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Mobile teledermatology for a prompter and more efficient dermatological care in rural Mongolia

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To the Editor

Many developing countries suffer a scarcity of trained clinicians, which are usually concentrated in urban centers, leaving large rural populations essentially underserved. Technology adoption could offer new opportunities for patients' benefit in term of costs, better care and in turn, better outcomes. [1] Telemedicine is a promising tool to ameliorate the widening healthcare supply and demand gap [2–4] through which the reach of consultants can be digitally extended, allowing them to virtually cover larger or remote regions[4]. Smartphone applications have been shown to be a simple, feasible, and reliable method for performing store-and-forward teledermatology consultations in rural unpopulated areas. Our study aimed to estimate the distance, time and the cost of travel saved by patients who received teledermatology service though a mobile phone platform in rural clinics in Mongolia, one of the least densely populated countries in the world. A cluster-randomised controlled trial was done for a period of 5 months from September 1, 2013 to January 31, 2014 at 20 rural health clinics in Mongolia. Three districts based on distance from Ulaanbaatar were selected: Khovd (2000 km), Khuvgul (1000 km) and Bulgan (350 km away); and ten general practitioners (GPs) working in rural health clinics from each of these districts were invited to participate in the study. Twenty of them attended a two-day training session at the National Dermatology Center in Ulaanbaatar to learn image-taking techniques and how to use the open-source electronic medical record system (OpenMRS) and Sana

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software on mobile phones. This is a mobile phone-based, open source software platform for telemedicine services that uses an Android-based system and supports multimedia, location-based data, and text [5]. It is easy to use and highly customizable; doctors can build tailored questionnaires for healthcare workers and can create decision trees for diagnosis, triage and treatment to broaden the healthcare workers' scope of practice. The questionnaires and web interface of OpenMRS and Sana were translated to Mongolian to mitigate the language barrier.

With a computer-generated sequence, rural health clinics were randomly clustered either to the intervention group, in which all GPs received teledermatology consultation support through OpenMRS and the Sana system; or the control group, in which GPs referred patients to dermatologists at district hospitals or the National Dermatology Center as per their usual standard of care. This randomisation allowed for an equitable distribution of rural health clinics from the 3 districts into both groups.

In the health clinics randomised to the intervention, GPs collected clinical data from patients through a step-by-step questionnaire on a smartphone. This data was uploaded to an OpenMRS with diagnosis-specific information and images (Figure 1) in order to provide consultant dermatologists enough clinical information in an organized manner, and allowing them to give feedback and advice to the rural health clinic within 24 hours. All GPs from both groups sent monthly reports of the number of hospital referrals done and information about the follow-up visits of the patients.

The primary outcomes measured were the number of hospital referrals sent by GPs, and the patients' cost of receiving dermatological care in rural Mongolia. We calculated the distance, time and cost of travel between each village clinic to district hospitals and the National Dermatology Center in Ulaanbaatar. Then, using the number of hospital referrals done by each clinic, we estimated the actual distance traveled, time and money spent by patients referred to tertiary-care centers during the study period both in the intervention and control group. Statistical analysis was done using hypothesis tests for proportions in STATA 13.1

During the 5 months the trial was done, a total of 450 patients were seen by 20 GPs with similar age and sex distributions at rural health clinics. In the control group, 229 patients visited GPs seeking dermatological care, and 28 (12.2 %) were referred to tertiary-care centers. In the intervention group, 7 out of 221 patients (3.1 %) were referred to tertiary-care centers for consultation ($p<0.01$). We can see the distance traveled, time and money spent by referred patients in both groups in Table 1: the number of kilometers, hours spent and cost in US dollars were markedly higher in the control group than the intervention group.

Through this study we were able to quantify some of the most important benefits of teledermatology.[6] We found evidence of a total reduction in costs, both for the patients (US $76.36 per patient) and the health care system by decreasing referrals to tertiary-care centers by 75% in the intervention group. This study also shows a significant reduction in the time to receive dermatological care; the patients in the intervention group saved a total of 19,892 km and 269 hours of travel when compared with patients in the control group (see Table 1). Finally, health care delivery was likely improved as GPs in the intervention group were

supported by a specialist consultant for all patients who needed dermatological care and thus did not need to refer them as often. Patients in the intervention group were also given a significantly wider variety of diagnoses and treatments than in the control group (p=0.03), and we think this could indirectly be a marker of better health care delivery.

The use of teledermatology services avoids unnecessary travel of the patients and promotes it when absolutely necessary, thus saving time and reducing the financial burden of patients who can be treated locally.[7–10] Teledermatology has been shown to reduce wait times, increase access, and improve patient satisfaction and quality of life.[11,12] The 3.1% patients who were referred to the district hospital in the intervention group were only those patients whose diagnoses were complicated or uncertain enough to warrant a face-to-face consultation with the specialist, compared to 12.1% in the control group. We did not measure satisfaction or patient outcomes in the intervention group compared to the control group, nor are we taking into account the costs of providing teledermatology services outside of the research setting, both limitations of our study and opportunities for further research. We believe this study is important because few others have quantified time, distance and costs of travel for patients in remote areas, especially in a country with such a low-density population like Mongolia. It is in settings like this that teledermatology may provide a particularly significant benefit, both to patients and to health systems.

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References

1. Schulman KA, Vidal AV, Ackerly DC. Personalized medicine and disruptive innovation: Implications for technology assessment. Genetics in Medicine. 2009; 11:577–81. [PubMed: 19606052]
2. Syed-Abdul S, Scholl J, Chen CC, et al. Telemedicine utilization to support the management of the burns treatment involving patient pathways in both developed and developing countries: a case study. Journal of Burn Care & Research. 2012; 33:e207–e12. [PubMed: 22249104]
3. Rubin CB, Kovarik CL. Teledermatologic Care, the Affordable Care Act, and 20 Million New Patients Picturing the Future. JAMA. 2014; 150(3):243–4.
4. Garcia-Romero MT, Prado F, Dominguez-Cherit J, et al. Teledermatology via a social networking web site: a pilot study between a general hospital and a rural clinic. Telemed J E Health. 2011; 17:652–5. [PubMed: 21790270]
5. http://sana.mit.edu/platform/
6. Landow SM, Mateus A, Korgavkar K, et al. Teledermatology: Key factors associated with reducing face-to-face dermatology visits. Journal of the American Academy of Dermatology. 2014
7. Armstrong AW, Dorer DJ, Lugn NE, et al. Economic evaluation of interactive teledermatology compared with conventional care. Telemedicine and e-Health. 2007; 13:91–9. [PubMed: 17489695]
8. Eminović N, Dijkgraaf MG, Berghout RM, et al. A cost minimisation analysis in teledermatology: model-based approach. BMC health services research. 2010; 10:251. [PubMed: 20738871]
9. Parsi K, Chambers CJ, Armstrong AW. Cost-effectiveness analysis of a patient-centered care model for management of psoriasis. Journal of the American Academy of Dermatology. 2012; 66:563–70. [PubMed: 21835497]
10. Moreno-Ramirez D, Ferrandiz L, Ruiz-de-Casas A, et al. Economic evaluation of a store-and-forward teledermatology system for skin cancer patients. Journal of telemedicine and telecare. 2009; 15:40–5. [PubMed: 19139219]

11. Kroemer S, Frühauf J, Campbell TM, et al. Mobile teledermatology for skin tumour screening: diagnostic accuracy of clinical and dermoscopic image tele-evaluation using cellular phones. Br J Dermatol. 2011; 164:973–9. [PubMed: 21219286]

12. Whited JD, Warshaw EM, Edison KE, et al. Effect of store and forward teledermatology on quality of life: a randomized controlled trial. JAMA Dermatol. 2013; 149:584–91. [PubMed: 23426111]

Figure 1.

Screen shot of the OpenMRS interface displaying the squamous cell carcinoma. Consultants can access diagnosis-specific information and images sent by GPs for advice.

Table 1

Summary of the intervention outcomes in both groups.

	Control	Intervention	p value	Difference	Savings (overhead)
Patients	229	221	-	-	-
Referrals	28 (12.2%)	7 (3.1%)	<0.01	-	-
Diagnoses	4	12	0.03	-	-
Distance (km)	22,482	2,590	-	19,892	494.69
Time (hours)	322	53	-	269	4.81
Cost (US$)	3,174	320	-	2,854	76.36