

Mobile teledermatology for rural Nepal: Dermatologic care using mobile phone in a primary health care centre

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Abstract

Introduction: Skin diseases are among the five most common health problems in Nepal. We have now tested the validity of mobile teledermatology with mobile phones to find a safe and easy way of diagnosis and treatment of skin diseases for the most vulnerable people in remote areas without access to dermatologists.

Methods: A medical officer at a primary health care centre examined the patient, obtained information of the patient and the skin disease, took photographs of the skin lesions. Then he transmitted all these data via Viber to a dermatologist in Kathmandu, who in real time formulated diagnosis and treatment and sent it via Viber to the medical officer. Subsequently the patient was examined face to face by a blinded dermatologist at the same primary health care centre. The time taken for each modality of consultation was recorded. A third dermatologist analysed and compared the diagnoses formulated during teledermatology and the face to face consultations.

Results: Altogether 107 skin diseases were diagnosed in 101 patients. There was an overall concordance of 88% between the diagnoses of skin diseases by mobile teledermatology and face to face consultations (Cohen k coefficient 0.85). The average face to face consultation time was 5 minutes, while it was 7 minutes more for teleconsultation. More than 75% of the photos were of good quality.

Conclusions: Mobile teledermatology using smartphones is a reliable, useful, cost effective method to provide expertise for improving dermatologic care for the needy population in rural and remote parts of Nepal.

Key words: teledermatology, dermatologic care, rural Nepal, mobile phones

Introduction

Skin diseases (SDs) are among the five most common health problems in Nepal with very significant morbidity. In the year 2013 there were approximately 2,700,000 outpatient consultations for SDs.¹ In our previous study from the rural areas of central Nepal the overall prevalence of SDs was 25% with a large impact on the quality of life for these villagers. The prevalence was higher in females (30%) than in males (18%).² There are around 125 dermatologists in Nepal, for a population of 26 million.³ Most of them are working in hospitals and medical colleges in big cities, although 85% of the population live in difficult terrains of rural and remote areas with limited access to medical care. The health care in these areas is mainly provided by medical officers (MOs) and health workers (HWs) at the primary health care centers (PHCC). MOs are general practitioners with

basic qualification in medicine and surgery, but with limited training to manage even the most common SDs, while HWs have no training at all in skin care. Very little or no resources have so far been allocated by the government for prevention and management of SDs. In this situation, it is obvious that the majority of the population in Nepal does not have proper dermatologic care.

It is unlikely that dermatologists will be available for the rural and far-off areas in the near future. Therefore, mobile teledermatology (MTD) might be a useful method to reach the population in remote regions and provide dermatologic care.^{4, 5} There is a rapid development of wireless internet and use of mobile phones in Nepal and other developing nations. The recent mobile phones have high quality cameras with adequate photographic resolution and data transmission capability.

In the present study we have tested the validity of MTD

for dermatologic care in rural Nepal, with the aim to find a safe and easy way of improving diagnosis and treatment of SDs for the most vulnerable people with limited resources living in distant areas in Nepal without access to dermatologists.

To our knowledge this is the first study regarding the use of MTD for the diagnosis and treatment of SDs, in Nepal.

Methods

Study Design

The study was conducted for a period of 3 months, in the year 2015, in a PHCC in a rural area of the Kavre district, about 30 kms east of Kathmandu. This PHCC provides general health care to inhabitants of 6 surrounding villages with a total population of around 30,000.³ During the study period, one day per week was allocated for skin consultations. The patients were provided free consultation and medicines.

Before starting the clinical investigation one MO from the PHCC was given one day training, consisting of overall information of the study design, description of various skin lesions and how to take history of the SD. The training also included use of mobile phone for photographing, uploading and transmitting photos as well as data by internet app Viber. The role of the MO was then to examine the patients and provide images and data for MTD consultation.

Two dermatologists participated in diagnosing the SDs, one gave a conventional face to face (FF) consultation at the PHCC and one was situated in Kathmandu providing the diagnosis based on data from MTD. The MO and these two dermatologists were constantly available during the skin clinic day. The images and data were sent to a third dermatologist, who analyzed and compared the results from the FF and MTD consultations.

MTD examination

All villagers who showed up at the PHCC on the skin clinic day with a skin problem were examined by the MO. Verbal consent was obtained from the patient/guardian to take photographs of the skin lesions and for the MTD consultation. One or more photos were taken. The photos were taken with green background in adequate day light, without flash and perpendicular to the skin lesion and uploaded in Viber. The patient's name, age, gender and type of skin lesions, locations, symptoms, duration and previous treatment were typed, on the space below the photo. These informations including photos were sent to the dermatologist in Kathmandu. The time to take photo, to upload and to type patient data and SD information as well as transmit the data (upload time) was registered. Skin lesions in the genitals and breasts in female were not photographed.

The dermatologist in Kathmandu immediately examined the photo and the information, and if required asked for additional photos/or information through Viber. Then he formulated a diagnosis/diagnoses and advised management, which was uploaded in Viber and sent back to the MO. The time taken for diagnosis, treatment formulation and transmission (reply time) was noted. All data were recorded, but not provided to the patient.

FF examination

Immediately after MTD consultation, the patient went to a separate room at the PHCC for a conventional FF consultation. The dermatologist examined the patient and provided diagnosis and management. The demographic data of the patient, diagnosis, treatment and time taken for face to face consultation were recorded in a prepared format. The patient was given a prescription with the diagnosis and treatment.

Consistency analysis of MTD and FF consultation

The dermatologist providing MTD or FF consultations was blinded to each other. The images and data from the MTD consultation, and data from FF consultation were sent to the third dermatologist, who did not participate in the consultations. He compared the data and determined the concordance of diagnoses of SDs between the MTD and FF consultation and assessed the quality of the images. The quality of photos was graded as excellent, good, fair and poor.

Digital Image acquisition

In this study the MO used Sony xperia C2305 smartphone, with 8 mpixel camera, android jelly bean operating system and the dermatologist providing MTD consultation used Galaxy tab 4 SM-T331, with android kit kat operating system. The wireless internet - asymmetrical digital subscriber line (ADSL) – provided by the Nepal telecommunications, with a speed of 192kbps, was used for the transmission of images and data. The internet application used to transmit the photographs of skin lesions and patient information was Viber.

Statistical analysis was done using SPSS and Cohen K coefficient was calculated to determine the concordance. The study was performed according to the ethical principal of Helsinki declaration and approved by the Institutional Review Board of the Institute of Medicine, Tribhuvan University.

Results

A total of 106 villagers showed up for skin disease consultation. Two patients denied being photographed and 3 patients had skin lesions on genital areas. They were provided FF consultation and not included in the study. A total of 101 villagers with SDs (m 25.7% f

74.3%) were enrolled in the study. The median age was 23yrs (IQR 13 – 40) range 1-80yrs (figure 1). The sample was unselected with the exception of those with lesions in the genital areas and breasts in females which were not photographed. Altogether 107 SDs were diagnosed in the 101 patients. In both methods of consultations, the most common SD categories were eczemas, followed by pigment disorders, viral infections, infestations and acne (Table 1). There was an overall concordance of 88% between the diagnoses of SDs by MTD and FF

consultations (Cohen κ coefficient 0.85). Regarding the most common SD categories, the concordance was 100% for pigmentary disorders, acne, fungal infections and pyodermas, while more than 80% for eczemas, viral infections and infestations (Table 1).

The average face to face consultation time was 5 minutes (IQR 4-6, range 3-9 minutes). The average upload time was 3 minutes (IQR 1-4, range 1-11), while reply time was 4 minutes (IQR 3-6, range 1-17).

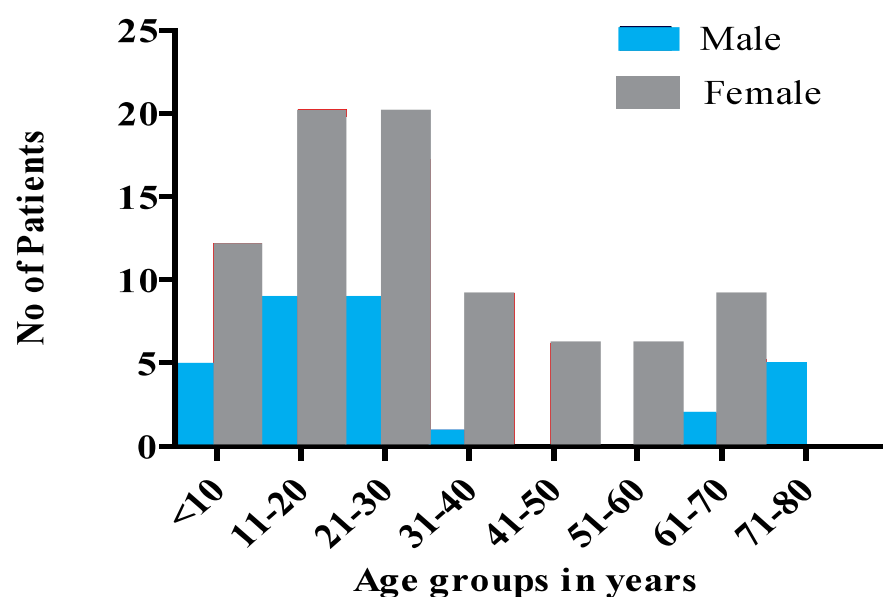


Figure 1. Age distribution of patients

Altogether 107 photos out of 148, one for each SD, were taken for the analysis. Regarding the quality of these photos, 42 (39.9%) were excellent, 36 good (33.6%), 13 fair (12.1%) and 16 poor (15%) (Table 2). The inconsistencies in the diagnoses between FF and MTD consultations were as expected more common in SDs where the quality of photos were poor.

Table 1. SD categories, diagnoses by FF and MTD consultations and concordance between them.

SD categories	Diagnoses of SDs by FF consultation	Diagnoses of SDs by MTD consultation, consistent with FF diagnoses	Diagnoses of SDs by MTD consultation, not consistent with FF diagnoses	Concordance (%) between FF and MTD diagnoses
Eczemas	35	29	6	82.8
Pigmentary Disorders	19	19	0	100
Viral infections	8	7	1	87.5
Infestations	8	7	1	87.5
Acne	7	7	0	100
Fungal infections	6	6	0	100
Pyodermas	6	6	0	100
Skin neoplasms	4	3	1	75
Others	14	10	4	71.4
Total	107	94	13	87.9

Table 2. Image quality

Image Quality	Number	%	95% CI	
			lower	upper
Excellent	42	39.3	29.9	47.7
Good	36	33.6	24.3	42.1
Fair	13	12.1	6.5	17.8
Poor	16	15.0	8.4	22.4
Total	107	100.0		

Discussion

In this study we have evaluated the accuracy of skin diagnosis using telecommunication technology compared to regular face-to-face examination in a distant region in Nepal without access to dermatologic care. Due to its visual nature dermatology seems to be an ideal specialty for teledermatology.⁶ In isolated geographical areas where dermatologists are not present telecommunication will provide access to specialist valuations and follow up treatment in many cases, as well as avoid unnecessary referrals. Apart from medical diagnosis and treatment, teledermatology can be useful in the training of general practitioners.

The two technical modalities which have mostly been used are live interactive teledermatology and store-and-forward teledermatology. The former is a real time video conference, while the latter uses photographs and feedback recommendations provided at a later time. Video conferences are effective, but very expensive, requires high resolution cameras, high speed internet and skilled manpower. Due to these factors, its use has not been successful in Nepal. The store-and-forward method is less expensive, but more time consuming and the dermatologist cannot get additional patient information if necessary.

MTD using mobile phones has lately been studied with good results. Mobile phones are very commonly used all over the world. The technical equipment used is not expensive and easy to handle and the inbuilt camera takes photographs with very good resolution. The image and data can be transmitted rapidly via internet with low to average speed to a dermatologist, who straight away see the photo and promptly suggest diagnosis and treatment. At the same time if needed the dermatologist can ask for additional photos or more detailed clinical history. All this is done in real time. Further, MTD using mobile phones can be conducted in all health facilities, including the PHCCs, where there is a doctor, a mobile phone with decent camera and a net connection.

In our study, there is a high overall concordance of 88% (Cohen k coefficient 0.85) between teleconsultation and face to face consultation. This consistency is probably in the same order as when two independent dermatologists face to face diagnose a group of patients. Our overall concordance is comparable to studies done by Nami et al⁷, Levin YS⁸, Barberie JS⁹, Shin H¹⁰ which ranged

from 71%-91.05%. It is well known that certain SDs are more difficult to diagnose than others, specifically in a photo version. Therefore, our result are not absolutely comparable with these articles as the SDs in the studied populations are not matched. Due to the difficulties for a return visit of patients in this isolated area it was not possible to obtain a valid second opinion regarding the clinical diagnosis or the treatment response. The average face to face consultation time was 5 minutes and it was 7 minutes more for teleconsultation in our study. It is in the same order of magnitude as in the study by Nami et al.⁷ In the present study we have shown that MTD is a reliable, useful and cost effective method to provide skin care to the poor populations in the rural and remote Nepal. Considering the current situation in this country, MTD may be the only realistic way to provide dermatologic care for the populations in isolated areas.

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References

1. Government of Nepal, Ministry of Health and Population, Department of Health services Annual Report, 2013.
2. Shrestha DP, Gurung D, Shrestha R, Rosdahl I. Skin Diseases and Impact on Quality of Life in the Central Development Region of Nepal: A Major Public Health Problem. *Journal of Institute of Medicine* 2014; 36(August):15-20.
3. National Population and Housing Census 2011: National Report. Central Bureau of Statistics, Nepal.
4. Thomas J, Kumar P. The scope of teledermatology in India. *Indian dermatology online journal*, 2012; vol 3 (September-December), issue 3
5. Tran K, Ayad M, Weinberg J et al. Mobile teledermatology in the developing world: Implications of a feasibility study on 30 Egyptian patients with common skin disorders. *J Am Acad Dermatol* (article in press)
6. Weingast J, Scheibbock C, Wurm E et al. A prospective study of mobile phones for dermatology in a clinical setting. *Journal of telemedicine and telecare* 2013; 19:213-218
7. Nami N, Massone C, Rubegni P et al. Concordance and time estimation of store and forward mobile teledermatology compared to classical face to face consultation. *Acta Derm Venereol* 2014 Epub ahead of print
8. Levin YS, Warshaw EM. Teledermatology: a review of reliability and accuracy of diagnosis and management. *Dermatologic clinics* 2009; 27-2:163-176
9. Barbieri JS. Teledermatology via smartphone reliably triaged patient. *JAMA Dermatol* 2014
10. Shin H, Kim H, HoRyu H et al. Teledermatology consultation using a smartphone multimedia service for common skin diseases in Korean Army: A clinical evaluation of its diagnostic activity. *Journal of Telemedicine and Telecare*. 20(2) 2014