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ROLE OF TELE-OPHTHALMOLOGY IN SCREENING POSTERIOR SEGMENT DISORDERS OF EYE

Ophthalomology

Dr. Shaik Khamer Jahan Ophthalmologist, Apollo Telehealth

Mr.Bharath Kumar Karnati* Optometrist, Apollo Telehealth*Corresponding Author

Dr.Ayesha Nazneen HOD and Sr Consultant, Apollo Telehealth

Mr. Premanand Chief Business Officer, Apollo Telehealth

ABSTRACT

Tele-ophthalmology utilizing digital retinal imaging technology, internet connectivity offers a solution to improve access to ophthalmology screening services in unreached zones of Andhra Pradesh where the burden of eye diseases is increasing and there is limited access to eye care services and specialists [2] The Mukhyamantri E-eye Kendram project established routine ophthalmic screening at 115 community health centers in 13 districts of Andhra Pradesh. A digital fundus camera operated by a trained ophthalmic assistant was used to acquire retinal images from the patients. A secured store and forward approach were set up and used for sharing and transfer of images to a specialist at a remote site for reading. This method enables detection of diabetic retinopathy, glaucoma, hypertensive retinopathy and age-related macular degeneration among the patients screened. This project illustrates the utility of Tele –ophthalmology for routine retinal screening for patients who have limited access to eye care services.This project demonstrates how teleophthalmology services can provide a platform for research in detection of retinal diseases. This approach could be used as a model to address the posterior segment diseases in other states of India.

KEYWORDS

Tele-ophthalmology, telemedicine, posterior segment disorders, ICO.

INTRODUCTION:

The diagnosis and management of retinal diseases like diabetic retinopathy, glaucoma, hypertensive retinopathy is hindered by inadequate eye care services offering retina examination. Annual retinopathy screening examinations for diabetic patients is recommended by WHO and ICO. In Andhra Pradesh, patients in need of eye screening, are subjected to waiting period of months or longer due to limited public health facilities [8]. The proactive approach of Department of Health and Family Welfare, Government of Andhra Pradesh led to a remarkable success and development of pioneering model of Tele-ophthalmology project which not only got replicated across the state but also became immensely celebrated model of Tele-medicine in India [11]. Tele ophthalmology can be performed in real timeor by a store and forward mode. Low-cost digital fundus cameras which provide focus and shoot methods can be used by non- physicians [9,10]. This study provides an empirical framework to broaden the scope of Teleophthalmology, a successful model for improving eye care accessibility.

Problem Definition

As per the available data for registered ophthalmologistsin All India Ophthalmic Society, India faces a dismal ratio of ophthalmologist to patient, which is 1:100000 [18,19]. The downside of the entire situation is that 70% of the available doctors practice in the urban areas and 70% population of India resides in rural areas. This leads to a very precarious situation of lack of access of eye care services to the vast majority of the population. Also, those who access the services (concentrated in the urban pockets) by travelling to urban areas, incur huge travelling and allied costs and loss of wages. Poised with the challenges of inadequate ophthalmic facilities and limited eye care specialists in the rural areas, this initiative has overcome all geographical, economic, social barriers earlier faced by the rural citizens and helped them in obtaining quality eye care services from Vision Centres located at their doorsteps [7].

To address this issue government of Andhra Pradesh in collaboration with Apollo Tele Health, initiated Teleophthalmology project in 2018 in 13 districts. The aim of this project is to reach out to rural population with technology enabled eye care services.

METHODS:

Tele-Ophthalmology project was initiated in 115 Community Health Center (CHCs).The Teleophthalmology center is manned by Vision assistant (VA) and equipment assistant (EA). Remote monitoring of the services is conducted by experts like ophthalmologist and optometrist at hub. The field staff comprising of VA and EA are trained practitioners on patient examination and fundus imaging.

Process Flow

The program enrolls beneficiaries for basic ophthalmological examination to determine visual acuity and refractive error. Fundus examination was conducted for the beneficiaries to evaluate anterior and posterior segment.

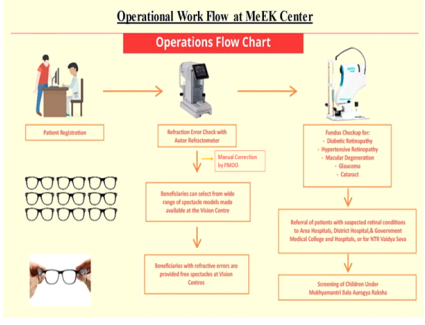

Figure 1: Operational work flow of MeEK CenterData obtained from clients in electronic medical record onsocio-demographic,clinical, past medical history, history of diabetes, hypertension, and cardiovascular disease. Basic ophthalmologic examination includes visual acuity, objective and subjective refraction, best corrected visual acuity (BCVA) is determined and spectacles are prescribed. Spectacles are made available at health centre within turn-around time (TAT) of one week after prescription. In a dark room, a digital fundus camera is used to take an image of the fundus — the posterior Segment of the eye that includes the retina, macula, fovea, optic disc and posterior pole.Secure password protected computer was provided for transfer of images from the camera. Screening was conducted for one patient at a time. A registered ophthalmic assistant was assigned to obtain demographic dataof each patient. FORUS 3 Nethra classic non-mydriatic fundus camera with 45 field of view were used to take fundus images.

Camera is directed along the patient's pupillary axis. The light is aimed to the pupil and retinal glow is seen.Light is directed through the lens onto the retina. While capturing, camera and the lens is moved to find a good focus and an image free of light reflections is captured.Dilating drops were not used.

Digital retinal image technology, internet connectivity, along with a store and forward approach is used for the application of Tele-ophthalmology. Fundus camera was integrated to transfer images onto a secured online cloud utilizing web access. The evaluation of photographs resulted in identification of cataract, glaucoma and diabetic retinopathy. The following diagnosis was applied excluding poor or suboptimal image which is unreadable: normal fundus, age related macular degeneration, hypertensive retinopathy, diabetic retinopathy, cataract (lens /media opacity) glaucoma, others (Branch retinal vein occlusion, drusen, macular scar) and poor or suboptimal image/cannot be read. Printout is handed over to the patient and digital report was sent to respective remote centers through Telemedicine. The report with recommendation based on results is provided included the following options. With no evidence of eye disease patient will return after one year for routine follow up care. Detected cases of cataract, glaucoma, diabetic retinopathy was referred to ophthalmologist. For suboptimal images, a repeat examination was recommended.

Data Source

The descriptive review was carried of the patients screened between November 2020 to August 2021 in Teleophthalmology project. Total 1,47,437 patients registered and screened during this period from 115 centers. All patients attending the community health center were included and given verbal consent for eye screening. Subjects who refused to give their consent and unclear fundus pictures due to media haze were excluded

Results:

Total 1,47,437 patients were screened out of which 88.2% are normal fundus,11.8% are other posterior segment abnormalities out of which includes 8.5% Cataract ,0.7% Diabetic Retinopathy,0.4% Hypertensive Retinopathy ,0.3% glaucoma and 0.1% Age Related Macular Degeneration.

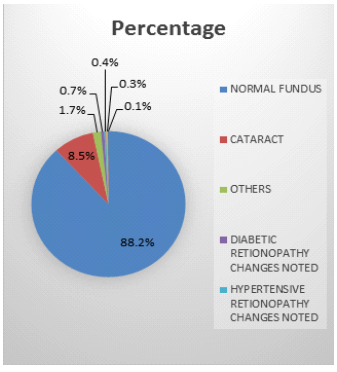

Figure 2: Fundus Screening analysis

The above chart shows leading causesof avoidable blindness and normal fundus which has been analysed in our study.

In our study, 4,614 eyes were eligible for final analysis. A total 1017 (44%) patients were diagnosed with diabetic retinopathy, 615(26.6%) patients with hypertensive retinopathy and 504(21.8%) patients with glaucoma and 171(7.4%) patients with age related macular degeneration. We found that macular diseases are most difficult to identify based on fundus photography due to lack of binocularity.The details of 11.8% (2307) cases details are provided below.

Table 1 Other posterior segment abnormalities

Diabetic Retinopathy					
Age	Male	Male (%)	Female	Female (%)	Total
20-29	1	0.16%	3	0.7%	4
30-39	22	3.7%	14	3.2%	36
40-49	217	36%	147	34.5%	364
50-59	291	49%	206	48.4%	497
60-69	53	8.9%	46	10.8%	99
70-79	7	1.18%	8	1.8%	15
80-89	0	0	1	0.23%	1
90-99	1	0.16%			1
Total	592	592	425	425	1017

Hypertension Retinopathy					
Age	Male	Male (%)	Female	Female (%)	Total
20-29	2	0.59%	0	0	2
30-39	7	2.08%	12	4.3%	19
40-49	125	37.2%	100	35.8%	225
50-59	164	48.8%	138	49.4%	302
60-69	30	8.9%	18	6.4%	48
70-79	8	2.3%	11	3.9%	19
Total	336	336	279	279	615
Glaucoma					
Age	Male	Male (%)	Female	Female (%)	Total
0-9			1	0.43%	1
10-19	1	0.36%	7	3.05%	8
20-29	7	2.5%	7	3.05%	14
30-39	24	8.7%	32	13.9%	56
40-49	125	45.4%	103	44.9%	228
50-59	97	35.2%	71	31%	168
60-69	18	6.5%	5	2.1%	23
70-79	2	0.7%	3	1.3%	5
80-89	1	0.36%			1
Total	275	275	229	229	504
ARMD					
Age	Male	Male (%)	Male	Female (%)	Grand
20-29	1	1.09%	1		1
30-39	5	5.5%	5	6.25%	10
40-49	31	34%	31	46%	68
50-59	38	41.7%	38	33.7%	65
60-69	12	13.1%	12	7.5%	18
70-79	4	4.4%	4	6.25%	9
Grand Total	91	91	91	80	171

The above table shows that cases of diabetic retinopathy is highest in the age group 50 to 59 years followed by 40 to 49 years and least in 80 to 89 age group. More common in males than in females. The case of hypertensive retinopathy is highest in the age group 50 to 59 years followed by 40 to 49 years and least in 20-29 age group. The patient flow was also high in 50 to 59 and 40 to 49 years age group. More common in males than in females.Cases of glaucoma is highest in the age group 40 to 49 years followed by 50 to 59 years and least in 10-19 years age group. Morecommon in males than in females. Cases of Age-related macular degeneration is highest in the age group 50 to 59 years followed by 40 to 49 years. And least in 70-79 age group as the number of patients of this age group visiting to the center were less. This can be attributed to their inability to visit vision center due to old age.

Discussion:

Teleophthalmology Projects in South India

In a screening done in rural South Indian population by telehealth facilities [20], diabetic retinopathy was detected in 19% of rural people with diabetes.In another study [17,21], 2.8% of patients were detected to have adnexal and orbital diseases by teleophthalmology. Similar Tele-ophthalmology projects like Madras Diabetic Research Foundation (MDRF), Chennai, Rural India Diabetes Prevention Project and Sankara Nethralaya Medical Research Foundation have identified similar cases in the projects. [1,16] Another example of application of technology in rural health care is the Aravind Teleophthalmology Network project. The Aravind Comprehensive Eye Survey Research Group Study [12,13] showed that the prevalence of diabetic retinopathy in rural South Indian population was 10.5%. Studies carried out between 2000 and 2001 by the Apollo Telemedicine Networking Foundation [14,15], were instrumental in ISRO including telemedicine as a major thrust area for the country.

In "Use of Telehealth Screening to Detect Diabetic Retinopathy and Other Ocular Findings in Primary Care Settings "study Overall, 9,946 diabetics participated in the WEH telehealth screening system. 15,180 eyes of 7,624 (76.7%) patients were eligible for final analysis. A total of 1,269 (16.6%) patients were noted to have DR changes in at least one eye. Other ocular findings included hypertensive retinopathy (709, 9.3%), increased or asymmetric cup-to-disc ratio (562, 7.4%), age-related cataract (379, 5.0%), In our study,total number of patients

screened were 1,47,437, out of which 88.2% are normal fundus,11.8% are other posterior segment abnormalities which include 8.5% Cataract ,0.7% Diabetic Retinopathy,0.4% Hypertensive Retinopathy ,0.3% glaucoma and 0.1% Age Related Macular Degeneration

The results from this study highlighted about the blindness caused by posterior segment disorders was at 11.8% which was similar to another study by Singh et al, at 11.6% conducted in tribal areas of Andhra Pradesh[19].

Posterior segment diseases can be diagnosed in early stages and can be prevented from progression by early treatment. This should limit disability, impairment or dependency and prevent more severe health problems developing in the future.

Teleconsultation has a significant role in the management of posterior segment conditions in bridging the gap between the patients and ophthalmologists in underserved zones. Posterior segment diseases can be diagnosed in early stages and can be prevented from progression by lifestyle modification and early treatment. [4,5] In our study we have observed that Diabetic retinopathy was highest in the age group between 50 -59 years and lowest in 20-29 age group. It is more common in males than females. Hypertensive retinopathy is higher in 50- 59 age group and lowest in 20 -29 age group and more common in males than in females. Glaucoma is highest in 40-49 age group and lowest in 10-19 age group,common in males than females. Age related macular degeneration is highest in 50 to 59 age group and more common in males than in females. Teleophthalmology enables optometrists to take ocular images and aid patients who have limited access to eye care. These images allow the ophthalmologiststo remotely make a diagnosis and do appropriate referral. Applications of teleophthalmology encompass access to eye specialists for patients in remote areas, ophthalmic disease screening, diagnosis and monitoring; as well as distant learning [22].

Tele-ophthalmology can also play an important role in the diagnosis and management of anterior segment, lid, and adnexa-related pathologies.

The virtual mode/technology helps in documentation of normal fundus (health check) vs abnormal fundus. It helps in detecting abnormalities and establishing a diagnosis which helps in taking decision [6].

Conclusion:

Especially in rural areas where there is no easy access for eye care services, technology like digital non- mydriatic fundus camera is instrumental in imaging the eye and sharing them through a digital platform to an ophthalmologist at a tertiary centerto provide eye care and referral if required [3].This instead reduces both patient and doctors travel time and is cost effective.

The optometrist or the ophthalmic assistant at the vision center is skilled to perform the preliminary examination including history taking, objective and subjective refraction and also captures fundus images which therefore reduces the ophthalmologist time in completing the consultation and finalizing the diagnosis, which indirectly increases number of consultations per day.

Looking at the findings we can conclude that the burden of ocular disorders is incredibly high in the community with the help of Teleophthalmology projects populationwith unidentified ocular disorders are being benefitted by early diagnosis and referral thereby preventing further progression of disease. Therefore, Government or private organizations shouldinitiate such projects in reducing burden of vision impairment in the community. This project illustrates the utility of Tele –ophthalmology for routine retinal screening for patients who have limited access to eye care services.

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