Project *Vayoraksha*: Implementation of novel mHealth technology for healthcare delivery during COVID-19 in geriatric population of Kerala

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Background & objectives: mHealth technologies, with their potential in improving public health, have recently gained considerable interest in India, offering an opportunity to deliver tailored and low cost interventions to the selected populations, especially in resource-poor settings. Project *Vayoraksha* aimed at developing and pilot testing mHealth technology-assisted strategies (*Vayoraksha* mobile application and field *Vayoraksha* network) to improve healthcare delivery and reverse quarantine at the field level among the geriatric population.

Methods: This field operational research study was implemented in Pathanamthitta, Kerala, from October 2020 to July 2021. The *Vayoraksha* mobile phone application for the geriatric users and a web interface used by healthcare workers involved in the field *Vayoraksha* network was developed with multisectoral expertise. *Vayoraksha* had facilities for symptom surveillance, teleconsultation and assessment of needs and included a community-based system to monitor and meet their needs that can help in reverse quarantine of the geriatric population.

Results: The project was implemented using the field *Vayoraksha* campaign involving frontline health workers and community volunteers. A baseline survey of 4782 geriatric population in the study area was conducted in Phase I, and 2383 (49.8%) had access to a smartphone facility to use *Vayoraksha*. Of these, 1257 (52.7%) were covered under the 'field *Vayoraksha* campaign' using intersectoral coordination and community participation. A total of 750 (59.6%) geriatric individuals downloaded the application of whom, 452 (60.3%) used the services of *Vayoraksha.* Needs were registered by 56 (12.3%) individuals of which 46 (82.1%) were medical needs related to the management of chronic diseases. More than 70 per cent of the needs were met through the *Vayoraksha* field network under the local primary health centre. More than 80 per cent of the geriatric individuals reported symptoms related to COVID-19 during the intervention period. Compliance with quarantine was observed in 77.7 per cent of the geriatric populations. Among those who used *Vayoraksha*, 26 (5.7%) availed tele-counselling services, and 3 (0.6%) used teleconsultation facilities. It was observed that *Vayoraksha* users had a higher proportion of the geriatric population who were young, educated, having chronic morbidity and living with family. Regular symptom surveillance was done within this group; only 12 (2.6%) of them tested positive for COVID-19 during this study.

Interpretation & conclusions: **Results of this pilot study are promising, with 60 per cent of the geriatric population downloading and using *Vayoraksha* within a short time. Technology-assisted interventions can supplement the existing system for improved healthcare delivery among the vulnerable groups and have good potential for scale-up in the near future in developing countries.**

The COVID-19 pandemic resulted in a global health crisis which has profoundly impacted individual lives across the globe, including India[1]. With the first reported case of COVID-19 being from Kerala, India in January 2020, several strategies were implemented for the prevention and control of COVID-19 in this State. Studies have shown that people in older age groups with comorbidities are at a higher risk of severe disease and mortality due to COVID-19. According to the last census done in 2011[2], the geriatric population (≥60 yr) in India was 8.6 per cent, which was projected to go over 10 per cent by 2020, and Kerala State houses the maximum proportion of the geriatric population in the country[2-4]. This poses a greater challenge to the government given the significant resources that were required for protecting this vulnerable group during the pandemic[5,6]. The situation was expected to be worse after the lockdown when the international and State borders were opened. A large number of non-resident Keralites were returning to Kerala, which was one of the factors associated with a spurt in the number of cases in the State. One of the strategies proposed to protect the geriatric population and those with comorbidities in this context was the implementation of reverse quarantine in the field[7]. Reverse quarantine typically keeps vulnerable individuals from the rest of the population, thereby reducing the chance of infection[7,8]. However, it was challenging to implement this in the community during the pandemic; therefore, novel unique strategies for successfully implementing reverse quarantine were crucial.

The mHealth technologies are thought to have considerable potential in improving public health and have shown improving health outcomes in India[9,10]. These technologies provide an opportunity for delivery of tailored interventions to the population at low cost, especially in resource-poor settings. A recent trial used a web-based application as a job aid to frontline workers in the community to improve maternal, neonatal and child care services among the tribal population in Gujarat[9,10]. Similarly, another study explored the effect of mHealth voice message services among women from low-income backgrounds and showed a positive impact on maternal health outcomes[11]. Although a few studies are currently exploring the effectiveness of mHealth-based interventions, there is no published literature on implementing similar interventions among the geriatric population during COVID-19 from India. Kerala State set an exemplary model initially with the lowest mortality and highest recovery rate compared to many other States. Pathanamthitta district of Central Kerala was one of the initial cities impacted by the COVID-19 outbreak in our country. Given that the State's biggest concentration of elderly people resided in this district, numerous innovative measures, such as mapping of vulnerable populations that involved a powerful local self-government and health system, were carried out. In this context, Project *Vayoraksha* was conceptualized to develop novel cost-effective mHealth technology-assisted strategies to improve healthcare delivery and implement reverse quarantine effectively and to pilot this at the field level in the Pathanamthitta district in the context of the COVID-19 pandemic.

Material & Methods

This pilot project was a field operational research study done in collaboration with the district COVID-19 control team, Pathanamthitta, Kerala, for improved healthcare delivery among the geriatric population from October 2020 to July 2021 after procuring the Institutional Ethics approval. A participant information sheet was given in the local language, and informed consent was taken from all the participants.

The study was conducted in two phases. The initial Phase I included ward-wise enumeration of the geriatric population (≥60 yr) by field-level workers with data on accessibility to smartphone facilities (either their phone or a phone belonging to a family member) and development of the *Vayoraksha* application. A multisectoral project team, which included representatives from various departments such as District Administration, Health, Information

Technology, Engineering, Local Self-Government (LSG), National Health Mission (NHM), Social Justice Department and co-ordinators of all field-level workers was formed, and intersectoral meetings were conducted along with training sessions. The study area selected was Pathanamthitta Municipality for this pilot project.

Field-level workers such as Anganwadi workers (AWW) and Accredited Social Health Activists (ASHAs) were the nodal persons at the division level to coordinate activities related to the geriatric population. Trained counsellors under the NHM were also mobilized to monitor the planned activities. Baseline data were incorporated into the application using a unique identification number for anyone ≥60 yr.

Phase II included the implementation of *Vayoraksha* on a pilot basis. Project *Vayoraksha* included two components, the *Vayoraksha* mobile application and the field *Vayoraksha* network. The first step was the development of mHealth technology, a mobile phone application that can be used by the geriatric population and a web interface used by healthcare workers involved in the field *Vayoraksha* network. Tutorial videos on using the application and the process flow with benefits were prepared.

Process flow in Vayoraksha: *Vayoraksha* includes a participant-facing Android mobile application (to be downloaded and used by participants) and a web portal to generate reports and enable inter-departmental co-ordination for service delivery. Once downloaded and installed, the participants could log onto the application using the unique identification number. Once the backend server verified the ID, participants could use the mobile application. All data related to the project were stored in a cloud-based system with encryption. Data were secured by login credentials and accessible only to the investigators. No public web interface was provided to the study participants. Each participant could log onto the portal using their registered mobile phone numbers through an OTP generated on a real-time basis. Once the participant logged into the application, he/she was provided access only to their information which was input voluntarily by the study participant after an informed consent process. The Health Department and Local Self-Government Department (LSGD) were provided access only to the information that would enable them to meet the needs of the study participants. Officials of the health department could view only the participant's name, address, phone number and reported symptom or health need to facilitate fulfilment of the need. Similarly, officials of the LSGD could view only the participant's name, address, phone number and reported non-medical need to facilitate fulfilment of the need. Login credentials were provided for users from the health department and LSG to prevent unauthorized access of data. The mobile application provided a facility for daily symptom monitoring (to monitor symptoms compatible with COVID-19) based on a self-administered questionnaire and requests for any medical or non-medical needs to be fulfilled. It also provides relevant information on COVID-19, daily updates from District COVID-19 Cell and phone numbers of services (*e.g.*, home delivery of household provisions and emergency transportation) (Fig. 1).

Data entered by participants (symptom status and medical/non-medical needs) were assessed through the web portal by designated district-level officers. Depending on the symptom status and self-reported needs, the information was communicated to relevant stakeholders at the field level (local body level) for necessary action. Anganwadi workers coordinated with ASHAs, primary health centres (PHCs) field teams and LSG to ensure that the various needs of participants were met.

Monitoring of symptoms and quarantine status: Daily monitoring of symptoms compatible with COVID-19 of the geriatric population and quarantine status of the geriatric population was collected. Urban PHC, Pathanamthitta, was catering to the medical needs and symptom surveillance of the population. Persons who reported symptoms compatible with COVID-19 diagnosis were mobilized for COVID-19 testing as per State government protocols. Participants self-reported this using a web form available in the mobile application. The mobile application prompted participants to report symptom status daily. In addition to self-reporting by the geriatric population, a random check for the quarantine status in a sample of the geriatric population was conducted by staff involved in the field *Vayoraksha* network. Reasons for the quarantine break were explored, and appropriate actions were taken to reduce the quarantine breaks.

Facilities to report medical and non-medical needs: These facilities were provided in the Android application and web portal of the coordinators of the field *Vayoraksha* network. The needs were sorted, and appropriate actions like home delivery of drugs by field-level workers, (Junior Health Inspector/ASHAs/
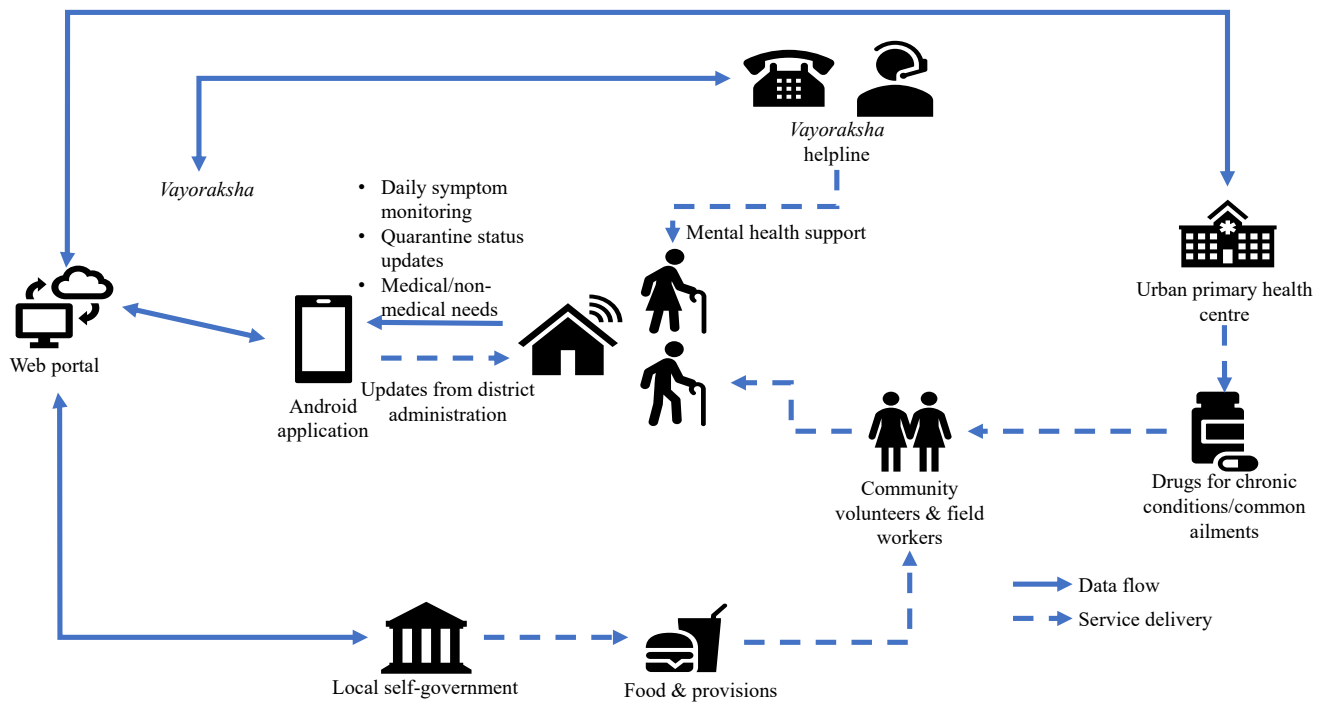
Fig. 1. Process flow in the field *Vayoraksha* network.

AWWs) were undertaken. LSG were catering to the non-medical needs of the population. Those unable to meet food requirements were provided food through community kitchens and budget hotels run by the local body. One coordinator was assigned to monitor and ensure the smooth functioning of the project.

Results

Development of the Vayoraksha application: *Vayoraksha* was designed to help improve healthcare delivery and in an effort to promote self-quarantine among the most vulnerable sections of the population. *Vayoraksha* was designed as a novel IT-based solution to integrate care provision for the geriatric population and ensure doorstep service delivery. *Vayoraksha* portal interfaced with LSGs, district administration and health department to meet the felt needs of the persons enrolled. These included, but not limited to, healthcare follow up for chronic illnesses, provisions for home, food supply, purchase and doorstep delivery of medicines. The services/facilities incorporated into the *Vayoraksha* application are shown in the Box.

Implementation of project Vayoraksha:

Strategies used: Being a pilot study undertaken in a selected area, a wide publicity exercise could not be

Box: Details of the services incorporated into *Vayoraksha* application

1. Symptomatic surveillance to assess the presence of symptoms similar to COVID-19

2. Needs assessment of the population (medical and non-medical needs)

3. Information regarding nearby services, including medical and non-medical services

4. Daily updates from the District Administration/Health Department about the COVID-19 situation in the district

5. Provision for meeting the needs of participants through field *Vayoraksha* network and access to services of trained counsellors

6. Assessment of quarantine status of geriatric population

7. Geriatric helpline number

COVID-19, coronavirus disease 2019

undertaken. At the same time, details of the project had to be communicated to the target population in sufficient detail. Using the trial and error method, a few strategies were deployed in the field

Strategy 1: One-to-one communication through phone: Considering the COVID-19 situation and to minimize the risk of contact with the target population, the initial strategy was to call the geriatric population who had
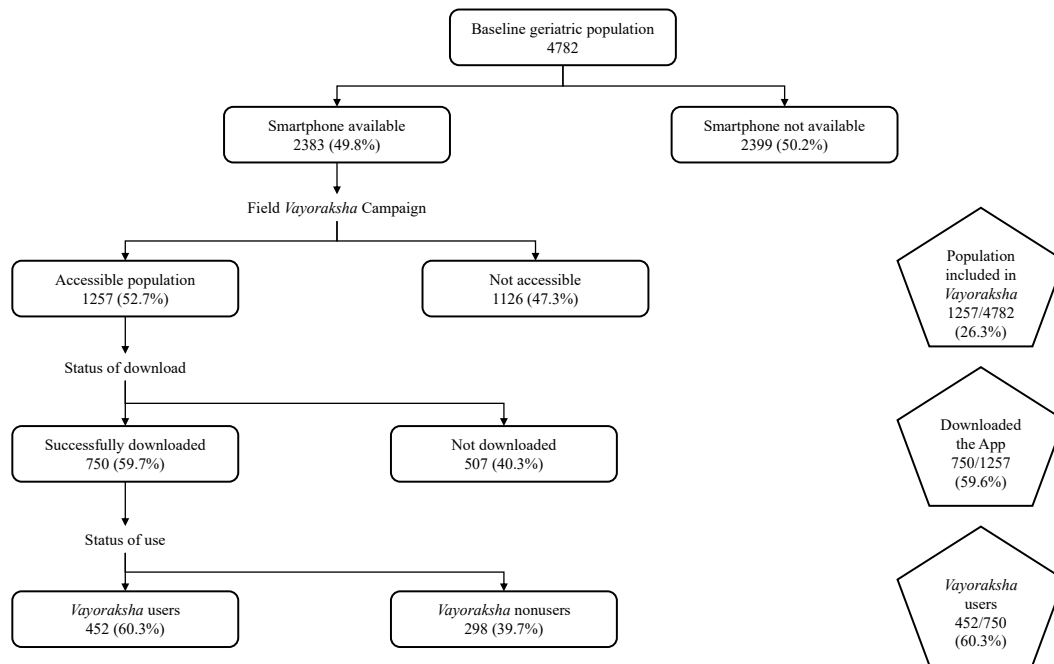
Fig. 2. Details of the geriatric population covered in different phases of project *Vayoraksha.*

access to a smartphone facility to sensitize them on the project and the benefits of using *Vayoraksha.* Tutorial videos on application usage were sent to the users through social media.

Strategy 2: One-to-one communication (interpersonal communication) in the community with the help of a multisectoral team – field Vayoraksha campaign: As many challenges were encountered with the initial strategy and had suboptimal results, we launched a 'field *Vayoraksha* campaign'. As the project involved a technology-related intervention, young college students more familiar with technology were mobilized from the COVID-19 volunteer group of the district administration, trained and sent to the selected community along with field workers. To address the trust issues about the project, a participant information letter on *Vayoraksha*, explaining the project and its benefits to participants, was prepared in the local language (Malayalam), authorized by the district collector and disseminated in the community. Two volunteers accompanied two field workers to cover the target population in each of the 32 wards in the Pathanamthitta Municipality area.

Other strategies used: Anyone in the family with a facility for installing and using the *Vayoraksha* mobile application on behalf of a geriatric person in his/her household was included to improve the feasibility of implementation. Volunteers were recruited to monitor the project at the community level.

District helpline number for psychological support: Psychological support was provided by trained counsellors of the NHM in association with a professional organization of psychologists under the technical supervision of the Nodal Officer of the District Mental Health Programme. These services were integrated with the geriatric helpline. The whole process was integrated and monitored using the mHealth technology.

A total of 4782 geriatric individuals from 32 wards were included in the baseline survey. Of these 2383 (49.8%) had access to smartphone facilities. Nearly 50 per cent of the eligible participants were covered in the field *Vayoraksha* campaign. Details regarding the pattern of use and user statistics in Project *Vayoraksha* are shown in Figure 2.

Details of beneficiaries of project Vayoraksha: A total of 750 geriatric individuals downloaded the *Vayoraksha* mobile application. Nearly 60 per cent of this population used the services of *Vayoraksha.* A comparison of sociodemographic variables based on the use pattern of *Vayoraksha* is shown in Table I. Users of *Vayoraksha* comprised a higher proportion

Table I. Comparison of sociodemographic details based on the pattern of the use of *Vayoraksha*

Variables	*Vayoraksha* users (n=452), n (%)	*Vayoraksha* non-users (n=298), n (%)
Age groups (yr)		
60–69	243 (53.8)	147 (49.3)
70–79	142 (31.4)	108 (36.2)
≥80	67 (14.8)	43 (14.4)
Gender		
Male	250 (55.3)	180 (60.4)
Female	202 (44.7)	118 (39.6)
Educational status		
Uneducated	26 (5.8)	15 (5)
≤10th standard	330 (73.1)	235 (78.9)
>10th standard	96 (21.2)	48 (16.1)
Possession of a ration card		
APL	340 (75.2)	225 (75.5)
BPL	112 (24.8)	73 (24.5)
Marital status		
Currently married	270 (59.7)	171 (57.4)
Widow/widower	177 (39.2)	121 (40.6)
Others	5 (1.1)	6 (2)
Geriatric population availing social security schemes	377 (83.4)	242 (81.2)
Geriatric population living with family	435 (96.2)	277 (93)
Presence of chronic morbidity	309 (68.4)	195 (65.4)
APL, above poverty line; BPL, below poverty line		

of young, completed high school education, having chronic morbidity and the geriatric individuals living with family. Among those who used *Vayoraksha*, >80 per cent reported symptoms related to COVID-19 (Table II). The common symptoms reported were loss of taste and smell. However, only 65 (14.3%) of these fulfilled the WHO criteria for a suspected case of COVID-19 (Table II). A majority of the participants suffered from chronic diseases, and medications for chronic diseases were the most common medical need registered by users. Non-medical needs included the purchase of essential grocery items and supply of meals which community kitchen/budget hotels provided. Nearly 75 per cent of the needs were addressed through the field *Vayoraksha* network. However, a few needs registered, such as doctor's consultation at home, requests for a particular brand of medications for chronic diseases and requests for non-essential commodities were not addressed. More than 75 per cent of the geriatric population followed compliance to quarantine.

Discussion

This study describes developing and implementing a novel mHealth-assisted strategy – Project *Vayoraksha* among the geriatric population in a community setting in Kerala. This is one of the few studies that explored mHealth in improving healthcare delivery in India, and to the best of our knowledge, the only study conducted among the geriatric population during COVID-19 from Kerala. The ubiquitous nature of mHealth enables the opportunity to augment healthcare service delivery to all, especially vulnerable groups such as the geriatric population[12,13]. According to the WHO reports, the proportion of the world's population >60 yr is to expectedly double between 2015 and 2050[14]. More than 80 per cent of these will be in developing nations like India[14]. These demographic changes call for new strategies involving technology to remould these nations into digitally empowered populations. The results of this study show that nearly 60 per cent of the geriatric population used services of Project *Vayoraksha*, which aided in the decentralization of

Table II. Distribution of the study population based on the use of *Vayoraksha* services

Variables	n (%)
Geriatric population who have registered needs in *Vayoraksha*	56 (12.3)
Type of need	
Medical	46 (82.1)
Non-medical	9 (16.1)
Both	1 (1.8)
Primary medical needs identified (numbers not mutually exclusive)	
Medications for chronic diseases	34 (7.5)
Medical consultations at home	6 (1.3)
Other medications (Vitamin supplements and painkillers)	15 (3.3)
Geriatric individuals who have reported having followed quarantine in the intervention period	351 (77.7)
Quarantine break	101 (22.3)
Reasons for quarantine break identified (numbers not mutually exclusive)	
Purchase of medications of particular brands	64 (14.1)
Visit friends and relatives	12 (2.6)
Attend family functions	6 (1.3)
Others	47 (10.3)
Geriatric individuals who reported symptoms (numbers not mutually exclusive)	
Geriatric individuals who reported symptoms	392 (86.7)
A suspected case of COVID-19	65 (14.4)
Fever	27 (6)
Cough	43 (9.5)
Breathing difficulty	35 (7.7)
Sore throat	11 (2.4)
Headache	25 (5.5)
Loss of smell	363 (80.3)
Loss of taste	387 (85.6)
Geriatric individuals who availed counselling services	26 (5.7)
Geriatric individuals who availed teleconsultation facility	3 (0.6)
Geriatric individuals who became COVID positive during the intervention period	12 (2.7)

activities, near real-time monitoring of symptoms, needs, coordination, effective management of resources and delivery of health services without the barrier of proximity in the context of the pandemic.

Existing literature has also highlighted the efficient role of digital tools and mHealth applications in assisting older people with independent living[15]. Evidence from recent systematic reviews suggest that mHealth interventions can improve health behaviours such as healthy eating, physical activity, and medication adherence and is a potential tool for disease prevention among the geriatric population[16,17]. However, the uptake of mobile phone technology among the geriatric population from developing countries is low compared to developed countries[6,18,19]. At this stage of understanding, we speculate that the significantly higher uptake of the *Vayoraksha* project in this maiden attempt was primarily due to the early involvement of local stakeholders, participatory management and quick adaptation to field-level challenges. Project implementation was aided by the involvement of frontline healthcare providers in the field *Vayoraksha* network and the mobilization of young community volunteers. Participation of the District Health department, the district administration and LSG was a crucial element in the swift and effective implementation of COVID-19 control

activities in the district. A similar project done in 2019 involved frontline workers in improving maternal and child outcomes using mobile phones and web-based applications among the tribal population in India[10]. In contrast to the study mentioned above, where the intervention is mHealth application enabled by community workers, project *Vayoraksha* was a direct participant-centred application, making it unique.

Adapting technology considering the characteristics of end users helps in improving the acceptability of the intervention. It was noticed in this study that the geriatric population <70 yr, currently married and those with higher educational status were more receptive to technology-based intervention, which ties well with the existing literature[6,12,18,19]. The geriatric population staying with their family members was found to use *Vayoraksha* as per other study findings. Constant motivation and support from family members to learn and use technology could be the reason for compliance with the intervention. Family support, especially from young grandchildren, emerged as a significant factor in the uptake of technology-based interventions in a recent study done among the geriatric population in the United States, which supports this finding[20]. A higher proportion of the geriatric population with chronic morbidity was observed among users of this application. The use of digital tools has proven to be effective in monitoring the geriatric population with chronic morbidity and multiple needs. In this study, more than 80 per cent of the needs reported were medical, especially medications for chronic diseases, which aligns with the available literature. Technology-based interventions provide autonomy-preserving tools to the geriatric population for monitoring and managing disease conditions[21,22].

In this study, more than 75 per cent of *Vayoraksha* users reported compliance with reverse quarantine, which was higher than the 61 per cent reported in the existing literature[8]. Owing to the potential limitation of this being a pilot study, widespread awareness could not be given to project *Vayoraksha*, which might have had less than expected awareness regarding the benefits. Furthermore, the short implementation period, owing to the pilot nature of the project, was inadequate for a community-based, technology-related project. There was no reliable or feasible mechanism to capture information on reverse quarantine among non-*Vayoraksha* users to make comparisons.

This study implies that it can facilitate policymakers and healthcare workers to improve health outcomes using technology-based interventions and can also act as a model to be followed in similar settings. Even though just a few field techniques were unsuccessful, even those examples can be used to plan future technology-based community interventions. When integrated into programmes like National Programme for Prevention and Control of Non-Communicable Diseases or National Programme for Health Care of the Elderly with the help of community-based healthcare workers, a comprehensive platform like *Vayoraksha* can significantly improve healthcare delivery among the vulnerable populations, even beyond pandemics.

Although the results of this pilot study are promising, with 60 per cent of the geriatric population downloading and using *Vayoraksha* within a short time, considering the low technology penetration among the geriatric population in a developing country setting and the challenges identified in this study, this technology cannot fully replace the existing system but can aid the health service delivery during pandemic situations.

Overall, the cost-effectiveness of mHealth-based interventions among different population groups could be explored. Technology-related projects have great scope for further development and application to a larger population if implemented using strategies tailored to the population's needs.

Conflict of interest: None.

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