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Comparison of eyecare utilization at two service delivery levels during the COVID-19 pandemic as a measure of their impact: A multicentric retrospective analysis across four North Indian high-volume eyecare organizations

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Purpose: The purpose of this study was to assess the performance of the tertiary centers (TCS) and vision centers (VCs) of the four organizations participating in this research, once the lockdown was lifted, and to compare it with the performance during the same period of the previous year. **Methods:** This was a cross-sectional study assessing eyecare utilization in the first 2 months after resumption of services post the lockdown in 2020 and comparing that across the same time period in 2019. Anonymized data containing basic demographic details, proportions of patient visits and their reasons, as well as referral information was collected. The drop percentage method was used, and *P* values were calculated using paired *t*-tests. **Results:** Four TCs and 60 VCs were included. Overall, outpatient attendance dipped 51.2% at TCs and 27.5% at VCs, across the 2 years. At both levels of care delivery, the percentage drop in females was more than that in males; however, the overall drop at VCs was less than that at TCs, for both sexes. Eyecare utilization in pediatric populations dropped significantly more than in adult populations, across the overall sample. There was no significant change in referrals for refractive error as a proportion of total outpatients, although there was a significant decline in the same for cataract and specialty treatment. **Conclusion:** VCs are valuable and successful model for eyecare delivery especially in the continued aftermath of the COVID-19 pandemic.

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The World Health Organization declared the expeditious spread of the COVID-19 virus a pandemic.[1] Similar to the rest of the world,[2] the Indian government ordered a complete lockdown on March 24, 2020 for a period of 3 weeks, with restrictions on daily life in accordance with the guidelines issued by the World Health Organization.[3,4] These restrictions have since been lifted in a phased manner, colloquially termed as "unlock,"[5,6] based on key public health reports.[7]

Globally, the aforementioned lockdown has adversely affected the medical care provisioned to and/or utilized by indisposed people, especially chronically ill patients in both developed[8] and developing countries.[9] A similar negative effect has also been reported in India.[10-12] Factors such as fear of catching the virus, limited transport/travel, and unavailability of services have been reported as barriers.[12]

In eyecare, decreased utilization of services was reported by ophthalmologists[13] and optometrists,[14] across the country. Barriers to eyecare utilization have been reported on extensively in pre-COVID-19 settings and can largely be classified as personal (lack of perceived need, fear, distance/travel, awareness, fatalism, lack of escort), economic (lack of money, opportunity costs, affordability), social (other obligations, not the primary decision maker, stigma, hearsay regarding services),[15,16] and service related (cost/affordability, accessibility).[17] These barriers were exacerbated during the lockdown.

In India, most high-volume eyecare organizations provisioning services to the community, function on the pyramidal model of care delivery.[18] Majority of the PEC in India is dispensed through outreach camps and vision centers (VCs).[18] The latter are fixed facilities in rural or urban-slum areas offering refraction, recognition, referrals to

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those needing further care,[19] as well as offering treatment for basic eye conditions.[18,20] They refer patients needing surgery or evaluation by ophthalmologists trained in subspecialities. Camps are transient screening activities held in the community, identifying patients in need for eyecare and transporting them to the base hospital to undergo free surgery. Although outreach camps were stopped during the lockdown and the subsequent period,[21] VCs, secondary centers (SCs), and tertiary centers (TCs) continued to function.

The Bodhya Eye Consortium (BEC) was formed in 2018 as a collaboration between six high-volume eye organizations. The BEC provides a platform through which these organizations conduct research, share knowledge on how to expand service capacity, and improve clinical services. Pooling data from these high-volume organizations provides stronger evidence for strategies needed to improve service delivery. Patients directly referred from VCs contribute only a small proportion of total patients seen at the TCs of these organizations, while direct walk-in patients constitute the majority.

The purpose of this study was to assess the performance of the TCs and VCs of the BEC member organizations, after the lifting of the lockdown, and to compare it with the performance during the same period of the previous year, to avoid the impact of other local factors such as seasonal variation. Previously, a South African study has reported minimal variation in healthcare utilization at primary care level in rural areas before and after the lockdown,[22] and similarly in India a south Indian study has reported on the impact of the aforementioned lockdown on their eyecare network being least at the primary level.[23] However, no previous literature is available comparing the utilization of different levels of eyecare delivery modes from north India. Taking these results into account, we hypothesize that as VCs serve a catchment population within proximity, disruptions due to the lockdown would have been minimal.

Methods

Study design, study period, and sampling

This is a cross-sectional study assessing eyecare service utilization in the first 2 months of resumption of services after the lockdown was lifted in 2020 and comparing it with eyecare utilization during the same time period in 2019. Since the four BEC member organizations participating in this study are spread across north India [Fig. 1], the lifting of restrictions varied. Thus, the study period is defined as the immediate time period after the lifting of restrictions, to maintain uniformity. The start of 2 months of data collection, post lockdown, was within 15 days of each other for the centers, ranging between June 1, 2020, and June 15, 2020.

The study was conducted at two levels of pyramidal eyecare delivery[18]: VCs and tertiary hospitals. All patients accessing services at these two levels of care delivery were included in the analysis.

Inclusion–exclusion criteria

BEC organizations which provided services through their tertiary hospitals and VCs during both times (pre-COVID-19 lockdown and COVID-19 lockdown time) were included in the study. Organizations not meeting the inclusion criteria or not having either of the two modes of care delivery were excluded from the study.

Data collection

Anonymized raw data was collected by the lead investigator from each organization in electronic spreadsheets. Basic demographic data, patient visits, reason for visit, and patient referral information were collected.

Statistical analysis

To compare the drop in total outpatients in tertiary and vision centers, the drop percentage method was used as the test statistic. *P* values were calculated by permutation tests based on one million simulations. Comparison of pediatric versus adult and male versus female at VCs was conducted through paired *t*-tests. Statistical analysis was done using R version 4.0.5. A *P* value less than 0.05 was considered significant. MapChart was used to generate maps.[24]

Ethical review

The study was approved by the individual Ethics Committees and/or Institutional Review Boards of all four participating organizations (IRB/2020/Oct/62, SNC/PO/202-114, CLGEI-38/2021, and EC/OA/04/2021) and followed the tenets set in the Declaration of Helsinki. All identifiable data were anonymized, and no individual data were shared between the organizations or disclosed during the analysis process.

Results

Four TCs and 60 VCs were included in the study [Table 1]. The average outpatient department (OPD) attendance, as given in Table 2 (for a 2-month period), dipped 51.2% (38–61%) at the TCs as compared to 27.5% (15–46%) at the VCs. The average number of male patients dropped 48.5% (34–61%) at the TCs against 24.1% (13–42%) at the VCs. The average number of female patients slipped 54.7% (43–62%) and 30.7% (18–49%) at TCs and VCs, respectively. The dip in average OPD attendance at the VCs was significantly smaller for the total sample, and males and females, separately. A similar pattern of significance was found at each partner organization.

Percentage drop in the below 18 years age group was significantly higher than the same in the over 18 age group in three organizations as well as in the total sample [Table 3]. The percentage drop in the above 18 years age group was

Table 1: Number of centers for each level of care across each organization and those meeting the inclusion–exclusion criteria of the study [Original]

Level of Care	Organization	Number in Organization	Included in Study
Tertiary Center	A	1	1
	B	1	1
	C	1	1
	D	1	1
	Total	4	4
Vision Center	A	44	15
	B	9	9
	C	17	8
	D	55	28
	Total	125	60

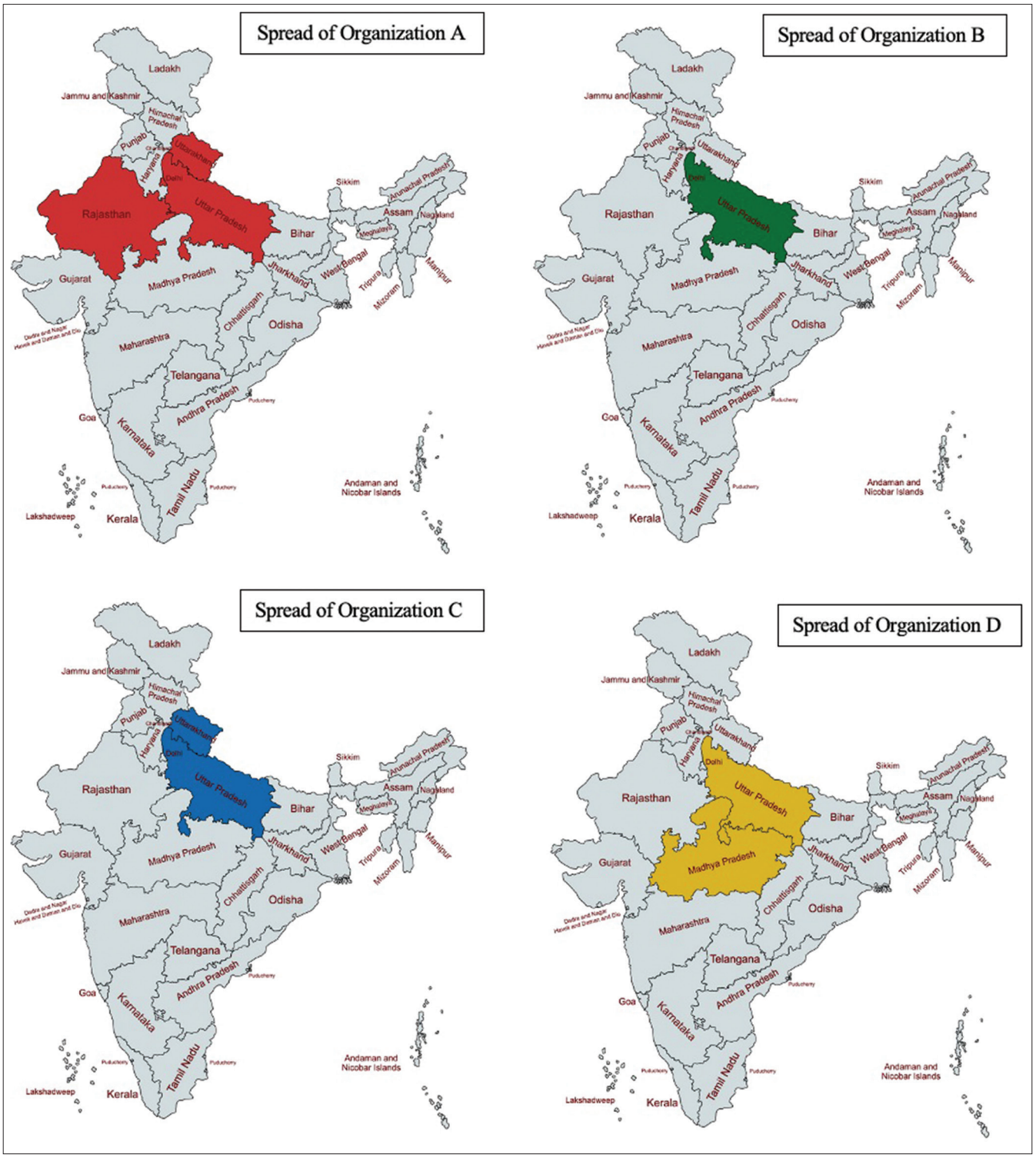

Figure 1: Spread of the BEC organizations participating in the study [Original]

higher only in one organization, which was also found to be significant. Drops in the percentage of below 18 age-group OPD patients did not change significantly across genders in the total sample or any of the organizations.

The number of patients diagnosed with refractive error expressed as a percentage of total outpatients did not change significantly. However, referrals for cataract surgery and other speciality treatment dropped significantly. Disaggregated data of patients reporting at VCs requiring refractive error correction were not available for one organization (organization B) and disaggregated data of patients referred for cataract and specialty were not available from two organizations (organizations B and D). Change in the percentage of patients diagnosed with or referred for cataract surgery or requiring a speciality intervention according to the vision technician was significantly

Table 2: Average outpatient department attendance per center in 2 months, segregated by gender. [Original]

Level of Care	Organization	*n*	2019			2020			Change		
			Total	Male	Female	Total	Male	Female	Total	Male	Female
Tertiary Level	A	1	26188	14368	11820	10127	5638	4489	-61.3%	-60.8%	-62.0%
	B	1	12775	7080	5695	7112	4395	2717	-44.3%	-37.9%	-52.3%
	C	1	25522	14005	11517	15774	9210	6564	-38.2%	-34.2%	-43.0%
	D	1	43766	25075	18691	19788	11919	7869	-54.8%	-52.5%	-57.9%
	Total	4	27063	15132	11931	13200	7791	5410	-51.2%	-48.5%	-54.7%
VC Level	A	15	578	274	304	314	159	155	-45.6%	-41.9%	-49.0%
	B	8	256	121	135	172	87	85	-32.8%	-28.2%	-37.0%
	C	9	827	409	418	592	310	282	-28.4%	-24.3%	-32.5%
	D	28	508	245	263	431	214	217	-15.2%	-12.7%	-17.5%
	Total	60	540	261	279	391	198	194	-27.5%	-24.1%	-30.7%
P (Permutation test, 1 m simulated permutations) [Comparing percentage drop between the tertiary level and VC level]									0.024	0.031	0.021

Table 3: Percentage drop in below 18 and above 18 age-group OPD patients at the vision centers. [Original]

Organization	Total			Male			Female		
	Below 18	Above 18	*P*	Below 18	Above 18	*P*	Below 18	Above 18	*P*
A	-56.5%	-44.0%	0.000	-51.7%	-40.3%	0.000	-61.4%	-47.3%	0.000
B	-19.9%	-35.2%	0.002	-22.4%	-29.3%	0.004	-17.8%	-40.6%	0.001
C	-34.4%	-27.2%	0.000	-35.3%	-26.8%	0.000	-33.4%	-27.5%	0.001
D	-39.2%	-10.6%	0.000	-41.7%	-6.5%	0.000	-36.3%	-14.3%	0.000
Total	-40.6%	-25.1%	0.000	-41.1%	-21.8%	0.000	-40.1%	-28.1%	0.000

P-values are from paired t-test

Table 4: Comparison of number of patients requiring refractive error correction and cataract surgery and speciality referrals as a percentage of total vision center outpatients across 2019 and 2020. [Original]

Organization	Refractive Error					Cataract and Other Speciality Referrals				
	Number of Patients		Percentage of OPD		*P*	Number of Patients		Percentage of OPD		*P*
	2019	2020	2019	2020		2019	2020	2019	2020	
A	155	77	26.8%	24.4%	0.663	97	57	16.8%	18.2%	0.695
B	-	-	-	-	-	-	-	-	-	-
C	214	118	25.8%	19.9%	0.1877	613	292	74.1%	49.3%	0.009
D	277	269	54.5%	62.3%	0.1688	-	-	-	-	-
Total	231	187	42.8%	47.8%	0.5332	290	145	53.8%	37.1%	0.033

lower for one organization, while at the other there was a marginal increase which was found to be statistically insignificant [Table 4].

Discussion

Overall, utilization of OPD services fared better at VCs as compared to TCs for all study organizations, with a similar trend across both genders. At the VC level, utilization of services for adults was significantly more than that for the pediatric population. Within the adults accessing services at the VCs, males accessed services more than females. The proportion of total OPD patients with refractive error did not change significantly during the pandemic at VCs overall, although referrals for cataract surgery and other speciality treatments reduced significantly.

Within the pyramidal model of eyecare delivery, VCs cater to populations close to 50,000,[18] are mainly located in rural areas and in urban slums, and have also been proven to be a cost-effective option for patients when compared to larger hospitals.[25] Khanna *et al.*[26] collate their importance, highlighting on-the spot service provision, completing the loop of care for the community by providing linkages to hospitals, affordability, accessibility, continuum of care, and community engagement and development. In our study, the overall decrease in service utilization at VCs was almost half that at tertiary hospitals. Thus, despite the pandemic and the lockdown, we see a lot of patients continuing to access care at the VCs, a fact which can be attributed to their easy access and deep-rooted presence in the community, helping overcome barriers such as distance, ceasing of public transport during

the pandemic, cost of treatment, and fear. Similar results were seen in the study pertaining to south India.[23]

Despite this, the decrease in attendance, at both tertiary and VC levels, was more for females as compared to males, overall, as well as at individual centers. The south Indian study reports a similarly decreasing trend in eyecare utilization by females at the tertiary center level; however, the percentage decrease is less than that reported in our study and similar calculations have not been performed for VCs or for males.[23] Existing research highlights the gender discrimination faced by females in access to healthcare, which can be attributed to the disproportionately large burden of household and farm work borne by them due to intrahousehold gender disparities,[27] leaving little time for personal chores and self-care. Such situations exist over and above previously reported barriers—increasing distance from clinics and hospitals, residence in rural areas, and females having little autonomy over their own actions. However, although the referenced literature and the results of this study are pertaining to north Indian populations, they are in direct contrast to those reported in a study comparing the utilization of eyecare services across different pyramidal levels by gender in north India, where more females than males accessed services at both VCs and larger hospitals.[20] However, the VCs in the referenced literature were located purely in the urban-slum areas.

Our study also observes that the overall decrease in eyecare utilization at VCs was significantly less for the above 18 age group, as it was for the below 18 age group ($P = 0.000$). Barriers to pediatric (under 18) health and eyecare access have been reported on extensively before the pandemic hit, encompassing social beliefs such as god's will, caregivers' inability to identify their health needs, poor availability, financial factors such as cost of services and opportunity costs, as well as the demographic profile and health-seeking behavior of caregivers.[28,29] However, while research regarding the impact of the pandemic and its' aftermath on eyecare for children is limited, with no information regarding the same being reported in the south Indian study either, considerable research has highlighted the impact of the situation on children and their health in general,[30,31] with declines in the use of essential developmental services such as immunizations,[32] antibiotics for pneumonia, treatment for malnutrition,[33] or even emergency care.[34]

During the first wave of the pandemic in India, while children were not in the medical high-risk category,[35] awareness regarding the same and the possible effect on their health in the upcoming waves was unknown, which may have led to fear becoming a major barrier to their access of health and eyecare. Further, we see that the overall utilization of eyecare by adults did decrease, especially females, which in turn decreases the utilization by children, who are dependent on adults. Eye problems faced by children may have also gone unnoticed and those that were noticed may not have been considered emergent enough to be dealt with. The overall trend of decrease in the access of eyecare services by the under 18 population at VCs is also seen at the VCs of organizations A, C, and D, although the opposite trend was seen for organization B. A reason for this reverse trend could be that since a project targeting children was in place at their VCs prior to the lockdown, reporting might have increased post lockdown for children previously referred and not provided services due to the lockdown or new children accessing services. This study is the first, to the best of our knowledge, to do an age-group analysis of the impact of the COVID-19 pandemic on care provision by VCs and their expanding role in eyecare provision, especially in the pandemic and its continued aftermath, when eye camps and school screening activities were completely halted.

The overall percentage of OPD patients at VCs requiring refractive error correction remained similar in 2020 after the lockdown. Refractive error is the leading cause of avoidable visual impairment and second leading cause of blindness,[36] which affects a population of 275.6 million people worldwide[37] but can easily be "detected through routine examination of patients who present to clinics, or through vision screening of the population at large." Refractive error, when detected in time, can be corrected easily either through spectacles, contact lenses, or refractive surgery. The targeted delivery of eyecare at VCs includes refraction and dispersion of spectacles—a cost-effective way to treat uncorrected refractive error.[38] Thus, VCs contribute extensively to decreasing the burden of uncorrected refractive error at the primary level itself, reducing economic and distance related barriers to eyecare utilization for patients. This was especially obvious during the lockdown and immediately after it; when restrictions in transport and travel bans were in place across the country, VCs provided easy access to both detection and treatment of refractive error at a single and nearby point of contact for the patients, as well as addressed their fear of extended travel, numerous trips, and hence potential exposure to the virus. This trend also highlights the backlog of need for refractive error correction in the catchment area of the organization due to the lockdown leading to an insignificant increase of patients once the restrictions were eased.

Despite cataract being the leading cause of blindness and the second leading cause of visual impairment in the world, affecting over 94 million people worldwide,[36] the overall proportion of patients requiring referrals for cataract surgery or other speciality care from VCs decreased significantly over the 2 years. While VCs act as the first point of care in terms of recognition for diseases requiring such interventions, they provide referrals to the nearest SCs or TCs within the organization for treatment for the same. Thus, the need for or anticipation of numerous trips to further off centers, exposure to larger populations and extensive procedures or surgery intensified barriers to eyecare access, such as cost of travel, opportunity cost, distance, and fear of exposure to the virus. A similar trend of significant decrease in utilization of cataract and speciality referrals was seen at center C as well, contrary to the trend seen at center A.

A limitation of this study would be that only the data of four high-volume organizations limited to north India was analyzed. Further, as the pandemic situation continued despite the lockdown being lifted, movement was limited. However, this study fills an important gap in literature by providing information regarding the trends in utilization of eyecare services at four high-volume eye networks spread across north India, with established networks in the community, hitherto unreported in literature.

Conclusion

This study highlights the importance of vision centres, as fixed facilities, which act as the first point of contact with the eyecare and even the healthcare system for many people, due to their deep roots in rural and urban-slum areas where other health facilities may not be present, or when present may be limited. The need for primary care and consequently primary eyecare stems from the Declaration of Alma Ata and the Sustainable Development Goals (SDGs).[39-40] Their easy accessibility and the one-stop-shop availability of basic treatment facilities, establishes them as a successful model, reducing barriers to access of eyecare, targeting underserved populations and thus contributing significantly to the provision of Universal Eye Health, and thus Universal Health Coverage.

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Conflicts of interest

There are no conflicts of interest.

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