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Teleophthalmology:
A Case of Eye Care Delivery

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ABSTRACT

As a result of COVID-19, a new approach for delivering eye care services to rural underprivileged areas were needed to improve eye disease outcomes. Sitapur Eye Hospital used a door-to-door model of medical delivery to alleviate the inability of rural residents from not receiving appropriate eye care during the COVID-19 pandemic. Sitapur Eye Hospital utilizes a healthcare delivery model that involves visiting patients door-to-door. The total number of patients that Sitapur Eye Hospital examined went from screening no patients in the months of April and May to screening 31,017 patients via the door-to-door service that was implemented in June 2020. Sitapur Eye Hospital managed to keep the prevalence of people who had severe eye impairment at pre-pandemic levels by offering a door-to-door service to patients who were unable to access appropriate medical care. The door-to-door healthcare model shows that leveraging telehealth and ride-hailing services alleviate certain barriers that make it difficult for people in rural areas to access eye care.

KEYWORDS

COVID-19, Delivery, Eye Care, Mobile Health, Telemedicine

INTRODUCTION

Visual impairment is a widespread problem that affects nearly 2.2 billion people worldwide, with most cases being either preventable or curable (WHO, 2021). Cataracts and glaucoma are the leading causes of blindness, with 94 million cases of cataracts and 7.4 million cases of glaucoma being diagnosed by 2018 (WHO, 2021). A study based in India recorded 18.7 million cases of blindness in the year 2000 (Dandaona et al., n.d.). Of those 18.7 million cases, 9.5 million were related to cataracts alone (Dandaona et al., n.d.).

Sitapur Eye Hospital (SEH) recognizes that blindness may be the consequence of neglected eye care in underprivileged communities. A study using data from the Behavioral Risk Factor Surveillance System, showed that those with self-reported moderate to severe visual impairment were approximately

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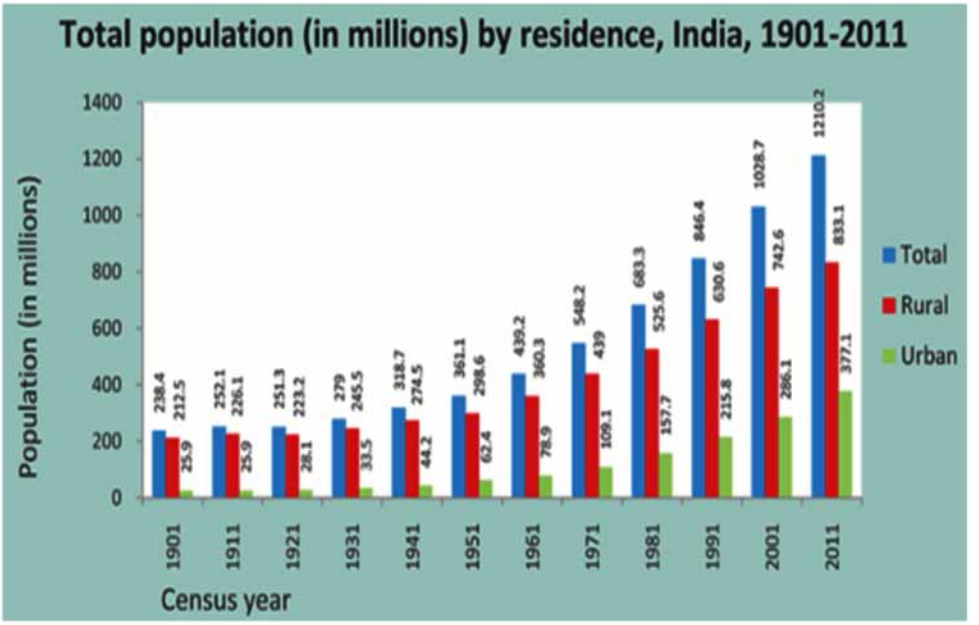
twice as likely to have a poorer health-related quality of life in comparison to people with no visual impairment (Crews, 2016). Vision impairment makes it more difficult to perform activities of daily living such as eating and dressing, as well as instrumental activities like shopping, driving, financial and medication management (National Academies of Sciences, 2016). It is important to treat any precursors to blindness, like cataracts and glaucoma, before it reaches an advanced stage.

A large subset of the Indian population resides in rural areas. 29% of the rural population is below India's official poverty line (Haub et al., 2010). The rural population of India stands at 833.1 million people in over 600,000 villages across the country, while the urban population stands at 377.1 million people (Chandramouli, 2011). Figure 1 illustrates the contrast between India's rural and urban populations from 1901 to 2011.

The financial burden due to blindness is also impactful and has the potential to leave individuals and their families in poor conditions. There is a certain level of dependency that comes with being blind. Blind individuals may not be as independent as they were before and may require additional help from family members or medical personnel. This may greatly impact the income- generating power of the entire family. A cost-of-illness study was performed that indicated that financial burden mainly resulted from indirect costs like deductibles, productivity loss, early retirement, and informal support/ care for relatives (Chuvarayan et al. 2019). A combination of informal support, medical devices, and loss of productivity accounted for 80% of blindness related costs in the study (Chuvarayan et al. 2019).

India has been described as a country of mass poverty (Mahapatra, 2021). The number of poor people with an income of $2 or less per day has increased by 75 million in a year due to the COVID-19 pandemic (Kochhar, 2021). Due to the constant demand to maintain their upkeep, people living in rural areas cannot afford to take a single day off work to receive medical care. This would reduce their income significantly and make them unable to support their family. Hospitals that provide quality services are too far away, with many rural residents having to travel more than 100km to reach their closest hospital (Singh, 2014). Transportation to and from these hospitals can be costly, while check-

Figure 1. India's rural and urban total population from 1901-2011 (Source: https://censusindia.gov.in/2011-prov-results/paper2/data_files/india/paper2_1.pdf)



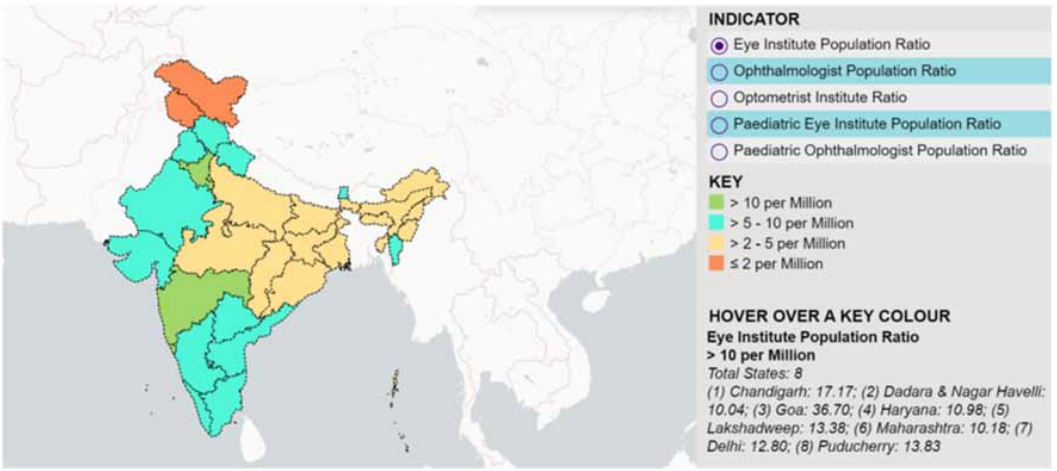
ups or surgeries can last for days at a time. This put working class individuals in a tough spot, often causing a decision between maintaining their health or providing food and shelter for their families.

Urban cities have natural advantages of providing a variety of healthcare services due to having greater financing mechanisms in comparison to rural areas (Banzon et al. 2020). The size of cities allows for economies of scale when compared to sparsely populated areas in India (Banzon et al. 2020). Healthcare expenditure in rural areas is greater because patients are more likely to pay money out of pocket, as well as having fewer providers practicing in the area (Georgetown University, 2019). This leads to rural residents not having the same access to effective healthcare opportunities like clean facilities, regular screenings, and prescriptions to improve eye care. These socioeconomic determinants of health make accessing proper medical care very difficult for individuals in rural India. Figure 2 is a map showing the disparities of eye facilities across India today.

The COVID-19 pandemic changed how many healthcare services were delivered due to the infectious and deathly nature of the virus. This prompted strict lockdowns and quarantines that greatly reduced the number of people being medically served, as patients could not travel or collect in large groups. A 14-hour curfew in India was put in place to decrease infection rates (Ghosh et al., 2020). This led to a decrease in mobility to grocery stores and pharmacies by 64.2%; travel to recreation and retail stores by 70.51%; transit to stations and parks by 65.6% and 46.17%, and travel to workplaces by 60.03% respectively (Ghosh et al., 2020). The pandemic also severely depleted the economic resources of an already financially struggling population, causing businesses to close and daily wage workers to lose their jobs (Joshi et al., 2020). Even more now is daily survival taking precedence over receiving visual health. The movement of physicians and supporting healthcare providers were reduced. They could not travel in groups and were required to help in hospitals that demanded more care. This called for an innovative model that would efficiently provide eye care for the rural population of India.

With COVID-19 creating barriers for in-person healthcare delivery, telemedicine became a popular outlet to continue healthcare management through the pandemic. Telemedicine can be defined as the use of medical information that is exchanged from one site to another using electronic communications aimed at improving a patient's health status (Kalavar et al., 2020). The utilization of telemedicine in Ophthalmology care was an innovative idea following the COVID-19 pandemic. Teleophthalmology is seen as a promising and innovative technology to modernize the existing eyecare facilities in India (Agarwal et al., 2021). Agarwal et al., article suggest countries to use a

Figure 2. Interactive map of eye care facilities across India (per million people) (Source: https://indiavisionatlasnpcb.aiims.edu/eye-care-indicator/)



Hybrid approach that involves merging teleophthalmology solutions into an existing multi-layer healthcare system (2021). A main goal of teleophthalmology is to help decrease the existing burden within India's healthcare system, which was extremely exacerbated during the COVID-19 pandemic. Telemedicine accompanied with mobile health delivery services, are two methods that can be used to improve eye care management among the rural population of India.

OBJECTIVE

This case study explores the question: How can mobile healthcare delivery and telehealth capabilities be applied to address the ophthalmological needs of rural India? The objective of this paper is to discuss the implementation of an innovative approach, that delivered eye care services to the doorsteps of people in rural India during the COVID-19 pandemic. Our goal is to review the current landscape of rural India and elaborate on a case study performed that draws insight on how to address the ophthalmological needs of this community; in addition to drawing insights on how technology can improve the ophthalmology needs of rural India. Outcomes of this study will be discussed to determine the effectiveness of a door-to-door model of delivering eye care screenings during the COVID-19 pandemic, and how telemedicine and Artificial Intelligence (AI) based technologies can play a major role in furthering efforts that deliver healthcare to rural India.

BACKGROUND

Mobile health delivery services in India date back to the late 1970s and 1980s. Tamil Nadu's central government showed massive success by kicking off the *Multipurpose Workers Scheme* in early 1980 (Muraleedharan et al., 2011). The goal was to provide every rural community, with a population of five thousand, with a trained health worker (village health nurse) to provide postnatal care, immunizations, contraception and other basic child and maternal health services during regular home visits (Muraleedharan et al., 2011). This effort had an immediate impact with how health services could be delivered in rural communities. In 1989, Dehli would follow suit by launching mobile health services through the distribution of twenty dispensaries across unauthorized colonies of migrant workers (Jamir et al., 2013). The health service team was comprised of medical officers, pharmacists, nurses, and other personnel to provide basic medical care, HIV/AIDS counseling, and health education programs to rural communities (Jamir et al., 2013). Today, there are over ninety dispensaries that cover the assembly constituencies, forty-five of which are run by Dehli Health Services, and the rest in collaboration with non-governmental organizations (NGOs) (Jamir et al., 2013). Literature shows how the delivery of eye care to the doorstep has been implemented before with the rural people of West Bangle, India. The *Sunderbans Eye Health Service Strengthening Project* began in 2013 to address the inequity in eye health experienced by the people of Sunderbans (Ahmed, 2016). Seventeen vision centers have been implemented to offer services for cataract detection, spectacle prescription distribution, and inpatient referrals (Ahmed, 2016). With the popular use of the vision centers, outreach camps have also been set up to reach more remote areas and focus on the needs of vulnerable populations like children, women and the disabled (Ahmed, 2016).

With the need of mobile health services in rural areas of India being evident, challenges with its adoption have been identified. These barriers lie overall within the rural communities of India when it comes to healthcare implementation. Studies have shown a lack of adequate knowledge among the population in many health areas (Kasthuri, 2018). Kasthuri reports on two studies showing only one-third of antenatal mothers having substantial knowledge on breastfeeding practices (2018). Kasthuri also touched on an article on geriatric mobility, showing 20.3% of its' participants being aware of common illnesses and prevention techniques (2018). These gaps in knowledge can be tied back to low prioritization of health in these populations and educational status (Kasthuri, 2018). A lack of access to healthcare is a main factor affecting the rural population in India (Kasthuri, 2018).

Kasthuri reports 'Physical reach' being one of the main determinants of access for rural communities (2018). A 2012 study in India found that only 68% of the rural population had access to outpatient facilities, and 37% were only able to access inpatient facilities in a 5km distance (Martinez, 2012). There are also challenges related to implementing teleophthalmology in most areas of India. It is important to develop standardized teleophthalmology solutions and operating procedures that are user-friendly, economical, and patient-friendly (Agarwal et al., 2021). This can occur more quickly with the support from central and state government bodies that develop smarter solutions that cater to the specific needs of rural locals (Agarwal et al., 2021). There is also a need for Ophthalmologists and residents to participate in special training and orientation that align them with the use of telemedicine technology (Agarwal et al., 2021). However, there is physician fear that lies in how accurate these platforms are, as well as a lack of a well-defined legal framework that pushes physicians away from teleophthalmology over fears of malpractice (Agarwal et al., 2021). Kalavar et al., cited the most common barriers to telemedicine include limited reimbursement, physician unfamiliarity with the technology, and a non-need to replace in-person care (2021).

As the adoption of mobile health delivery services has faced its' fair share of challenges, cases of implementation do exist, shedding light on both the pros and cons of its effectiveness on population health. Compos et al., reported how the creation of mobile health services provides healthcare to underprivilege populations who do not have the means or access to travel to inner city health institutions (2012). These services reduce barriers to access and build trusting relationships to improve health, reduce costs and disparities (Compos et al., 2012). Cheong performed a study in Singapore that showed advantages of mobile health services as stopping the advancement of additional costs and preventing further complications such as amputations (2015). There are studies that touch on the disadvantages with the delivery of mobile health services as well. Song's 2014 study showed a lack of evidence on the effectiveness of the clinical services being offered compared to other groups, the lack of presence of other health care institutions, and non-commitment in the funding of these services and mobile clinics from the government (2014). Dash's study on India also recognized disadvantages of these mobile services related to the lack of permanent staff, financial instability of the government, and lack of planning regarding regular monitoring of clinics (2011). However, this same study posed advantages of mobile health services for remote locations by increasing immunization coverage by 80%, along with a reduction in infant deaths (Dash, 2011).

METHODS

This section will describe SEH's approach to delivering eye care services in rural India. Pre and Post COVID-19 delivery methods will be analyzed.

Pre COVID-19 Operations

SEH, Sankara Netralaya, the Aravind Eye Hospital, and other not-for-profit hospitals are working towards the *National Programme for the Control of Blindness* in India to reduce the prevalence of blindness to 0.3% (DGHS.gov, 2017). Considering the resource deficit in rural regions and the COVID-19 pandemic, hospitals such as the SEH have innovated a process that provides eye care delivery service (eye screening and prescription services) at the doorstep. Cataract and other eye disease cases leading to blindness were diagnosed and sent to SEH for definitive eye care treatment/ surgery during the door-to-door visits.

SEH provided resources and continuing care to areas that most need it. The initial process of eye care consisted of registration, triaging, and a visual acuity test station to determine the need for cataract surgery. Determining the correct power for glasses and measuring intraocular pressure to assess risk of glaucoma were also performed. SEH conducted 426 eye camps from June 2019-April 2020, serving over 73,000 patients and providing fully subsidized glasses to over 14,000 patients.

Table 1 and Table 2 describe the number of cataract camps held and services performed by SEH from June 2019- May 2020.

Determining Location of Camps

SEH Trust provides eye care services for communities who lack appropriate access to eye care. These underprivileged regions lack awareness regarding available eye care services and knowledge on eye diseases. Before the COVID-19 pandemic took effect, SEH offered eye care services through outreach camps by connecting with volunteers and sponsors to get an accurate representation of the community. The outreach team collaborated closely with local community leaders such as the Panchayat bodies, and non-government organizations (NGOs) to assist with organizing said camps. The location of the camps is finalized through a mapping system. The camp sponsor is responsible for promoting the camps through word of mouth, posters, loudspeakers, and volunteers from nearby villages and remote areas. This ensures that the community is informed of the date and location of each camp. The space, furniture, and set up are also the responsibility of the sponsor.

As seen in Table 3, the range of publicity determines the number of expected patients who will attend the outreach camps. Figure 3 depicts a visual representation of patients from rural villages gathering in the outreach camps to receive eye care.

Figure 4 represents the pre-Covid eye care model where patients would travel from local rural villages to outreach camps. These patients would receive eye care services from SEH in a central location.

Table 1. SEH Cataract Camps and Services June 2019-December 2019 (Source: Sitapur Eye Hospital)

Month	Jun	Jul	Aug	Sep	Oct	Nov	Dec
No. of Camps	45	54	51	51	33	31	45
Opd	5,121	8,705	8,683	9,900	6,745	6,712	7,442
Surgery Advise	1,731	2,850	2,759	3,433	2,780	3,517	3,165
Admission	1,371	2,296	2,063	2,666	2,284	3,082	2,480
Surgery	1,163	1,853	1,754	2,375	2,006	2,796	2,223
Refractions	1,885	3,610	3,397	3,423	2,230	1,914	2,119
Glass Sale	1,158	2,149	2,039	2,035	1,283	1,033	1,297

Table 2. SEH Cataract Camps and Services January 2020-May 2020 (Source: Sitapur Eye Hospital)

Month	Jan	Feb	Mar	Apr	May
No. of Camps	8,069	9,457	2,609	0	0
Opd	3,743	4,531	1,166	0	0
Surgery Advise	3,026	3,455	893	0	0
Admission	2,692	3,074	801	0	0
Surgery	2,470	2,639	644	0	0
Refractions	1,542	1,626	404	0	0
Glass Sale	53	49	14	0	0

Table 3. Camp Size in relation to average radius of publicity and the volume of expected outpatients and inpatients

Camp Size	Small	Medium	Large	Very Large
Average Radius for publicity	5 Km	5-10 Km	10-15 Km	15-20 Km
Expected out patients	200-300	300-500	500-800	>800
Expected In-Patients	40-60	60-100	100-150	>150

Figure 3. Patients, relatives, and volunteers at a camp pre-pandemic

Staffing

SEH staffs between 10 to 12 personnel for each camp. These personnel are made up of clinical and non-clinical staff such as Ophthalmologists, Optometrists, Opticians, patient counselors, medical salespersons, camp organizers, and a driver. The number of staff deployed depends on how large the camps are. Figure 5 depicts the different personnel (clinical and nonclinical) traveling to each outreach camp and providing eye care services in one central location.

Operations

The outreach camps operate in a standardized manner. The workflow for each patient being screened is described in Figure 6.

Figure 4. SEH pre-Covid eye care delivery model

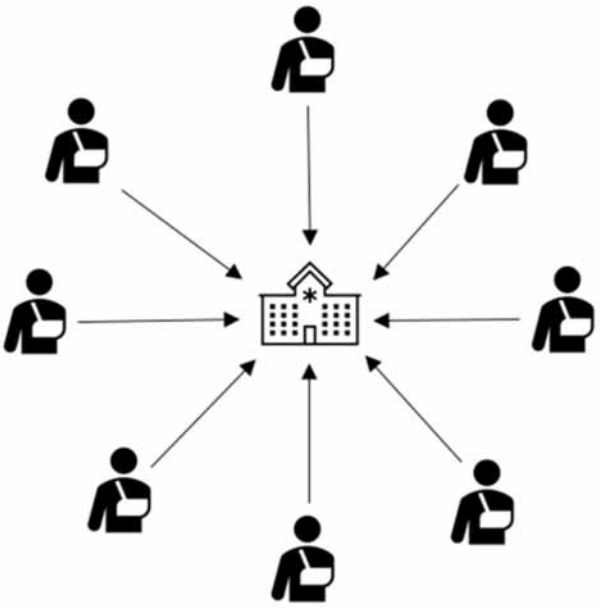


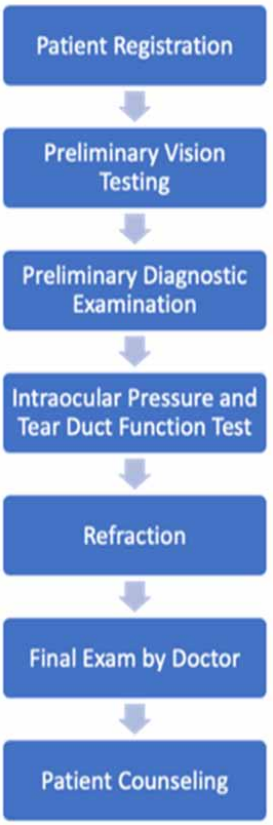
Figure 5. Pre-Covid staff flow for delivering eye care to patients

The outreach camps were designed to screen for many different common eye problems, but mainly focused on identifying cataracts. Minor eye ailments and refractive errors are treated at the campsite with medication or eyeglass prescriptions. For those who may need hospital admission, further attention and steps were taken.

Follow Up for Post-Outreach Camp

Patients who are diagnosed with cataracts are brought into the hospital for surgery at no cost. Those who are identified as having special needs or need admission from the campsite are transported by a bus to SEH for further treatment. All patients at the outreach camp have access to transportation facilities, door to door services, food, lodging, medicine, and eyeglasses. After treatment, transportation is also provided to patients to return them to their original campsite. A review and follow-up of treated patients is conducted at the base hospital 30 to 45 days post-op. Camp patients can report to the base hospital prior to the scheduled follow up in case of any issues emerge.

Figure 6. Operational workflow for patients seen at SEH camps



During COVID-19

Teleophthalmology has the potential to solve the problem COVID-19 created, by coming straight to the community and addressing the need at the core. People can receive adequate care without compromising their occupations and income. The COVID-19 pandemic made it difficult to setup outreach camps because crowding in small spaces was prohibited. The mobile door-to-door model allowed healthcare workers at SEH to reach regions in India's population that were more secluded. SEH were able to diagnose and treat patients cost effectively while preserving time spent providing care.

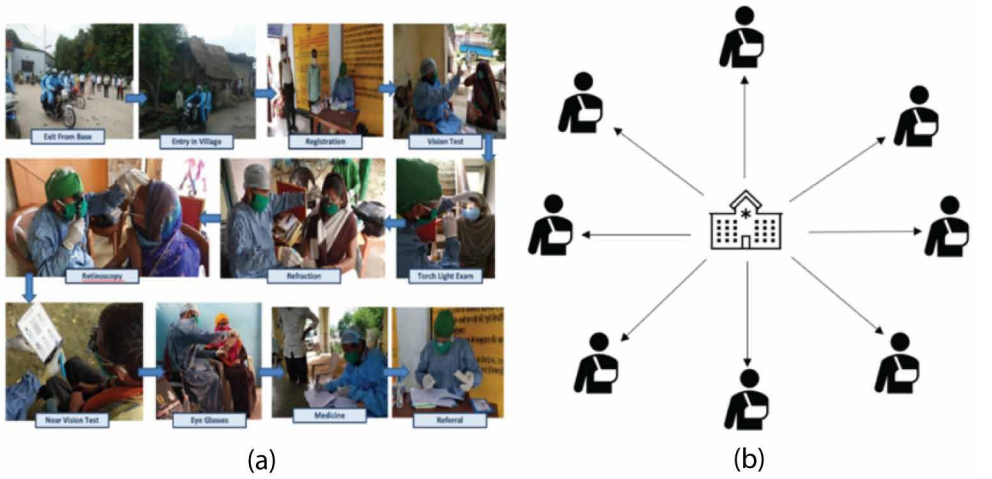
SEH modeled their redesigned teleophthalmology program as a Uber-like eye care service, which was true in the literal sense of the word, by being an exceptional out of the box type of eye care delivery method akin to the actual commercial car service of the same name. This teleophthalmology model provided care to the end user at his or her residence.

Location

COVID-19 did not allow for the original outreach camp operations model to continue, as patients or health care personnel were not allowed to gather in a place other than a hospital. The new model was a form of door-to-door screenings that modelled food delivery services, such as UberEATS, was initiated in June of 2020.

Figure 7a gives a representation of actual patients receiving screenings and care within their own homes during the COVID-19 pandemic. Figure 7b shows how personnel were taking eye care from the outreach camps and traveling to individual patient's homes during the COVID-19 pandemic.

Figure 7. (a) Patients in India receiving eye care through door-to-door service; (b) SEH post-Covid eye care delivery model



Staffing

Six teams were created, each consisting of two people executing the door-to-door eye care service. The team included one clinical staff member, an Optometrist, and one non-clinical member operating as the Camp Organizer. Although the teams consisted of experienced and well-trained ophthalmic community eye care personnel, they did not have experience working through a global pandemic. For the safety of staff and patients, SEH trained the teams on COVID-19 protocols, mask and glove sizing, hand hygiene, and how to properly don and remove personal protective equipment (PPE). Figure 8 depicts the post-Covid staffing workflow previously described for SEH's door-to-door eye care services.

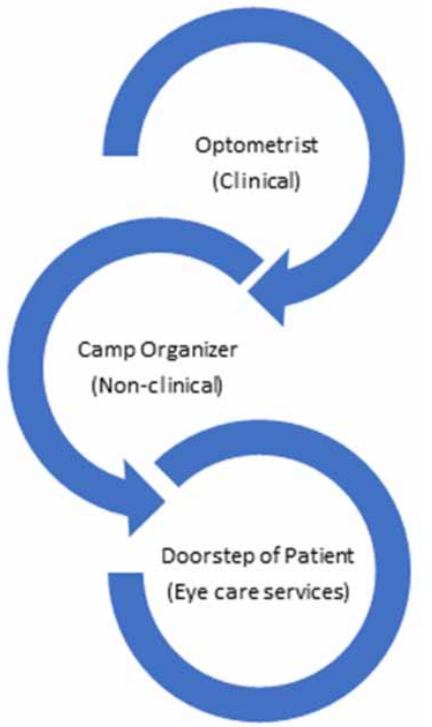
Operations

While on the ground, the team worked 5 hours in a pre-designated area. There was one allotted off day during the week, accounting for 25 to 26 working days per month. The door-to-door technique consisted of the co-coordinator and volunteer co-coordinator traveling to residents and sharing information about eye screening for their village. There was also a *Duggi System* in place where volunteers would play a traditional drumbeat to inform the villagers about the eye-checkups. SEH chose nearby locations in the early stages of implementing the model so that the safety of staff and patients was ensured. Hence traveling to areas with a high risk of COVID-19 infection was restricted at that time. As the risk of infection began to show decline, the area of work increased, allowing for more eye screenings. The Optometrist set their equipment at a prominent place in the village where all patients could come and get their eye screening. Each day, approximately 45 patients were screened free of cost, while the medicine and eyeglasses were available at subsidized rates. The price of eyeglasses was dependent upon the income of the patient. This created a sense of dignity for the client as they were able to pay for their own healthcare. Each screening took about ten minutes and the patients with advanced cataracts or with urgent needs like glaucoma required surgery. Patients were given a satisfaction survey after the screening process, which was important in gaining success and support in continuing the model.

Follow Up Post Outreach Camp

The patients who required surgery or treatment were referred to the base hospital in Sitapur for further investigation. Due to the COVID-19 pandemic, SEH was only maintaining the data of referral patients

Figure 8. Post-Covid staffing flow for delivering eye care



and referring only emergency cases to the hospital. Once COVID-19 restrictions were lifted, SEH was able to call all treated patients back to the base hospital for follow-up. There was also a survey that could be completed by patients to assess their satisfaction with this process.

OUTCOMES

Costs

Throughout the pandemic, costs increased from the pre-pandemic rates due to the addition of PPE. Most of the partners with SEH provided the hospital with basic equipment such as alcohol swabs, while most of the materials like PPE were provided by the hospital. Patients over 50 years old who were identified and diagnosed during active screening were covered under the National Program for Control of Blindness (NPCB). Other patients who were willing to undergo treatment and surgeries had the opportunity to avail subsidized/paid facilities also. SEH did not receive any grants for this program and did not have any surplus of money left over. The hospital had to submit the surgical data of the patients via the online portal of NPCB to claim any surgical subsidies.

Results

Before COVID-19, the outreach camps were the sole method of conducting eye screenings for large groups of people. From June 2019 to April 2020, 426 camps were conducted in multiple locations around Sitapur. At each of the pre-COVID camps, around 180 people were examined with around 33% being diagnosed with a visual impairment. During the pandemic, groups of people were not allowed to congregate, causing operations to switch to door-to-door screenings. No patients were seen in April 2020 and May 2020. In June 2020, the innovation of delivering eye care at the doorstep led

to patients being able to be screened again. With more accessibility and the same number of staff, more door-to-door screenings could be conducted when compared to the previous outreach camps (see Table 4). The team was able to examine 60 to 65 people per day through the door-to-door screening method. As seen in Table 4, the number of door-to-door screenings conducted compared to screening camps increased from 426 to 645. However, the number of people examined through the door-to-door method dropped drastically from 73,443 people to 31,107 during the pandemic. The percentage yield of patients suffering from severe impairment requiring intervention and referral remained close at 35.7% during pandemic versus 40.4% pre-pandemic. As a corollary of fewer patients examined, fewer eyeglasses were distributed from 14,566 (19.8%) pre-pandemic, to 5082 (16.38%) during the pandemic. Table 4 depicts the comparison of particulars from Pre/Post-COVID in relation to the door-to-door delivery care model being implemented in June 2020.

DISCUSSION

The implementation of door-to-door screenings and utilizing a two-person mobile team proved to be very effective in providing vital eye care to people living in distant villages with limited resources. This was also seen to be effective through the unique situation that the COVID-19 pandemic presented. The mobile camps were extremely successful in being able to reach many people during a time when people were too afraid to leave their homes in fear of contracting the COVID-19 virus. SEH was fully operational and provided care to patients who were able to make it to the hospital from surrounding areas. The mobile camps offered additional services to those who were not able to travel far to receive treatment. They were able to diagnose and treat rural residents in a cost-effective and efficient manner. This model of eye camps ended up being an excellent modern eye care delivery service providing care and services to the doorstep of the patient. By coming straight to the community and addressing the need at the core, the people who required help were able to receive aid, as well as guidance on how to continue receiving proper eye care in the future. The mobile teams' use of two wheelers to go door-to-door was very effective, and the yield of patients diagnosed with severe eye disease that required surgical treatment were close to pre-pandemic ranges.

However, with the success of the mobile heaths service, the two wheelers used did present a few challenges. The two wheelers were hindered when it came to transporting heavy and large ophthalmologic equipment to sites as they do not have large carriers. Despite this setback, SEH was still able to help several people in need. For future services, larger vehicles like ambulances or vans can be repurposed to hold larger equipment, as well as having more personnel travel to provide eye care services. The larger vehicles would also be able to travel farther distances than the two wheelers can, helping more regions around rural India. Utilization of these mobile operation vehicles will

Table 4. SEH outreaches between pre and post COVID-19 Pandemic

S.No.	Particulars	June 2019 - April 2020 (Before)	June 2020 – April 2021 (After)
1	No. of Camps/D2D Conducted	426	645
2	No. of people examined	73443	31017
3	No. of people refracted	24331	9634
4	No. of people dispensed subsidized spectacles	14566	5082
5	No. of people referred to Base hospital from D2D	29675	11082

allow for easier patient access and the delivery of larger ophthalmological equipment. Even though more camps were conducted using the door-to-door method, there were still less people screened and examined because of limited ability to travel far to access more people. To provide care to the same number of patients as before the Covid-19 pandemic, more personnel would need to be hired. This would also require donations of ambulances or other vans to transport the personnel to more remote areas. The trips that staff take from door to door can be very tiring physically and mentally. Increasing staff to accommodate a larger number of patients would greatly improve the effectiveness of the door-to-door model.

As mobile health delivery services continue to leverage healthcare across rural areas in India, it is important to consider how technology can be integrated to better improve these services. mHealth has become a hot topic in the management and delivery of healthcare, as the use of mobile devices for healthcare services (Gopalakrishnan, 2020). Community Health Workers (CHW) play a crucial role in the connection between health systems and communities they serve by improving access to health services (Gopalakrishnan, 2020). Digital health tools are now being designed to assist many of these CHW with decision support, access to information and work planning (Gopalakrishnan, 2020). mHealth initiatives are increasingly being evaluated to improve care in India (Bassi, 2018). However, mHealth adoption is only being seen in a few states, with almost complete exclusion of underserved areas in the north-eastern regions, Jammu, and Kashir (Bassi, 2018). It is particularly important to test technological solutions, like mHealth, in underserved areas that would benefit the most from its' capabilities (Bassi, 2018). Rural health services can be improved by providing health personnel with technology that will allow an ease of information transfer and access to eye care data. An example can be seen in rural India with Sankara Nethralaya (SN), where comprehensive eye exams are being performed. SN is a tertiary eye care center in south India that has provided comprehension eye care to the rural population for three decades (John et al., 2012). SN partnered with the Indian Space Research Organization in 2003, leading to a mobile teleophthalmology unit being designed (John et al., 2012). Technology was used to take external photographs of pupils via a digital camera and converted them into digital imaging for transfer to the base hospital by a satellite link or real-time video conferencing (John et al., 2012). This created a means of real-time communication between the optometrist and the on-base ophthalmologist regarding a patient's eye care (John et al., 2012). Google has also made advancements by using A.I based technology to assist in diagnosing diabetic retinopathy for patients in rural India. With the aid of ophthalmologists from Sankara Nethralaya and Aravind in labeling retina images, an A.I model was created to identify key markers of diabetic retinopathy: nerve tissue damage, swelling, and hemorrhaging (Google, n.d.). It was close to 100 ophthalmologists having rendered more than 1 million grades for the AI model, leading to the development of an actual Automated Retinal Disease Assessment (ARDA) device (Google, n.d.). More studies and clinical trials are underway to have this device FDA approved and implemented in clinical settings within India (Google, n.d.). The use an AI model to assist with diabetic retinopathy diagnosing is another technological tool that combines mobile health services with technology, to improve the outcomes in diagnosed with eye disorders and receiving the proper eye care.

CONCLUSION

Currently, there are few studies available on eye care delivery services performed during the COVID-19 pandemic, that has led to success within rural India as seen with Sitapur Eye Hospital. Being able to expand their methods on a larger scale would be extremely helpful in decreasing the incidence of blindness across the globe. Other governmental agencies or non-profit organizations could adopt the same approach as that of SEH to assist rural populations in receiving proper healthcare. This approach can be expanded and modified to create more access to general healthcare services and create more opportunities for education and prevention tools. The practicality of teleophthalmology could prove to be extremely beneficial as this is a viable option that should be explored further and

scaled in future projects, as technology efforts continue to be implemented into eye care delivery services. The benefit of this type of door-to-door delivery of healthcare has the potential of providing preventative healthcare that could lead to exponential health benefits in modern medicine. Rural areas that are subject to healthcare disparities can benefit from not only mobile eye care delivery, but other methods that implement technology like mHealth and AI. The ability to bring healthcare services to the doorstep improves healthcare delivery for those who are less privileged or privy to available healthcare services. Future research on this form of healthcare delivery should be performed and expanded to include telemedicine capabilities to reach rural residents in India. The case study performed at SEH can identify aspects that worked and didn't work for future related work, as efforts are being moved to include more technological and telemedicine capabilities.

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CONFLICT OF INTEREST STATEMENT

We have no conflict of interest with any external entities.

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