failure of the dermatologist to make a definitive diagnosis in eight cases (11.6%) is in keeping with previously published figures which range from 3 to 11%.[14,18,19,20] The cause of this may be technological. Videoconference image quality is dependent on the bandwidth used. Increasing the bandwidth reduces pixilation, motion delay and improves image resolution. Diagnostic accuracy has been shown to improve with increasing bandwidth, rising from 59% accuracy at 128 kbs^{-1} to 80% at 384 kbs^{-1}.[19,21] At 128 kbs^{-1} image resolution is considered to be inadequate to diagnose isolated skin lesions, and it has been suggested that patients with potential melanomas should have a face to face consultation.[4] Eczematous, acneiform[14,18] and papulosquamous lesions[16] have also been identified as being more difficult to diagnose. In this study, these conditions were also found to be difficult to diagnose by videoconferencing.

The level of patient satisfaction with the use of the technology may stem from the fact that many were saved a journey to Durban to see the dermatologist. This is in keeping with previous reports that between 85 and 100% of patients expressed satisfaction with videoconferenced teledermatology consultations,[4,5,16,22] 90% of patients were willing to have another teledermatology consultation,[4] and more than half of the patients felt that teleconsultation was as good as a face to face consultation.[23] Patients have, however, expressed concerns or reservations about privacy,[24] their embarrassment of being photographed,[25] the completeness of information transmitted, and their anxiety about the use of technology.[26] Some patients have felt that the technology hampers their expression of problems and concerns,[27] and they are concerned about the lack of physical contact.[13]

The referring doctors in this study were satisfied with 82.1% of the teledermatology consultations and felt that they derived educational benefit from 85.9% of the consultations. It is possible that as early adopters of the technology these doctors may be biased by their enthusiasm for something new. In other studies, referring doctors have reported high levels of satisfaction with teledermatology,[12] the educational benefits derived,[14,28] and noted the possibility of teamwork.[29] In time, referring doctors have been found to make fewer referrals[30] and manage more dermatology cases themselves.[31] The level of satisfaction of the dermatologist was related to the adequacy of the images seen and the level of confidence in the diagnosis made. While satisfied 67.6% of the time, there was dissatisfaction in 14.7% of the cases. For the patients who were transferred for a face to face consultation, satisfaction dropped to 35.3% while dissatisfaction rose to 25%. Where the dermatologist was uncertain and offered a differential diagnosis there was zero satisfaction and 50% dissatisfaction. When dermatologists' satisfaction with a videoconferenced consultation has been low, there has been less concordance in the diagnosis made at the face to face consultation.[12,16] It has been suggested that the patient should be referred for a face to face consultation when the dermatologist is not confident of the diagnosis,[12] as was done in this study.

A concern when planning the implementation of videoconferenced teledermatology was that diagnosis might prove to be more difficult in a predominantly dark-skinned population. In this limited series, skin colour did not appear to affect the ability of the dermatologists to make a diagnosis. This could be due to the dermatologist's experience with dark-skinned patients, who constitute about 98% of the outpatients at the referral centre. Further studies are required to confirm that skin colour is not an impediment to synchronous teledermatology in the African setting.

Several technical and logistical issues caused delays in the implementation of the service. In 2003, the videoconference unit at Port Shepstone was located in the radiology unit and was linked to an ultrasound machine. Four sessions were held at two-monthly intervals. While appropriate for tele-ultrasonography, the venue was small and the white walls made it difficult for the autofocus of the video camera in the unit to adjust to the brightness of the background. After the fourth session it was decided to move the equipment to another room with more space. The move of the ISDN lines proved to be problematic. There were delays in the line being moved and then one of the two lines was faulty, resulting in problems in either image or sound

quality. These were resolved and the service recommenced in mid 2004. After only one session the referring doctor who had a particular interest in dermatology went on maternity leave and no other doctors took advantage of the service. After discussions with the staff at Port Shepstone the service was started again and has been running once a month with the involvement of more medical officers.

The problems experienced highlight some of the issues relating to sustainability of telemedicine projects. Five criteria have been developed for assessing the potential for success of telemedicine: i) the programme must address a defined clinical problem; ii) organisational support must be evident; iii) the service must be accepted by physicians and patients; iv) costs and outcomes must be measured; and v) the operations must be self-supported or sustainable.[5] The need for this teledermatology project and similar projects is clear, as there is a shortage of dermatologists in the state health sector. Organisational support can be divided into infrastructural support and administrative support. Infrastructural support at the distant sites is still problematical. The KwaZulu-Natal Department of Health has identified information technology "super users" at each of their hospitals. The super users are not IT professionals and do not have IT support as part of their job descriptions. This is not an ideal situation. Administrative support is present but needs to be developed to include electronic management of the patients' records and patient bookings. In addition, more staff need to be trained in the use of the equipment at the referral hospitals and more dermatologists need to participate in this venture in order to build capacity.

It is common to find a new telemedicine service driven by an enthusiast, with the service failing when the enthusiast moves on or loses interest. This project has resulted in several doctors participating at the referring hospital and an acceptance by the receiving department to make teledermatology part of their normal practice. The doctors involved appear to be satisfied with the service, as are their patients. The costs and outcomes have not been measured and this will need to be addressed. The project is supported by the Provincial Department of Health and is currently sustainable.

The National Department of Health launched phase one of a series of pilot telemedicine projects in radiology, tele-ultrasonography and tele-ophthalmology in 1999.[32,33] This project has not been expanded. The expected benefits of telemedicine are that it will improve access to care for patients in rural areas, provide high quality care at a distance, reduce patient travel, allow rural doctors access to specialists, thereby reducing their isolation, give peer support and provide education for rural doctors.[4,7,11] This audit of a pilot teledermatology project by videoconference suggests that these benefits are obtainable in a South African setting.

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