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Research Article

Scaling-up Community Eye Care Services Using Short Message Service Technology and Mobilizing Community Volunteers: Evidence of mHealth Pilot Intervention from Rolpa District, Nepal

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Received: February 24, 2021; **Published:** June 30, 2021

Abstract

Background: In Nepal, disparities exist in the distribution of eye services and resources. In places where resources are limited and confined to urban areas, mHealth can play a vital role in increasing community referrals. This study attempted to scale up of the rural eye care services through the use of mHealth technology by mobilizing the community health volunteers known as female community health volunteers in Nepal.

Methods: Pilot study was conducted in two phases: Phase-I (June to December 2016) and Phase-II (August 2017 to July 2018). During Phase-I, the performance of 209 female community health volunteers, making referrals to community eye centre, Rolpa using mHealth technology, was compared with 109 female community health volunteers making traditional paper-based referrals. In Phase-II, volunteers active in the Phase-I inclusive of a new cohort of school teachers retrained, and the incentive was provided coinciding per referrals. The findings from the Phase-II was then compared with the Phase-I.

Results: Almost all (99%) cases attended to community eye centre for consultations had some form of eye illness. In Phase-I, an average referral rate of 1.5 patients per volunteer using mHealth technology was recorded in contrast to 0.4 patients per volunteer using the traditional referral approach. The community eye centre has experienced an influx of patients by 20% after the implementation of screening and referrals using mHealth technology. In Phase-II, both the number of registered and visit confirmed cases increased by around six times than in the Phase-I.

Conclusion: The mHealth technology, when used in a low-resource setting by mobilizing community volunteers, can be effective in increasing community referrals and facility-based consultations.

Keywords: *Eye; Telemedicine; Nepal; Referral and Consultation; Community Health Workers*

Abbreviations

CEC: District Community Eye Centre; FHF: The Fred Hollows Foundation; mHealth: Mobile Health; TIO: Tilganga Institute of Ophthalmology

Introduction

In the past few decades, Nepal has witnessed significant progress in the field of eye health system strengthening. The burden of blindness (using the WHO definition for blindness) has reduced from 0.84% [1] to 0.35% [2]. Nepal's eye care service delivery system has often been cited as a model in the region [3]. Although the non-government sector mostly governs the country's eye health sector, both the Nepal Eye Health Policy (2015) and National Health Policy (2019) have emphasized the integration of primary or basic eye care services into government health care system. However, there is a coexistence of significant disparity in the distribution of existing eye care services and the allocation of resources across the country. Geographically, most of the human resources for eye health are confined within urban areas of Nepal. All ophthalmologists have positioned themselves in the Hilly and Terai region, whereas no evidence of a single ophthalmologist delivering eye care in the mountainous region indicating the magnitude of disparity in providing eye health services in Nepal. Consequently, nearly 37% of the population in Provinces 1 and 3 have access to 60% of eye care human resources. In comparison, 40% of human resources for eye health serve the remaining 63% population, leaving the largest segment of the poor and rural community inaccessible to community eye care services available at the district level [4].

The significant hindrances experienced by the eye health system in delivering basic eye health services in the low-resource setting is shortage of human resources for eye health [4], inadequate equipment and associated logistics management leading to limiting the identification of people with eye illness or problems in the remote community. In addition, there are limited skill-mix training opportunities available with integration of mHealth technology [5] to mobilize community health volunteers to screen, refer, and to promote basic eye care services in the community [6]. Identified disparities, coupled with low-income country characteristics of the eye health system, are contributing adversely in achieving the ambitious targets of global initiatives, and the goal of universal coverage of eye health in Nepal.

Many low- and middle-income countries (LMICs) are adapting to new, portable and mobile technology to reach the unreached population to provide eye care services corresponding to their country's resources and capacity [6-9]. Integration of telehealth, mobile health, or mHealth into the public health system has been used widely in recent years to provide basic health services in LMICs. With publicly available evidence around the potential of increasing uptake and quality of health services delivery, using mHealth technology in the low resource setting has proven to be effective in screening common ophthalmic diseases, referral, and strengthening the overall eye health system [5]. Various mHealth interventions implemented to screen and to change eye health-seeking behaviour [8], including the use of structured Short Message Service (SMS) and mobile registrations have been proven to be an effective reminder mechanism to promote improved patient appointments and to improve eye care utilization at the community [6].

Integration of mHealth technology component into training and mobilization of community health volunteers to screen and to refer potential abnormal eye conditions can be beneficial in shifting the way we deliver community eye care services.

Aim of the Study

The aim in this study was to analyse the effectiveness of mHealth technology in promoting access to and utilization of services at the community eye centre based in rural Nepal. To our knowledge, this is the first time a study has been conducted on the use of mHealth technology in the eye health sector with a geographical focus on Nepal.

Materials and Methods

A pilot study design was used and the study was conducted in two phases. Rolpa district of Nepal was taken purposely for the study as Tilganga Institute of Ophthalmology (TIO) has been providing specialized eye health services as sole eye health service provider in the

district.

Tilganga Institute of Ophthalmology (TIO) has been the leader in delivering eye care services in remote hill and mountain areas in Nepal through the operation of static eye health facilities called community eye centres (CECs) and with the provision of regular outreach micro-surgical eye clinics (OMECs) and screening eye clinics. TIO's CEC facilities available in the district headquarter and periodic outreach clinics were the only provisions of eye care services available and accessible to the population of Rolpa district in Nepal. The alternative option for the district population to access eye care services from other eye hospitals often involves lengthy travel time (minimum one day travel time equivalent) and associated expenses, therefore, CECs are one of the major static eye health facilities available in the district level that provides primary to secondary level eye care services covering the entire population of the Rolpa district and neighbouring districts partially.

This pilot study comprised of two phases of interventions with a geographical focus on the Rolpa district of Nepal. In Phase-I, from June to December 2016, all 311 Female Community Health Volunteers (FCHVs) of the district were trained specifically for basic eye health screening, treatment and referral. The training was organized separately for group with mHealth intervention and non-mHealth group to maintain consistency in the training delivery experience among each group. The training was primarily focused on building capacity of FCHVs to differentiate normal and abnormal eye conditions of all age groups except children using six criteria of healthy eyes through naked-eye torchlight inspection and examination. They were also trained on keeping a good record of identified and referred patients at the community-level. All the FCHVs were provided with essential information inclusive of services available at the CEC facility, identification of basic eye conditions, and condition to make certain referrals of patients as necessary from the respective community to CEC.

Among 311 FCHVs, 209 were kept in mHealth technology user groups and the remaining 102 were kept in traditional paper based referral groups. The mHealth group was further trained to use the mobile based Short Messaging Service (SMS) system to register the clients for referral services by composing the structured text message together with some basic troubleshooting of messaging function in their mobile device. This group was suggested to register the clients using structured SMS to generate clients' unique identifier for referral. These unique identifier codes of three to five digits were auto generated by web application designed and supported by Medic Mobile. FCHVs were asked to use the unique identifier to keep records for themselves as well as to refer the clients to the CEC. Pre and post-test evaluation methods were applied to assess the knowledge, skill and the use of mobile applications using SMS technology by FCHVs.

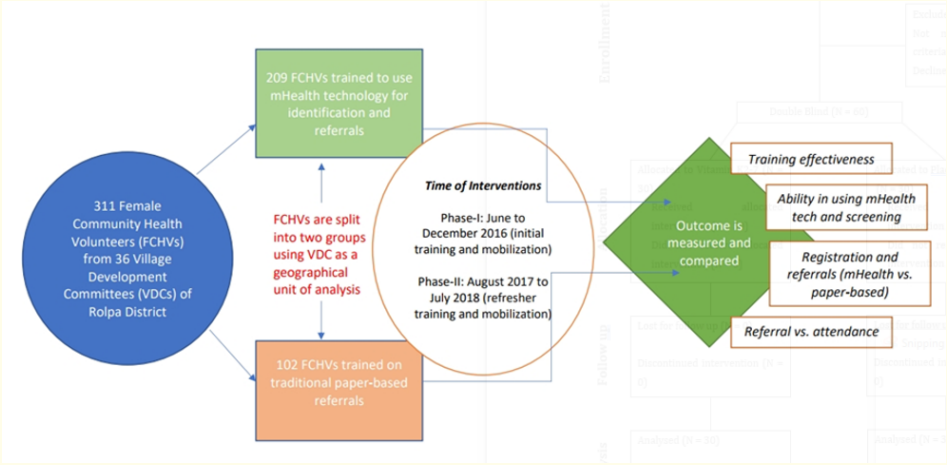

Figure 1: *mHealth technology group and traditional paper-based referral group allocation using VDC as a geographical unit of analysis.*

FCHVs initiated the screening of eye conditions of general population in the different locations of the district. Client identification and screening by the FCHVs took place during their regular home visits, from government's public health facilities, and even during ad-hoc meeting with the clients of their catchment communities. When FCHVs find any suspected or abnormal eye conditions, they delivered counselling to prospective patients. Further, they generated referral slips together with unique identification code to each client and asked identified patients to make a consultation visit to the CEC. In the case of potential eye health problems, FCHVs informed the CEC using the automated SMS technology and then CEC acknowledged the receipt of SMS and maintained the record of referred patients visited in the CECs for consultations.

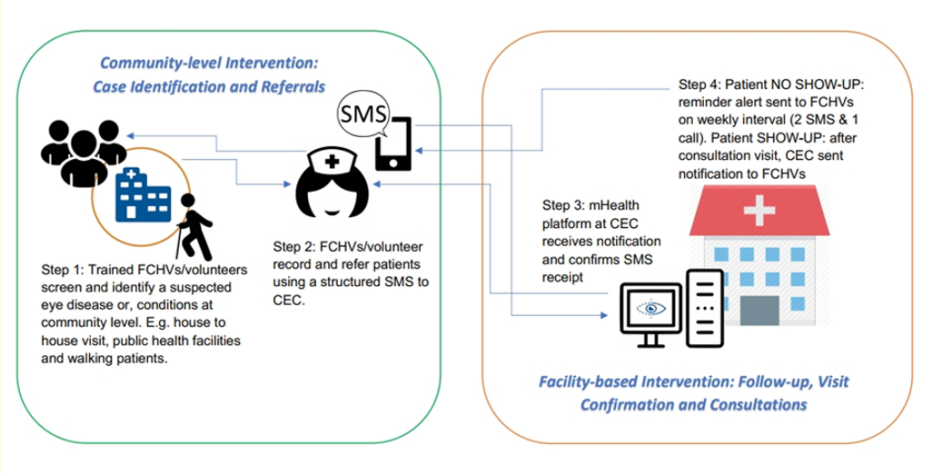

Figure 2: *Flowchart diagram of community-level and facility-based mHealth (SMS) interventions.*

In case of no show-ups of referred cases, CEC staff would send two reminder follow-up SMS and one final call follow-up in a week interval. Referrals made by FCHVs using mHealth application were compared with the ones using traditional paper-based referrals. The record of referrals, CEC visits, and SMS generation was maintained at the CEC facility by the Medic Mobile. The performance of 209 FCHVs, making community referrals using mHealth technology, was compared with 109 FCHVs making traditional paper-based referrals.

In Phase-II, thirty-five FCHVs included in Phase-I, who had a referral record of at least one case using the mHealth application, were randomly selected and retrained on basic eye problems and the use of mHealth technology. Similarly, 11 school teachers who had been involved in other school eye health programs of TIO were also selected and trained along with the Phase II FCHVs. To increase the referrals, FCHVs and school teachers, collectively called as volunteers, were provided with the financial incentives based on a number of cases referred. A number of referrals made by volunteers in the Phase-II were then compared with the Phase-I outcomes.

This study used quantitative data collection and analysis methods using the data obtained from the medical record of the CEC and mHealth platform maintained by the Medic Mobile service provider.

At the field site, data editing was conducted by the enumerator and field supervisor. The monitoring team also checked the completeness, accuracy, and timeliness of the data and information relevant to the study. Final data editing was carried out by the research department of the TIO by coding and classification of data as necessary. Collected data were entered into separate data-based software for cleaning using Microsoft Excel (2010). Afterward, data were analysed in SPSS Statistics V19. Number and percentage were calculated for

categorical data, while the mean standard deviation was derived from continuous variables. For paired continuous non-normal data, the Wilcoxon signed-rank test was used for the difference. A p-value of less than 0.05 was considered statistically significant.

The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by institutional Review Committee of Tilganga Institute of Ophthalmology (Ref no.: 07/2016) and informed consent was taken from all individual participants.

Results and Discussion

Effectiveness of training

In Phase-I, pre and post-test scores on knowledge of basic eye health were analysed among 272 out of 311 participants.

Test	Participants	Mean Score	Standard Deviation	P-value
Pre-test	272	.66	.15	< 0.001
Post-test	272	.82	.12	

Table 1: *Change in knowledge after training on basic eye health (n = 272).*

The mean pre-test score of FCHVs was 0.66 ± 0.15, which was increased to 0.82 ± 0.12 in the post-test conducted after two days of basic eye health training. This increase in knowledge was statistically significant (p-value < 0.001), indicating that training was effective.

Volunteers' adaptability and ability in using mHealth technology and screenings

In Phase-I, 209 FCHVs were trained to make referrals using mHealth technology, and 102 were trained to make paper-based referrals. Of the first group FCHVs, 124 (59.3%) were working actively with a minimum referral of at least one patient from their communities. However, among those using paper-based systems, only 20 (19.6%) FCHVs were active (P < 0.001). This finding suggest that the community health volunteers equipped with low cost mobile technology and skills to use the technology are better performers than those having only the traditional paper based system of recording and referring.

Of all registered cases, 643 cases visited Rolpa CEC in two phases. Out of this number, a vast majority (99.1%) of cases had some form of eye disease when examined by an ophthalmic assistant at CEC. This finding supports the fact that the trained volunteers are capable of screening and identifying common eye diseases at the community-level.

Confirmation of Eye Diseases	Number	Percentage
Yes	637	99.1
No	6	0.9
Total	643	100

Table 2: *Number of visit-confirmed cases with real eye problems (n = 643).*

Mobile registration

In Phase-I, a total of 491 cases were registered. Of them, 311 (63%) reported that they had visited eye centres for a check-up. Of those who visited eye centres, only 58 (19%) had attended to the Rolpa CEC for consultations and rest went to higher centres outside the district.

In Phase-II, a total of 843 patients were registered, of which 585 (69.3%) had made a visit confirmation and 100% of them mentioned that they had visited Rolpa CEC for consultations.

Referrals: mHealth (SMS) technology versus paper-based system

In Phase-I, there was an average referral rate of 1.5 patients per FCHV using a mobile SMS application and 0.4 patients per FCHV using paper-based referrals. Thus, mobile-based referrals were higher than paper-based referrals.

Influx of patients: base-year against mHealth intervention

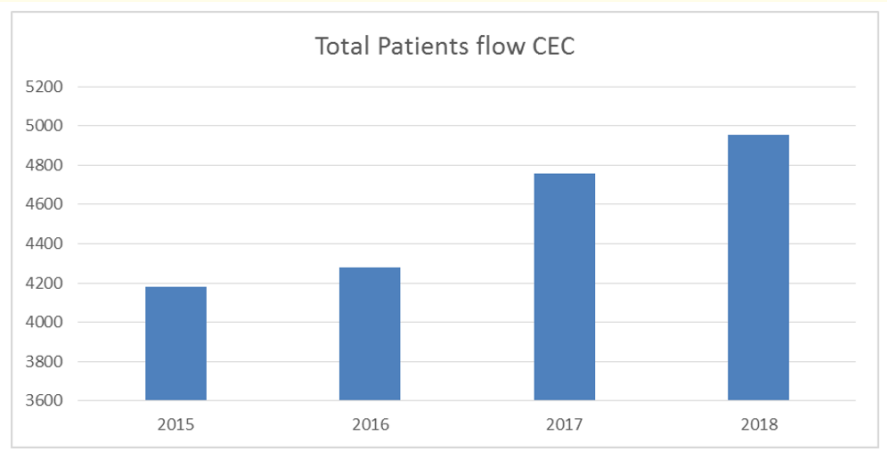

Figure 3: *Trend of patient flow in Rolpa CEC from base year to mHealth Implementation year.*

The trend of overall patient flow seems to have an incremental effect from the base year 2015 to 2018. The trend shows that there was an increase in total patient flow in CEC after the implementation of mHealth pilot initiatives using SMS referrals. In 2016, there was an increased patient flow by 2.4% than in 2015, which was further increased by 11.2% in 2017 compared to 2016 and again increased by 4.1% in 2018 than in 2017. Comparing to the base year 2015, there was an approximate rise of 20% patient flow rate in the year 2018.

Performance: FCHVs versus school teachers (Phase-II)

Of the 35 FCHVs, 16 (45.7%) were active, meaning they referred at least one patient, while 9 out of the 11 school teachers (81.8%) were active (P value: 0.036). The referrals made by FCHVs ranged from 0 to 71 while by school teachers were from 0 to 81.

Visit confirmation: Registered cases versus CEC attendance (Phase-I and Phase-II)

During the initial seven months of the Phase-I intervention, trained 209 FCHVs have been able to register a total of 491 cases using mobile technology, making 0.3 registrations per FCHVs per month. Of those who were registered, 311 had visited to the eye centre making 0.2 visit confirmation per volunteer per month.

In 11 months of Phase-II, 46 volunteers have been recorded a total of 843 cases, making 1.7 registrations per volunteer per month. Of the registered, 585 had made a confirmed visit to eye centre making 1.2 visit confirmation per volunteer per month.

Thus, in the Phase-II, both the number of registered cases and visit confirmed cases increased by around six times than in the Phase-I intervention. This indicates that there has been a significant improvement in the Phase-II intervention, which could be due to the positive effect of refresher training and incentives provided to the volunteers coinciding with their performance.

Phase	Total FCHVs/ Volunteers	Duration (months)	Registered cases	Visit Confirmed cases	Registrations per volunteer per month	Visit confirmed cases per volunteer per month
I	209	7	491	311	0.3	0.2
II	46	11	843	585	1.7	1.2

Table 3: *Comparison of visit confirmation and registered cases (Phase-I and Phase-II; n = 255).*

Discussion

This study identified that the training was effective in increasing the knowledge of Female Community Health Volunteers (FCHV) on basic eye health care screening and referrals. The role of FCHVs in identifying eye conditions in the children has been noted as effective and competent [10]. Almost all patients referred by the FCHVs to the CEC had some form of eye problems that needed immediate and further ophthalmic consultations. This applies that the FCHVs are capable of providing primary screening of major eye disease in the community. This finding is further supported by a study conducted in India [11] indicating the involvement of existing community health care workers in primary eye care utilization can be a win-win approach. Moreover, another systemic review of similar published articles revealed that the use of community health volunteers in delivering selected health care services could be promising, especially in LMICs [12].

This study has observed a proportionately higher number of referrals leading to higher access to and utilization of the eye care services available at the CEC using mobile-based registration in comparison to the traditional paper-based referrals. In contrast to the base year, there was a subsequent incremental effect in the influx of patients at the CEC after the immediate implementation of the mHealth initiatives in the Rolpa district. The impact of mHealth technology attributing to increase the patient flow at the CEC is similar in a systematic review [13] which found that sending text message using a mobile device could be effective in promoting medical compliance and appointments. SMS reminders, were widely accepted at community-level [7]. The use of mHealth technology have resulted with the substantial referral to eye care providers, and eye care service utilization was higher among those referred using mHealth methods compared to traditional paper-based processes.

SMS reminders played a crucial role in increasing the follow-ups of identified cases. Likewise, another systematic review on the effectiveness of the SMS uses [14] noted that 77% of the paper highlighted improved health outcomes indicating the use of SMS in the health care settings. Also, Cochrane review of the articles [15] found that SMS reminders in making appointments had a better attendance rate than compared to the postal or no appointment reminders. Thus, SMS registration using mHealth application has a pivotal role in promoting health service utilization and sending SMS reminders has a positive effect on the reduction of non-attendance [16] for eye care out-patient appointments.

There were more case registrations in the second phase of the intervention, which could be due to the refresher training provided to only those who were actively screening and referring identified cases to CEC combined with the provision of incentive for volunteers cor-

responding to their referral numbers. A study carried out by Singh D., *et al*. showed that remuneration provided to the community health volunteers could potentially affect their motivation and focus [17]. Also, the guideline on the Community Health Worker (CHW) Incentives and Disincentives has mentioned that the monetary incentives, along with other support, can increase the motivation of CHW [18]. Extrinsic incentives, in turn, has played a potential role in making a substantial number of screening and referrals by FCHVs from their respective community to the CEC and contributed to scale-up of community eye care services.

The limitation of this study were: we didn't include the control district to assess the independent effects of the mHealth intervention, the volunteers had often reported many barriers including the network error, there might had been several socio-demographic, educational and occupational factors of the volunteers that might have affected the study results.

Conclusion

In conclusion, evidence from this study indicates that the mHealth technology, when used in a remote setting, can be effective in scaling-up and promoting access to community eye care services. This study also highlights that the Female Community Health Volunteers, front-line health volunteers widely available in the rural community of Nepal, are capable of adapting to mHealth technology and competent enough to deliver basic screening, early identification and referral of potential eye conditions at the nearby static CEC available in the district. The efficiency of their performance can be further increased and improved by providing a combination of opportunities involving incentives and skill-mix refresher training on mHealth technology to catalyse the sustained impact of community eye health service delivery in the low-resource setting.

Acknowledgements

This work was supported by The Fred Hollows Foundation. We would like to acknowledge our funding and technical partners (The Medic Mobile, Nepal) for their support. We extend our deepest gratitude to the community people of Rolpa, volunteers, local stakeholder, Community Eye Centre and field researchers of this research. Also, we would like to appreciate the contribution of Mr Pradeep Banjara and Mr Hari Karki for their support in this research.

Conflict of Interest

All authors have completed the ICMJE uniform disclosure form. The authors have no conflicts of interest to declare.

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Volume 12 Issue 7 July 2021