

**SMART PHONE BASED TELEOPHTHALMOLOGICAL SERVICES OF MKCG MCH, BERHAMPUR**Sanjukta Mahapatro<sup>1</sup>, Suchitra Dash<sup>2</sup>, B. Nageswar Rao Subudhi<sup>3</sup><sup>1</sup>Senior Resident, Department of Ophthalmology, MKCG Medical College and Hospital, Berhampur, Odisha.<sup>2</sup>Professor, Department of Ophthalmology, MKCG Medical College and Hospital, Berhampur, Odisha.<sup>3</sup>Professor and Head, Department of Ophthalmology, MKCG Medical College and Hospital, Berhampur, Odisha.**ABSTRACT****BACKGROUND**

The rural citizens who constitute major portion of Indian population are underprivileged as they have very little or no access to tertiary eye care. In order to make eye care services accessible to everyone, the concept called teleophthalmology has come into existence. A mobile van with eye-care-experts and equipment regularly reconnoiters through the rural population in the district of Ganjam to carry out screening, offsite diagnosis, monitoring, providing treatment and distantly educate the paramedics. The whole gamut of activities of this initiative can be categorized into three broad aspects. The first one is to screen out patients with treatable ailments and advise them for future course for a better prognosis. The second one is to educate the paramedics and ophthalmic assistants of their locality and generate consciousness among the mass. The third one is smart-phone-based transmission of information of patients to the Prof. & Head and to other senior faculty of Department of Ophthalmology for treatment on the spot or to store information for use subsequently.

**MATERIALS AND METHODS**

A mobile van (air conditioned) which has inhouse sterilization chemicals, betadine, spirit, sterilized drum, surgical instruments, surgical gloves & surgical masks, slit lamp, autorefractometer, fundus camera, streak retinoscope, ophthalmoscope, trial box, vision drum, tonometer, colour vision chart, magnifying lenses, smart phones, on-board computer etc. were deployed for the purpose. Ophthalmological experts and paramedics organized camps in villages.

**RESULTS**

1541 rural patients were examined and treated at their doorsteps. Medical treatment was provided on the spot of examination. 44 camps were organized over a period starting from July 2016 to February 2018.

**CONCLUSION**

Vision centers provide access to permanent primary eye care and a comprehensive eye examination having a clear advantage over outreach camps. Consultation with professors at base hospital helps in diagnosis and patients' satisfaction. It also saves cost for both provider and patient. Teleophthalmological mobile van services are a good, cost effective option in providing primary eye care in rural areas. Patients are immensely benefited. Smart phones are utilized for exchange of vital information between the camp sites and the base hospitals.

**KEYWORDS**

Remote Consultation, Teleophthalmological Screening, Smart-Phone based Information Exchange.

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**BACKGROUND**

The benevolent propensity of the Department of Ophthalmology of MKCG MCH, Berhampur to outreach the underprivileged poor rural population to render services to mitigate ocular problems has led to a bold teleophthalmological initiative. Smartphones are employed to take pictures of the eyes and transmitted to the consultant

ophthalmologists at the base hospitals from remote locations.<sup>1</sup> This enables patients in the villages to seek expert opinion without having to travel for long enough. Such a practice is in vogue in Wales.<sup>2</sup> A mobile van with ophthalmologists, paramedics & eye-care equipment regularly reconnoiters through the rural population with a view to carry out screening, offsite diagnosis, monitoring and distantly educate the rural paramedics. Such an initiative has two modes of operation. One is the online interactive mode via the communication and imaging techniques of the smart phones and the other is to give treatment at camp site and to store information for action afterwards. Patients with curable and incurable ocular ailments are examined at the camp site and are advised for further course of treatment. Screening of prospective cases of keratoplasty, oculoplasty, cataract surgery, etc. are done prior to hospitalization and surgery. Cases of preventable abnormalities like diabetic

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*Corresponding Author:*

*Dr. Sanjukta Mahapatro,*

*w/o. Dr. Srikanta Mahapatro,*

*Ex-Paralakhemundi Bungalow,*

*Main Road, Courtpetta,*

*Berhampur, Odisha.*

*E-mail: sanjuktamahapatro14@gmail.com*

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retinopathy, childhood blindness, glaucoma, etc. are located and such patients are counseled to clear any misconception and to educate them for following a regimen of prescriptions and proscriptions. The enormously beneficial results of this initiative percolate and proliferate among poor and it also generates euphoria among the villagers. Rendering service to the underprivileged at their sites is a challenge and it is indeed an art that calls for preparations. The concept of teleophthalmology is in active practice around the world as it eliminates the need for referrals and journeys, etc. while promoting screening of large number of patients at their inaccessible and remotely located villages.<sup>1,3,4,5,6</sup> The urban population also have been benefited by the practice of teleophthalmology.<sup>7</sup>

Financially challenged, ignorant and remotely located rural people relegate inconveniences due to ocular abnormalities to fate. Realizing this fact, administration of the Department of Ophthalmology of the MKCG MCH, Berhampur has extended a warm helping hand by initiating a mobile van with ophthalmologists and paramedics enabled by the on-board equipment to offer treatment on the spot to the underprivileged ones. The whole gamut of activities of this initiative can be categorized into three broad aspects. The first one is to screen out patients with treatable ailments and advise them for the future course for a better prognosis. The second one is to educate the paramedics of their locality and generate consciousness among the mass. The third one is the smart phone based transmission of information of patients online to the Professor & Head, Department of Ophthalmology and to senior faculty for treatment on the spot or to store information for use subsequently.

The study was conducted in the PG Department of Ophthalmology, MKCG MCH, Berhampur from July 2016 to February 2018. A total of 44 camps were conducted. The participants of the study were ophthalmologists, post graduate students, ophthalmic assistants and paramedical staff.

### **MATERIALS AND METHODS**

A dedicated teleophthalmology mobile van (air conditioned) which has house sterilization chemicals, betadine, spirit, sterilized drum, surgical instruments, surgical gloves and surgical masks, slit lamp, autorefractometer, fundus camera, streak retinoscope, ophthalmoscope, trial box, vision drum, tonometer, colour vision chart, magnifying lenses, trial box with trial frame for glass correction, computers and smart-phones were deployed for the camps. All patients had undergone a comprehensive eye examination by the ophthalmologists. Patients requiring further investigations or surgery were referred to the base hospital. Data with respect to number of patients screened and diagnosed were analysed. Records at base hospital were examined to determine utilization of services after referral to the base hospital from camp sites.

A dedicated social worker would advertise the program and the benefits of the forthcoming teleophthalmological camps by the use of wall paintings, posters, thandora, public announcements, banners, etc. beforehand. Such a worker

assists the team of the mobile van about planning and smooth execution of the camp. The role of the volunteer is to visit from door to door in the locality two days prior to the date of the camp so as to assess the possible number of patients to be examined. We have started the programme of eye donation by motivation of public with the help of teleophthalmology vehicle. The help of social, religious and voluntary organizations was used for the selection of site, local publicity, arrangement and mobilization of people and other infrastructure. Ophthalmic assistant and medical health workers were utilized for the arrangement of awareness through motivation camp. The doctors in teleophthalmology vehicle conduct classes, discussions, organize question and answer sessions, show slides, video films to medical & paramedical staff, patients & public. The ophthalmic assistants distributed booklets, posters, eye donation form, etc. Medical treatment was provided on the spot of examination. Distribution of medicines like eye drops & eye ointments supplied by the Government to patients in the camps were carried out.



**Figure 1. Tele Ophthalmology Mobile Van of MKCG MCH, Berhampur**

### **Steps Undertaken for Examination in the Camp-**

- Enrolment of the Patients
- Assessment of Vision and Refraction
- Slit Lamp Examination.
- Tonometry for IOP measurement.
- Indirect Ophthalmoscopy after dilatation.
- Blood pressure, Blood Sugar, haemoglobin, etc. were determined.
- Consultation with professors at the base hospital.
- Prescriptions and Proscriptions.

Examination of the pictures and videos transmitted from the camps by a senior ophthalmologist of the MKCG MCH, Berhampur is carried out with a view to arrive at a conclusive diagnosis. A team at the base hospital may choose to keep medical records of the patients of the camps for analysis later on.

### **What do we do in Camps-**

- Eye examination of all patients, screening for Diabetic Retinopathy, screening for Retinopathy of Prematurity, screening for diseases in school children, motivation for keratoplasty and other surgeries.
- Awareness programmes conducted to promote eye-care.
- Train teachers for vision screening programme.

- Educational promotions.
- Online Medical treatment.
- Minor Surgeries at campsite.
- Stored information for future analysis.
- Giving assurance to do free surgery at base hospital and to provide food and accommodation.
- To provide free post operative care.

**Who Organized the Camps?**

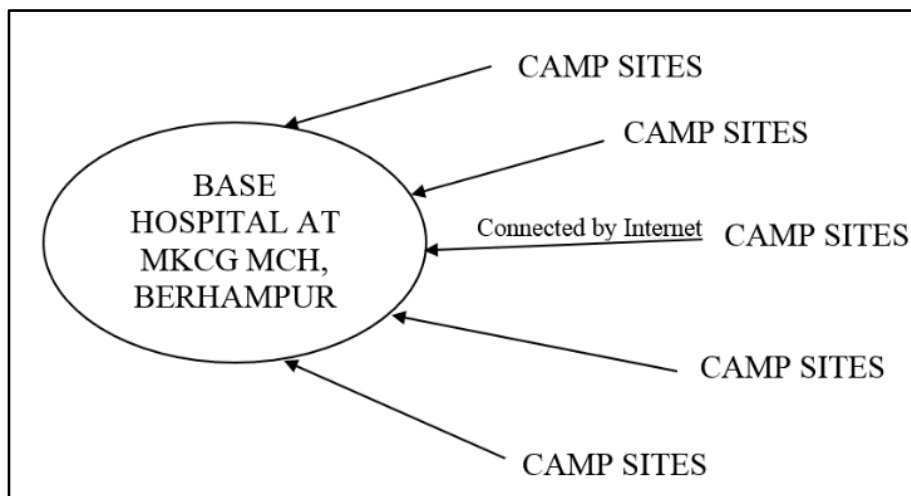
Any individual, voluntary social service organization such as Lions club, Rotary club, industries, trusts, banks, hospitals, rural service organizations, recreation club, farmer’s associations, panchayat presidents interested in the community welfare.

**How are the Camps Organized?**

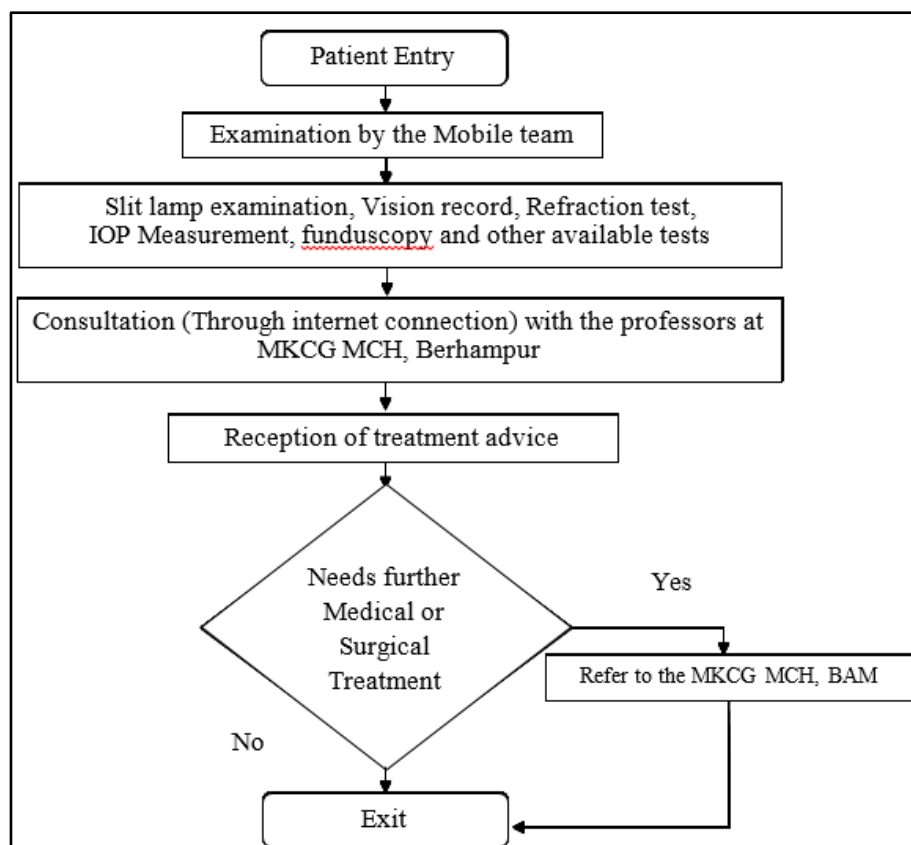
A village with a population of at least 5-10 thousand including the surrounding areas, is selected for conducting an eye camp. A convenient venue (such as a large school or panchayat office or hospital premises with adequate place for the mobile unit). A suitable date (which does not interfere with local festivals and other functions or with other camps) should be selected for conducting the camps.

**Role of Organizer?**

The organizer should play the primary role in identifying and setting up the campsite, arranging facilities, creating awareness among the target population regarding the camp.



**Figure 2. Concept of Campsites**



**Figure 2. Flow Chart Explaining the Functionality at Campsites**

**RESULTS**

A total of 44 camps were conducted by using the teleophthalmology vehicle from July 2016 to February 2018. Irrespective of age & sex all the patients were examined and treated inside the teleophthalmology vehicle. The medical team went to different places of Ganjam District on different dates with the order of Professor & Head, Post Graduate Department of Ophthalmology, MKCG MCH, Berhampur. 1541 patients were examined and treated. 631 cases (40.94%) screened for cataract surgery. 600 cases (95.08%) came to hospital for cataract operation. 30 cases (1.94%) diagnosed for glaucoma and 24 cases (80%) came to base hospital for surgery out of which 20 cases (83.33%) operated upon. 32 Corneal ulcers (2.07%) diagnosed and treated. 30 cases (93.75%) of Corneal ulcer came to hospital for admission. 16 cases (1.03%) of Corneal opacity were diagnosed and motivated for keratoplasty for restoration of their sight. 14 cases (87.5%) came for Keratoplasty. 359 cases (23.29%) of refractive errors diagnosed and prescribed for glasses. 28 cases (1.81%) of Diabetic Retinopathy were diagnosed. 12 cases (42.85%) were referred to higher center for laser treatment. 46 cases (2.98%) were diagnosed having Pterygium. 35 cases (76.08%) had undergone excision with conjunctival autograft in the operation theatre of MKCG MCH, Berhampur, after being referred from the campsites. In 11

cases (0.71%) primary repair of injuries were done at campsite. 54 cases (3.5%) of dry eyes were diagnosed and treated. Out of 37 cases of Posterior Capsular Opacity, 22 cases (59.45%) had undergone YAG laser. Out of 9 cases of Diabetic Retinopathy, 7 cases (77.77%) had undergone laser treatment. Out of 72 cases of watering, 24 cases (46.15%) had undergone DCR Surgery and 17 cases (85%) had undergone DCY Surgery. Out of 4 Ectropion, 2 cases (50%) had undergone surgery for correction. Out of 5 Entropion, 3 cases (60%) had undergone surgery for correction. 4 out of 9 cases advised for Tarsorrhaphy (44.44%) had undergone procedure. Out of 4 cases of Retinal Detachment, 1 case (25%) had undergone surgery. Out of 18 cases of Corneal Ulcer, 12 cases (66.66%) had undergone Therapeutic Keratoplasty. Out of 16 cases of Corneal Opacity, 14 cases (87.5%) had undergone optical Penetrating Keratoplasty. 8 cases were advised for Evisceration out of which 6 cases (75%) had undergone the procedure. 3 cases were advised for Nucleation. Only 1 case (33.33%) had undergone Enucleation. Other cases were treated medically at campsites.

The aforesaid results are tabulated in the three following tables.

Sl. No.	Venue of Camp	Date of Camp	Total Number of Patients	No. of Cataract	No. of Glaucoma	No. of Corneal Opacity	No. of Corneal Ulcer	No. of Refractive errors	No. of Diabetic Retinopathy	Other
1.	C.H.C. Polasara	12.07.2016	70	28	3	1	2	12	2	22
2.	C.H.C. Kelluapalli	28.07.2016	22	8	21	0	7	1	1	3
3.	C.H.C. Hinjicatu	06.08.2016	43	6	1	2	0	22	1	11
4.	S.D.H. Bhanjanagar	12.08.2016	20	6	2	2	1	3	0	6
5.	C.H.C. Sheragada	17.08.2016	59	35	3	2	1	10	1	7
6.	C.H.C. Buguda	23.08.2016	27	7	1	1	0	14	1	3
7.	C.H.C. Aska	25.08.2016	30	9	1	1	1	9	1	8
8.	C.H.C. Kukudakhundi	03.09.2016	63	36	2	2	0	15	2	6
9.	C.H.C. Dharakote	07.09.2016	121	24	4	4	2	29	3	55
10.	C.H.C. Khallikote	17.09.2016	39	8	3	2	0	14	1	11
11.	C.H.C. Digapahandi	22.09.2016	20	6	0	1	0	2	1	10
12.	C.H.C. Adapanda	27.09.2016	50	31	1	1	2	3	2	10
13.	C.H.C. Belaguntha	14.10.2016	23	2	2	2	0	10	0	7
14.	C.H.C. Kodala	20.10.2016	21	10	0	2	0	4	0	5

15.	C.H.C. Jagannath Prasad	25.10.2016	21	9	0	1	0	5	0	6
16.	C.H.C. Gallery	28.10.2016	20	7	1	1	0	2	0	9
17.	S.D.H. Chatrapur	03.11.2016	42	2	0	0	0	14	0	26
18.	C.H.C. Chikiti	08.11.2016	24	4	0	0	0	11	1	8
19.	C.H.C. Kukudakhandi	14.11.2016	27	4	0	0	0	13	1	9
20.	P.H.C. Podamari	22.11.2016	40	20	0	0	0	12	1	7
21.	C.H.C. Hinjicatu	24.11.2016	44	20	0	1	0	12	0	10
22.	Area Hospital, Aska	30.11.2016	32	6	2	1	0	7	0	16
23.	S.D.H. Bhanjanagar	05.12.2016	33	4	2	0	0	0	1	26
24.	C.H.C. Keluapalli	29.12.2016	7	5	0	0	0	1	0	1
25.	Govt. Hospital, Sheragada	10.01.2017	75	52	0	0	0	10	1	12
26.	C.H.C. Badagada	02.01.2017	61	29	0	0	0	18	0	14
27.	C.H.C. Bellagaon	19.01.2017	30	11	0	0	0	5	0	14
28.	C.H.C. Buguda	28.01.2017	39	16	0	0	0	4	0	19
29.	C.H.C. Digapahandi	04.02.2017	18	7	0	0	0	5	0	6
30.	C.H.C. Dharakote	21.02.2017	21	9	0	0	0	5	0	7
31.	C.H.C. Belaguntha	27.02.2017	17	7	0	1	0	7	0	2
32.	S.D.H. Chatrapur	25.02.2017	14	3	0	0	0	1	0	10
33.	C.H.C. Chikiti	27.02.2017	1	1	0	0	0	0	0	0
34.	Buguda Camp	11.04.2017	25	14	0	2	1	5	0	3
35.	Aska Camp	22.04.2017	9	4				2	0	3
36.	Dharakote	10.05.2017	19	10	0	0	4	4	0	6
37.	Goutami	27.05.2017	19	10	0	0	4	4	0	6
38.	C.H.C. Khallikote	30.05.2017	22	5	0	0	0	9	6	7
39.	S.D.H. Chatrapur	01.06.2017	40	15	0	0	0	2	1	17
40.	Balipada	08.06.2017	45	32	0	0	0	5	0	7
41.	Jana Jagaran	26.06.2017	24	8	0	0	2	9	0	6
42.	Jana Jagaran	06.07.2017	37	24	0	0	0	3	0	8
43.	Khariagada Camp	22.09.2017	34	21	0	0	0	5	0	6
44.	Josada Foundation Kalipali Grama Panchayat	24.10.2017	58	27	0	0		18		12
45.	Jana Jagaran Karadakona P.H.C.	11.02.2018	20	17		1		1		1

**Table 1. List of Activities of Teleophthalmology Vehicle from July-2016 to February-2018**

Types of Diseases	No. of Cases	% of Total No. of Cases
Cataract	631	40.94
Glaucoma	30	1.94
Diabetic Retinopathy	28	1.81
Refractive Error	359	23.29
Corneal Ulcer	32	2.07
Corneal Opacity	16	1.03
Others	446	28.94

**Table 2. Different Types of Cases Seen at Campsites**

Types of Treatment	No. of Cases advised for Surgery	No. of Cases Operated	Percentage
Cataract Surgery	631	600	95.08
Combined Surgery (Cataract Surgery + Trabeculectomy)	11	9	81.81
Trabeculectomy	13	11	84.61
Excision of Pterygium	46	35	76.08
<b>Laser Treatment</b>			
• YAG Laser for P.C.O.	37	22	59.45
• Green Laser for Diabetic Retinopathy	9	7	77.77
DCR	52	24	46.15
DCY	20	17	85
Ectropion	4	2	50
Entropion	5	3	60
Tarsorrhaphy	9	4	44.44
R. D. Surgery	4	1	25
<b>Keratoplasty</b>			
• Therapeutic	18	12	66.66
• Optical	16	14	87.5
Evisceration	8	6	75
Enucleation	3	1	33.33

**Table 3. Treatment Provided to Patients at MKCG MCH, Berhampur after Referral from Campsites**

**Advantages of Tele-Ophthalmology**

**For the Patients-**

- People at remote areas get access to tertiary care from reputed hospitals and doctors.
- Local ophthalmologists can retain their patient base.
- Reduced travel cost and saves time for patients.

**For the Hospitals-**

- Hospital can reach remote villages and serve local population.
- Hospitals can have CME programs with other hospitals and doctors.
- Primary diagnosis can be done through Tele-ophthalmology that facilitates patients to come to the tertiary care center only for physical interventions like surgeries / procedures.
- Instant sharing of knowledge for either a surgery or diagnostic technique by broadcasting it to other hospitals.
- Hospitals can run training programs involving the staff of other hospitals in a structured way.

**DISCUSSION**

Teleophthalmology is being used to provide eye care to the remotely located rural population.<sup>1</sup> Teleophthalmology is currently burgeoning as a way to improve clinical decision making efficiency and is likely to become a key factor in the provision of modern eye care.<sup>3</sup> An action plan for eye health was aimed to make the ophthalmology services available across the globe to strengthen ocular health services in different countries and to integrate ocular health services with other health care services.<sup>4</sup> To date, in order to improve the availability and accessibility of eye health services, telemedicine applications and in particular, Teleophthalmology technology has been developed and applied in different countries.<sup>1</sup> Such a service can be considered as a basic ophthalmology service and regardless of socioeconomic status, it may simply be available to people who are not able to visit a specialist but need to know his/her opinion. Some of the advantages of this approach are saving costs, reducing unnecessary referrals to the specialists, reducing the number of unnecessary travels and developing effective communication between optometrists and ophthalmologists.<sup>5,6</sup> It is notable that due to the resource restrictions, the teleophthalmology system was developed using the method of "store and forward" and it was a web-

based system where a slit lamp was used to take eye images. Although using a slit lamp allows examining the eye under high magnification, it is expected that new technologies, such as the smart phones and their built-in cameras can also be used in teleophthalmology services.<sup>8</sup> Despite the advantages of teleophthalmology technology, there are concerns about the quality of images and the accuracy of diagnoses.<sup>9</sup> For example Kiage et al. showed that poor quality images can severely limit the ability of teleglaucoma assessment to diagnose optic nerve damage and glaucoma.<sup>10</sup> Teleophthalmology has been used to follow-up glaucoma patients in the community. A study in Peterborough examined low-risk glaucoma patients who were followed up in the community by a designated optometrist.<sup>11</sup> Similar community-based programs in Cambridge have demonstrated improved diagnostic accuracy and reduction in the need for hospital follow-up with the establishment of virtual image-based triage clinics.<sup>12</sup> No diagnoses of glaucoma were missed suggesting that although inaccuracies and disagreements exist, virtual assessment is a safe adjunct in glaucoma care.<sup>13</sup> A further example of community-based management of retinal diseases is the monitoring of retinal diseases, an incidental finding on routine fundal examination, which may be associated with an increased risk of choroidal melanoma.<sup>14,15</sup> In Wales, a pilot teleophthalmology program has been deployed in the emergency eye services where a Smartphone was used to capture and send images to a consultant ophthalmologist. This innovation was designed to overcome the geographic difficulties in obtaining an expert opinion as patients requiring a senior clinical opinion needed to travel 3 hours to be seen at a large hospital by a consultant.<sup>2</sup> Our services at rural area are also dependent on Smart Phone with mobile data. Community-based studies have also demonstrated its safety involving number of children with treatable disease.<sup>16,17</sup> In England, there are currently 2.6 million people aged 12 or over diagnosed with diabetes.<sup>18</sup> Of these, 1.9 million (76%) were screened at least annually under the NHS Diabetic Eye Screening Programme (DESP).<sup>19</sup> In the Scottish DESP, Leese et al observed that factors such as a younger age, longer diabetes duration, poor glycemic control and social deprivation rather than distance/time taken to travel for retinal screening were associated with poor attendance at screening.<sup>20</sup> In the United Kingdom, opportunistic "teleophthalmology" rather than "screening", by engaging primary care services and optometrists using this approach has already been used in glaucoma and may be useful for detection of diabetic eye disease in the population who do not attend screening.<sup>21</sup> The emerging evidence supports the use of teleophthalmology of diabetic retinopathy screening. As Kroenke has noted, teleophthalmology is not only useful for providing health care access to patients living in rural, remote areas, but can also be cost-effective in highly urban areas also.<sup>7</sup> Critically, the degree of cost effectiveness is related to several other factors including the size of the population eligible for screening,<sup>22</sup> the prevalence of diabetic retinopathy in that

population, age,<sup>23,24</sup> Glycemic control,<sup>25</sup> and patient concordance with screening.<sup>26</sup>

## CONCLUSION

Ophthalmological community activities can be promulgated by increased frequency of interactions via communication lines with the base hospitals. The enthusiastic rural people can be encouraged to participate in a dialogue by volunteering to initiate interactions from the patients who are otherwise silent. Use of better imaging and communication techniques can ease the teleophthalmologic movement. Introduction of early diagnosis among the rural people can prevent or avert inadvertent discomfort. Video-shows about ocular health will enlighten the villagers en-masse.

Benefiting the ignorant and underprivileged is a piously blissful activity. The smiles on the faces of those who relished the good prognosis of the teleophthalmological services will prove to be a heavenly blessing on the programme and the staff associated with it. Increased number of requests for carrying out more and more visits to the rural sites speak volumes of praise worthiness of the initiative. It has earned laurels and accolades. Patients are immensely benefited. Like a spine beneath the rose, such initiative has incurred high costs. Yet the benefits outweigh the cost.

## Limitations

Adequate administrative support is needed to increase the number of mobile vans with eye-care-equipment. The cost of one trip by the van along with the prior survey and advertisement is high.

Reluctance of orthodox sections of rural population to accept eye care at the doorsteps is a hindrance which can be mitigated by pursuance.

The quality of microwave-based transmission of information by the smart phones depend upon the weather conditions and the accessibility of the remote locations of camps.

Due to the paucity of resources, the researchers focused on only few diseases. However, the teleophthalmological practice could be tested and expanded for other eye diseases as well.

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