

▶ Follow-up data for patients managed by store and forward telemedicine in developing countries

Richard Wootton*, John Menzies† and Paula Ferguson‡

*Scottish Centre for Telehealth, Aberdeen, UK and University of Queensland, Brisbane, Australia; †JTA International, Brisbane, Australia;

‡Tabubil Hospital, Tabubil, Papua New Guinea

Summary

There is very little published information about the outcomes of patients treated by telemedicine in developing countries. Over a two-year period, seven medical students from five universities spent their electives at a hospital in Papua New Guinea. They assisted with the review of a total of 44 e-referrals made by local doctors; the referrals resulted in 61 queries in a wide range of specialties. The major categories of these queries were internal medicine, paediatrics and surgery. Follow-up data were obtained in 22 of the 44 cases (50%) after a median period of 13 weeks (interquartile range 3-19). The cases were reviewed by an independent doctor. Telemedicine was considered to have assisted with the diagnosis in all cases (median score 5 on a five-point scale from 1 = not helpful at all to 5 = very good/excellent). The advice to the referring doctor for further action was considered helpful in all except one case (median score 5 on the same scale). The outcome for the patient was considered to be good in 15 of the cases (median score 4 on the same scale). Medical students were able to facilitate e-referrals by relieving the pressure on the local doctor to undertake the necessary clerical and technical work. The students reported a rewarding elective experience. The follow-up data showed that low-cost telemedicine can provide useful advice in a low resource setting.

Introduction

Anecdotally, and in a number of general publications, it has been well documented that doctors in developing countries value telemedicine services.¹⁻⁵ Generally, most of the longer running programmes have employed relatively 'low-tech' methods based on email and/or web messaging. Presumably, referring doctors find such services useful or they would not continue to participate.⁶

Whilst there is some information about the outcomes of patients treated with the benefit of telemedicine in industrialized countries, very little published data exists about the outcomes of patients treated by telemedicine in developing countries. For a telemedicine programme to be used by a referring clinician and to be sustainable in developing countries, it must be simple, reliable, cost-effective, suited to the available technology (often there is limited availability of computers, telecommunications and mains electricity), and the advice has to be appropriate for the available resources (often there are limited diagnostic and treatment options).

In developing countries clinical resources are always limited. Usually there is substantially more clinical work than the limited number of doctors, nurses and aid workers can manage. Often when clinical time is precious, activities such as research into follow-up outcomes of projects or services, does not occur – even when services are provided free of charge.

In 1998 the Swinfen Charitable Trust⁷ was set up with the aim of assisting poor, sick and disabled people in the developing world by establishing telemedicine links between developing world hospitals and medical specialists. The specialists, predominantly from industrialized countries, generously provide free consultative advice and support; originally, plain email was used for communication. Generally, the service is used by clinicians working in remote locations where there are often limited telecommunications and sometimes only intermittent electricity supply. Doctors from over 30 countries have utilised the service.

Basically, a doctor in a remote part of the world can request assistance from a contributing consultant specialist in the Swinfen network. A hybrid communications system is used, based on email and web-messaging. The clinical request for assistance is stored on a secure web server, together with any relevant images, e.g. clinical photographs. Each e-referral is reviewed after its arrival and a request for advice is sent to one or more relevant specialist clinicians somewhere in the world who are part of the Swinfen Charitable Trust network.

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Correspondence: Dr J Menzies, JTA International, Level 10, 46 Edward Street, Brisbane 4000, Australia (Fax: +61 7 3210 2161;

Email: john.menzies@jta.com.au)

Advising consultants can log into the central server, view the case details and provide specialist advice to the requesting clinician. On logging into the server, the advising specialist can also obtain an overview of the hospital from where the enquiry has emanated. This includes a description of the presence, or absence, of diagnostic tests and treatment modalities so that the advising clinician can avoid recommending tests or interventions that are unavailable. Generally, a specialist reply is provided to the referrer within one day (median 19 hours). In some cases, only a single response is required to assist the referring clinician. In other cases several messages, with or without attachments, may be required to answer complicated diagnostic and treatment questions.

As many of the sites are very remote, and as many clinical staff did not have time or resources to conduct follow-up studies, it was difficult to assess the value and outcomes of the telemedicine service. In 2005, a project was established by the Universitas-21 organization (U21, a group of 21 major universities around the world with medical schools) and the Swinfen Charitable Trust⁸ to facilitate the latter's work. The aim of the present study was to evaluate in selected countries, the clinical outcomes of the free telemedicine service provided by the Trust.

Methods

Medical students at U21 universities around the world who had both an interest in telemedicine and a desire to complete an elective term in a developing country were offered the opportunity of spending their elective term at a hospital that used basic telemedicine services. One of the facilities where the medical students could spend their elective period was Tabubil, which is the small mining town at the centre of the Ok Tedi copper and gold mine operations (see Figure 1). Tabubil is located deep in the jungle of the Western Highlands of Papua New Guinea (PNG). The main access to the town is by limited small commercial and charter aircraft services. The small hospital at Tabubil services about 24,000 local villagers within a 200-km radius and the mining community of approximately 2000 Papuan New Guineans.

The mine site and the hospital are surrounded by several hundred kilometres of jungle in both mountainous and lowland plain terrain. There are hundreds of small villages in very remote and isolated areas, often without fuel, power or communication. The average population density is two persons per square kilometre. Simple public transport does not really exist beyond the mine sites. Some villagers may walk up to 100 km over a three- or four-day period to attend the health services.

Tabubil hospital is run for the PNG government by the Ok Tedi Mining Company. Apart from one expatriate Australian doctor, the clinical staff are all trained in PNG. Each year, the hospital sees some 185,000 outpatients and admits 1600

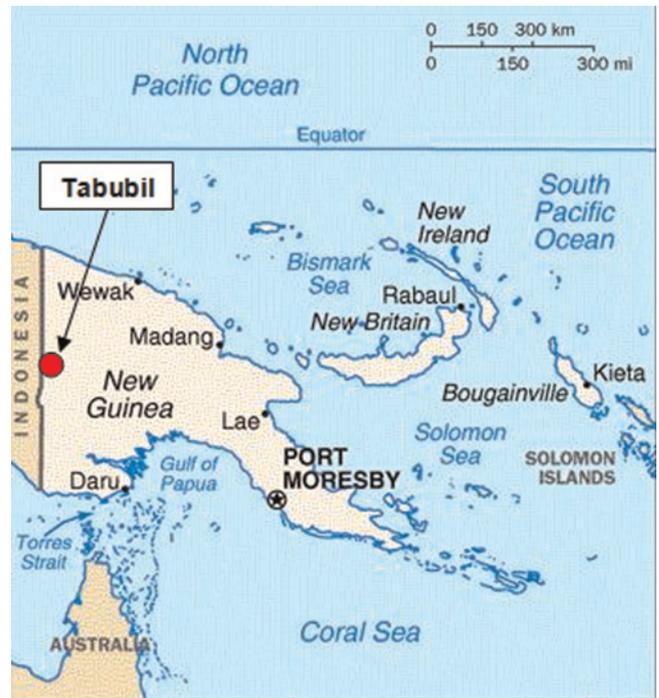


Figure 1 Location of Tabubil Hospital and health services

inpatients. A general surgeon and physician are available locally. However, until the telemedicine service was introduced in 2006, local patients needing other specialist consultations had to travel over 600 km by plane to the capital, Port Moresby, if they could afford a commercial air fare.

All doctors at Tabubil Hospital can use the telemedicine service which is based on a store and forward, web-based messaging system to help manage semi-urgent and non-urgent attending patients. Unlike many other parts of remote PNG, Tabubil Hospital has reasonable access to electricity, basic computers and telecommunications which are provided by the mining company.

Seven medical students, generally in the final years of their course, indicated that they wished to participate at Tabubil. The students came from five universities (three from the University of Queensland, and one each from the Australian National University, the University of Hong Kong, the National University of Singapore and King's College London). Whilst the students met most of their own costs, the Ok Tedi Mining Company generously provided free charter air travel from Cairns in Australia to Tabubil in PNG. The Company also provided free board and accommodation for the students whilst at the hospital.

The medical students assisted with the evaluation and support of the telemedicine service. These activities were in addition to the medical students gaining practical clinical experience. The medical students were provided with basic telemedicine technical training prior to their departure for their elective term, including practice with clinical photography. They were supplied with the Swinfen Charitable Trust clinical photography guide and a suitable digital camera where necessary, and practiced using the

e-referral system before departure, so that they could help local doctors and nurses with both new telemedicine referrals and the follow-up of previously referred cases.

During the study period from November 2005 to January 2008, the medical students, who stayed for periods from three to seven weeks, assisted local clinicians to initiate new referrals. The students also gathered retrospective data for all earlier e-referrals during their stay. Working in collaboration with local hospital and community based staff, the medical students attempted to gather as much information as possible about each referral. This involved reviews of medical records, discussions with hospital and community clinical staff who knew the patient and/or their family and discussions with other clinicians in other parts of PNG. The overall benefit for the patient was based on the opinion of the referring doctor and where appropriate, also the patient or their family.

Attempts were made to gather the following information for each case referral that had occurred:

- (1) Date of follow up;
- (2) Patient survival status;
- (3) Medical follow up details;
- (4) Patient's current condition;
- (5) The treating doctor's expectation for the patient following discharge;
- (6) Patient compliance with advised treatment;
- (7) What would have happened if e-health had not been available (in the treating doctor's opinion);
- (8) Specific clinical information relating to patients who had died;
- (9) The value of the provided e-health advice.

Furthermore, in relation to the last data item, attempts were made to gather seven usage attributes. These related to:

- (1) Functional benefit for the patient;
- (2) Symptomatic benefit for the patient;
- (3) Clarification of diagnosis for the doctor and patient;
- (4) Clarification of management for the doctor;
- (5) Overall benefit to the patient;
- (6) Cost savings for the patient and/or the health service;
- (7) Any other benefits that were not anticipated.

The students themselves did not decide on the benefits and outcomes. The students either: (a) simply gathered the data so that the attending doctor could make the decision and then helped to record it, or (b) where the decision/observation had already been made, they collated/transcribed it onto data-collection forms, or (c) in those cases where the original referring doctor was no longer available, the collected data were reviewed by a current doctor at Tabubil or the independent reviewer (see below).

Data review

The data were reviewed by an independent generalist doctor who had a good working knowledge and experience of the

levels of care that can be offered in all parts of PNG and telemedicine techniques. As some data elements could not be gathered, the analysis was limited to the three critical values that reflected the clinical outcome for the patient and the benefits for the referring clinician. Each case was assessed from three outcome perspectives:

- (1) Did the telemedicine advice clarify the diagnosis for the doctor and the patient?
- (2) Was the suggested telemedicine action helpful for the doctor to manage the patient?
- (3) What was the overall clinical outcome and benefit for the patient?

Each perspective was graded using a five-point Likert scale (from 1 indicating that the advice, action or outcome was of little or no benefit, to 5 indicating that the advice, action or outcome was very good or excellent). Generally, a score of 5 meant that the result was as good as, or approaching, the same standard as if the local clinician had been consulting with the distant specialist in Tabubil Hospital itself.

Results

During the study period of just over two years from November 2005 to January 2008, 44 e-referrals were made which resulted in a total of 61 queries in seven specialities as shown in Figure 2. As the study involved a number of retrospective medical record reviews, it was not always possible for the medical students to find the information relating to the value of the telemedicine advice. Due to the diligent work of the medical students and the cooperation of local clinical staff, patients and their families, it was possible to gain sufficient data in most cases to understand the outcomes for the patient and their referring doctor. In two cases where the data collected by the medical student had to be interpreted, it was clear that there had been sufficient notation and/or recollection by attending clinical staff at the time to make a reasonably objective

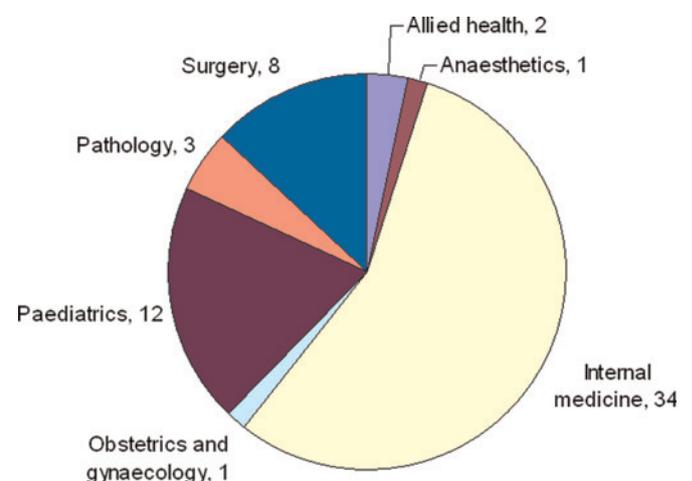


Figure 2 Discipline of the original 61 clinical enquiries (from 44 cases)

observation about the benefit of the telehealth intervention.

In some cases only limited information was available as some discharged patients had returned to their jungle village and had not subsequently returned for follow up or other care. Nonetheless, adequate follow-up data was available in 22 (50%) of the e-referral cases after a median period of 13 weeks. The discipline mix of the 22 cases that could be followed up was similar to that of the original 44 e-referrals, as shown in Figure 3. In most cases, the referring clinician sought advice to help make, or confirm, a diagnosis. In a few cases, assistance was sought to help manage a patient when the diagnosis was already made.

Case review

In all 22 cases it was assessed that the telehealth replies provided some useful advice to the referring clinician. The specific data about each case, the outcome scores and the follow-up interval (median 13.3 weeks) are shown in Table 1. In 5 cases the advice provided useful answers or assisted with a few elements of the enquiry. In 4 of the cases, the information was generally good, and in 13 cases it was regarded as very good or excellent.

In relation to the second outcome perspective, i.e. whether the advice provided for subsequent management action was helpful for the doctor and patient, the analysis revealed that in 21 of the 22 cases the telemedicine service was of value. In the one case where the advice was of very limited value, it was due to the replying clinician not understanding the limited diagnostic support that was available at Tabubil Hospital. In 4 of the cases the advice was considered useful in providing implementable action. In 17 cases the advice for subsequent action was considered to be good, very good or excellent.

When considering clinical outcome, it became clear that consideration had to be given to a number of factors. Once the referring doctor received the advice from the distant clinician they were able to use the information in many

ways. Usually, the information could be applied to helping diagnose and/or treat the patient. In some cases, it was not always possible for a patient and their family to leave the local Tabubil area where clinical services are limited and travel to a larger town or the capital city for the recommended care. Sometimes patients and their families, after learning of the specifics of the diagnosis and prognosis of a condition, elected not to seek further care. Accordingly, for some patients a successful outcome of the e-health consultation was obtaining accurate advice so they could make a fully informed decision about their care.

The results of the third outcome perspective were thus more diverse. In two of the cases, follow-up outcome data after discharge from hospital was not available. In one case it was assessed that there was a little improvement in outcome but that a lot more could have been achieved. In four cases it was assessed that there was limited improvement of the patient's condition or the patient benefited by having a better understanding of their condition. In 15 cases, the patient and/or their family had good, very good or excellent clinical outcomes.

Discussion

The Swinfen Charitable Trust has been providing free consultative advice to clinicians in rural, remote and dangerous parts of the world since 1999. The advice has always been gratefully received and used to help diagnose patient conditions and manage their care. Unfortunately, it had not been possible until 2005 to gather data to allow a formal analysis of the service and in particular, the benefits it brought to the requesting doctor and the impact it had on the clinical outcome for the patient and their family.

The primary reason why data collection has previously been limited is the unavailability of clinician time to undertake the task, as referring clinicians in developing countries are commonly overwhelmed by their clinical workload and do not have time for research activities. In developing countries where clinical resources are usually limited, medical students from industrialized countries can play an important role in helping to support local health workers.⁸ In particular they can help gather data to assist with evaluation of health services.

In the present project, medical students with appropriate preliminary training and mentoring from local medical staff who used the telemedicine service and from senior academic staff in Brisbane, were able to gather outcome data for patients that had received assistance from an earlier or current e-health consultation. The medical students were able to observe and experience the diagnosis and management of many interesting clinical conditions they would not have been able to see in their usual teaching hospital. In addition, they assisted with diagnosis using telemedicine and helped with gathering outcome data.

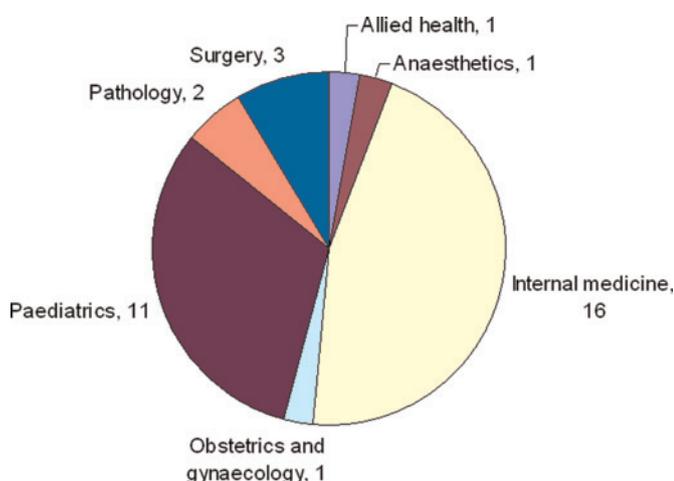


Figure 3 Discipline of the 35 clinical enquiries that could be followed up (from 22 cases)

Table 1 Telemedicine case details. Scores on a five-point scale (1 = the advice, action or outcome was of little or no benefit; 5 = the advice, action or outcome was very good or excellent; U = unknown.)

Case no.	Patient details	Was the original question answered i.e. did it help with the diagnosis?	Was the advice for further action helpful?	Was the outcome good for the patient?	Follow-up interval (weeks)
5034	Adult male - dermatology problem	5	5	5	1.2
5027	Adult male - back pain	5	5	5	18.8
5033	Young boy - possible TB meningitis	5	4	4	2.9
5024	Young girl - ataxia and neurological symptoms	3	2	U	31.8
5028	Female infant - heart problems	3	3	3	19.0
5022	Adult female - liver problem	4	4	3	47.0
5021	Adult female - obstetric issue	5	5	4	47.4
5025	Young boy - ataxia	3	3	U	32.4
5032	Male infant - stridor	4	4	4	9.6
5026	Adult male - mandibular problems	5	5	5	20.9
5039	Young girl - weakness, exophthalmos - leukaemia	4	4	4	15.9
5069	Female infant - possible Erb's palsy	5	5	5	11.1
5058	Adult male - complex neurological issues	5	5	4	16.1
5082	Adult female - possible SLE	5	5	5	4.5
5091	Infant boy with a lung mass	3	3	3	16.7
5098	Adult male with skin lesions	3	3	2	15.5
5107	Young adult female with cerebral TB	5	5	5	8.3
5112	Young adult female with fingernail problems	5	5	4	7.0
5115	Adult male renal failure following diarrhoea and vomiting	5	5	4	1.5
5117	Adult female with skin complications of elephantiasis	5	5	5	1.2
5172	Infant male with severe acute neurological symptoms	4	4	3	0.8
5173	Adolescent female with facial rash	5	5	5	0.5
	Median	5	5	4	13.3
	Lower quartile	4	4	3.75	3.3
	Upper quartile	5	5	5	19.0

Data gathering was not always easy. In most cases it was possible for the medical students to gather the data retrospectively from the medical records held at Tabubil Hospital. Where data were not recorded, the patient and/or their family were contacted to obtain up-to-date information about the condition of the patient. In two cases, original admission retrospective data was available, but contemporary outcome information could not be gathered because the patients had not returned to hospital following their initial treatment visit.

Although this project will continue with further analysis of more recent e-referrals, it can be concluded from the results of the first two years' activity, that the e-health service was of considerable value in the majority of cases. In particular the e-health service advice helped the local referring doctors to obtain useful consultative information from specialists that would not usually have been available locally, and assisted them in making an accurate diagnosis. In addition, in most cases the advice was very valuable in helping the referring doctor to better advise upon and/or manage the patient's condition. Furthermore, in the majority of cases the received consultative advice had a positive impact on the clinical outcome for the patient.

The present study has also shown that a low cost and reliable email/web messaging service can help clinicians in a very remote part of the world. Assistance can be provided

with diagnosis and management of patients with many semi-urgent or non-urgent medical conditions. This is particularly important in those countries where the electricity supply, the telecommunications and computer resources may be limited and/or only sporadically available. We believe that an important reason for the encouraging results to date is the ability of this e-health service to provide effective clinical advice that is relevant to a local clinical setting where there are limited diagnostic and treatment modalities.

Conclusion

Many health projects and services in developing countries are not evaluated due to the difficult circumstances facing clinicians in these often remote and challenging parts of the world. Advanced year medical students who undertake elective terms in developing countries can, with suitable preliminary training, undertake important evaluation data gathering and provide technical support to local clinical staff who often do not have the time and/or technical training to use e-health services and carry out evaluation exercises.

The basic email/web messaging service provided by the Swinfen Charitable Trust to many developing countries around the world, provides a useful service to clinicians who have limited, often intermittent access to medical specialists for consultative advice. The service is provided

to some of the most isolated and/or dangerous places in the world. A review of the outcome results for patients in one of the countries – PNG – indicates that the service has delivered significant benefits for both the referring clinician and the patient for whom the advice was sought. We believe that this type of e-health service has significant potential for many other countries of the world. Given that the service only requires basic computer and Internet facilities and the fact that it is useful even when electricity supply and telecommunication is limited, it should be considered before more expensive, high-technology services are contemplated.

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References

- 1 Patterson V, Swinfen P, Swinfen R, Azzo E, Taha H, Wootton R. Supporting hospital doctors in the Middle East by email telemedicine: something the industrialized world can do to help. *J Med Internet Res* 2007;9:e30
- 2 Geissbuhler A, Bagayoko CO, Ly O. The RAFT network: 5 years of distance continuing medical education and tele-consultations over the Internet in French-speaking Africa. *Int J Med Inform* 2007;76:351–6
- 3 Martínez A, Villarroel V, Seoane J, del Pozo F. A study of a rural telemedicine system in the Amazon region of Peru. *J Telemed Telecare* 2004; 10:219–25
- 4 Heinzelmann PJ, Jaques G, Kvedar JC. Telemedicine by email in remote Cambodia. *J Telemed Telecare* 2005;11 (Suppl. 2):44–7
- 5 Mukundan S Jr, Vydareny K, Vassallo DJ, Irving S, Ogaoga D. Trial telemedicine system for supporting medical students on elective in the developing world. *Acad Radiol* 2003;10:794–7
- 6 Wootton R. Telemedicine support for the developing world. *J Telemed Telecare* 2008;14:109–14
- 7 Wootton R, Jebamani LS, Dow SA. E-health and the Universitas 21 organization: 2. Telemedicine and underserved populations. *J Telemed Telecare* 2005;11:221–4
- 8 Wootton R, Swinfen PA, Swinfen R, Warren M, Wilkinson D, Brooks P. Medical students represent a valuable resource in facilitating telehealth for the underserved. *J Telemed Telecare* 2007;13 (Suppl 3):92–7