Strategies and challenges in Kerala’s response to the initial phase of COVID-19 pandemic: a qualitative descriptive study

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ABSTRACT

Objective To understand the structures and strategies that helped Kerala in fighting the COVID-19 pandemic, the challenges faced by the state and how it was tackled.

Design Qualitative descriptive study using focus group discussions and in-depth interviews.

Setting State of Kerala, India.

Participants 29 participants: four focus group discussions and eight in-depth interviews. Participants were chosen purposively based on their involvement in decision-making and implementation of COVID-19 control activities, from the department of health and family welfare, police, revenue, local self-government and community-based organisations. Districts, panchayats (local bodies) and primary health centres (PHCs) were selected based on epidemiological features of the area like the intensity of disease transmission and preventive/containment activities carried out in that particular area to capture the wide range of activities undertaken in the state.

Results The study identified five major themes that can inform best practices viz social capital, robust public health system, participation and volunteerism, health system preparedness, and challenges. This study was a real-time exploration of the intricacies of COVID-19 management in a low/middle-income country and the model can serve as an example for other states and nations to emulate or adjust accordingly.

Conclusion The study shows the impact of synergy of these themes towards more effective solutions; however, further research is much needed in examining the relationship between these factors and their relevance in policy decisions.

INTRODUCTION

When COVID-19 grew into a pandemic of extraordinary magnitude, several countries started following different strategies to contain and mitigate the spread. The unprecedented nature of the virus has contracted the economy of the world and there is a divergence in opinion on strategies adopted by different nations in handling the pandemic.1 Kerala, the southernmost state of India, reported its first confirmed case of COVID-19 on 30 January 2020.2 Amid the persistent vulnerabilities of high population density (860/km2),3 the high proportion of old age populations (12.6% of the total population)4 and a large number of expatriates,5 the state showed slow progression of cases, reporting zero new cases by the beginning of May 2020.6 While the case fatality rate reached around 7% globally and 4% nationally in the month of May, Kerala could maintain a low fatality of less than 1%.7 8 The state’s efficient handling of the initial phase of the pandemic received global appreciation.9 10

As the COVID-19 pandemic is raging across the world, the responses and collective actions galvanising solidarity across nations
are making the pandemic a social phenomenon. Qualitative methods help in understanding the social responses and the gaps between the assumptions and realities as well as why certain interventions work and others fail.\textsuperscript{11} It can play a pivotal role in understanding the socio-political and management approach to control epidemics like COVID-19, especially to narrate and put forward effective solutions and strategies that could be used by other communities.\textsuperscript{12} This demands a study on the intricacies of COVID-19 control to fill the lacunae put forth by various literature. The study aimed to understand the structures and strategies that helped Kerala in fighting the COVID-19 pandemic. The study also explored the challenges faced by the state and how they were tackled.

**METHODOLOGY**

This qualitative research was undertaken in Kerala spanning from May to August 2020. To understand the way in which the state and district level decision makers zeroed down to several combinations of measures and how people could cope-up with the decisions of the government, the paradigm used for the study was advocacy and participatory. We used a descriptive approach for the study and conducted in-depth interviews and focus group discussions. Participants were chosen purposively based on their involvement in decision-making and implementation of COVID-19 control activities. For a comprehensive understanding of the phenomenon, the researchers attempted a triangulation of data sources and the participants were chosen from the department of health and family welfare, the police, revenue, local self-government (LSGD) and community-based organisations. Districts, panchayats (local bodies) and primary health centres (PHCs) were selected based on epidemiological characteristics of the area like the intensity of disease transmission and preventive/containment activities carried out in that particular area to capture the wide range of activities undertaken in the state. Four focus group discussions and eight in-depth interviews were conducted (table 1).

The investigators who were well trained in qualitative research contacted each participant over the phone and the study objective was informed and willingness enquired. The researchers had no personal relationship with the participants. The only presupposition in the study was social capital and a good public health system would have helped the state in handling the initial phase of the COVID-19 pandemic. Once verbal consent was obtained, the date, time and place were fixed according to the convenience of the interviewee. In the case of interviews using online platforms, informed consent was emailed and interviews were conducted at a time convenient for the interviewee. Every participant was informed about the freedom to refuse the invitation or to withdraw from the study at any point of time. Among the focus group discussions conducted, one was conducted at a PHC maintaining social distancing and taking adequate precautions, the other three were conducted over an online platform. The time duration for focus group discussions was 1–1.5 hours. An in-depth interview with a member of the state medical board was conducted at the author’s institute, and IDI3 with health inspector-1 was conducted at the PHC. The remaining in-depth interviews were conducted via an online platform. IDIs lasted for 45 min to 1 hour. The interviews were done with a topic guide (table 2) and were participant-led. Discussions and interviews were conducted maintaining confidentiality after obtaining informed consent and were audio-recorded. At the end of each interview, the researchers summarised the information to the participants, to determine the accuracy. The recordings were transcribed and translated to English. Thematic analysis using a hybrid coding process was the approach followed. Data were coded using Nvivo and were rigorously reviewed and categorised. The emerging patterns, themes and relationships were identified. Consensus on emerging themes was reached through regular discussion among the researchers. Direct quotes were used wherever possible. Findings were shared with all the participants through email, allowing them to critically analyse and review their comments. The study has been reported in accordance with the Standards for Reporting Qualitative Research guidelines.\textsuperscript{13}

**Table 1** List of focus group discussions and in-depth interviews

<table>
<thead>
<tr>
<th>Focus group discussion</th>
<th>In-depth interview</th>
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<tbody>
<tr>
<td>FGD1 State COVID-19 expert committee members (SCE1–SCE7)</td>
<td>IDI1 State medical board member</td>
</tr>
<tr>
<td>FGD2 District programme managers and district officials (DPM1–DPM4, DO1–DO3)</td>
<td>IDI2 State police official</td>
</tr>
<tr>
<td>FGD3 Police officers of rank SI and CI (PF1–PF6)</td>
<td>IDI3 Health inspector 1</td>
</tr>
<tr>
<td>FGD4 Health staffs—3, junior health inspectors (JHI1–JHI3), junior public health nurses (JPHN1–JPHN4)</td>
<td>IDI4 Health inspector 2</td>
</tr>
<tr>
<td>FGD5 Local self-government people’s representative (municipality)</td>
<td>IDI5 Local self-government people’s representative (village panchayat)</td>
</tr>
<tr>
<td>FGD6 Local self-government people’s representative (village panchayat)</td>
<td>IDI6 Local self-government people’s representative (municipality)</td>
</tr>
<tr>
<td>FGD7 State-level public health expert</td>
<td>IDI7 State medical board member</td>
</tr>
<tr>
<td>FGD8 State PEID cell coordinator</td>
<td>IDI88 State PEID cell coordinator</td>
</tr>
</tbody>
</table>

PEID, Prevention of Epidemic and Infectious Disease.

**Patient and public involvement**

As our study was an attempt to understand the socio-political and management approaches adopted by the state of Kerala during the COVID-19 pandemic, patients and the public were not involved in the design, conduct, and reporting of the study.
RESULTS
Data analysis led to the emergence of 50 codes and five themes (Table 3).

Social capital
Historical aspects and socio-political movements
The unique public health history of Kerala was commented on by majority of the participants.

By the beginning of the nineteenth century the princely state of Kerala initiated vaccination and within 25 years community-based vaccination programs evolved. Kerala was ahead in education and health compared to other states of India, contributed by the missionaries and the socio-political movements even before independence. The investments in public health and social determinants of health continued during the post-independence era. (State-level public health expert, IDI7)

The state has a legacy of linking health to non-health sectors. The socialist movements and land reforms were instrumental in nourishing equity by mitigating the difference in economics, education and social advantage between different communities.

Social determinants of health and health indicators
Kerala model of health care focussed mainly on social welfare elements like education, agriculture, water, and sanitation, which could bring substantial improvements in the health status of the population. This prompts the state to act at the level of social determinants in every emerging health issue. (SEC1, FGD1)

In the context of COVID-19, the high literacy rate of Kerala has helped in better penetration of knowledge and awareness among people, thereby creating more alert and response in the civil society. This has attributed to the involvement of people especially youth in campaigns and community organisations.

It was not necessary to inform people, they were aware of COVID 19 and the importance of hand hygiene and sanitation practices. Even many expatriates reported and quarantined themselves. Monitoring alone was needed in those places. (Health inspector 1, IDI3)

The level of literacy and healthcare-seeking behaviour enabled people to understand the mode of spread of infection and improved the willingness to follow the protocols and guidelines.

With the health system well in place, the delay in symptom onset to admission was around 2.5 days. (State medical board member, IDI1)

Robust public health system
Efficiency and distribution
The most important strength of Kerala’s health system is the wide distribution of health facilities, most importantly the PHCs that facilitate the grassroot-level healthcare of the community. Every panchayat (LSGD for every 20000–40000 population) in Kerala has a PHC and an AYUSH (indigenous system of medicine) hospital and
evenly distributed compared with other parts of the country. Every PHC has 5–6 peripheral outreach centres known as subcentres manned with a junior health inspector and a junior public health nurse (JPHN). Along with the government facilities, there is a wide network of private hospitals in Kerala that cater to a major proportion of the state’s healthcare needs.

The well-qualified and trained healthcare staff with good unity of command resulting from the experience in managing several communicable diseases over the years is the backbone of Kerala’s healthcare system. The efficiency was not confined to identification, reporting and clinical management of cases, but also to the strong mechanism of supervising, monitoring and grievance redressal.

… So, once we have any program or guidelines in place, there is a system to receive it … and that is very important. In the absence of an efficient system, preparing guidelines is a futile exercise. I repeatedly use the word system … because in such responses system does matter, at the micro and macro level. (State PEID cell coordinator, IDI8)

**Disease surveillance system**

Integrated Disease Surveillance Project initiated in 2005 with daily and weekly reporting of communicable diseases through paramedical field staffs, clinical surveillance throughout hospitals and laboratory surveillance represent a robust surveillance network at the grassroots level.

Even though the disease was new, COVID only needed to be included in the established surveillance mechanisms of the state. In the same way as identifying a diarrhoea cluster through syndromic surveillance, we needed to identify ILI clusters here. (JPHN2, FGD4)

The existing strong surveillance mechanism for infectious diseases incorporating private institutions through Integrated Disease Surveillance Programme, Prevention of Epidemic and Infectious Disease (PEID) cells for medical college institutions and Joint Effort for Elimination of Tuberculosis for surveillance of respiratory symptoms has helped in building up mechanisms for tackling any emerging outbreak.

Anganwadi workers (outreach workers of Integrated Child Development Service Scheme) and a well-motivated group of Accredited Social Health Activists recruited through National Health Mission forms a network to capture potential health issues that can emerge in the community. During the pandemic, COVID-19 control became a part of their routine activities.

**Participation and volunteerism**

**Leadership**

Effective leadership made the system well accommodative and open for community participation.

… I would like to call it an enlightened leadership … accepting scientific advice and trying to understand things as much as possible, has played a big role. (SCE 1, FGD1)

The knee-jerk administrative response and the checks and balances were evident from the very beginning of the pandemic. The daily press conference by the chief minister of the state and open discussions with the media made the leadership more democratic. Each district was assigned to a state minister and review meetings were held as and when needed. The vertical and horizontal integration made the administrative system of the state more transparent and acceptable to the people. At the subdistrict level, a medical officer was posted as the nodal officer to coordinate the activities related to COVID-19 and to ensure proper communication.

**Intersectoral coordination**

It would be too reductive to even think that, it’s the health system which alone has done all these activities. It’s the combined effort of all sectors, along with people who can understand and comply with the instructions of the state, which made this fight more fruitful. (DPM1, FGD2)

The role of various departments notably, LSGDs, public distribution system, police, disaster management, education, information technology, media and fire force were evident from the beginning. They played a pivotal role in addressing the medical and non-medical needs of the people, and in control measures including ensuring quarantine and maintaining social distancing. LSGD integrated different departments at the field level and provided financial assistance for COVID-19 control activities. The proactive action of LSGD in social mobilisation along with non-government organisations and self-help groups like Kudumbashree (Kudumbashree is the neighbourhood group of women, part of the poverty eradication mission of the government of Kerala and is widely distributed across Kerala) was evident during the pandemic. They were instrumental in ensuring an uninterrupted supply of food to quarantined people, migrant labourers and the destitute by initiating a ‘community kitchen’ immediately following the lockdown along with public distribution system. Disaster management authority along with LSGD identified unoccupied buildings and converted it to quarantine and treatment facilities.

The fire force department helped in procuring and delivering drugs and other medical needs, using the district and gram panchayat funds. The police force played an important role in enforcing the preventive measures at the community level including the use of face masks and preventing social gatherings. They ensured food and shelter to the vulnerable including migrants and the destitute.

… I would like to describe our police department in two phases, one before COVID and the other after COVID. Even though police are more community-oriented in Kerala through ‘Janamaithri’ (people friendly) police stations and students’ police cadets,
the police department was more focused on enforcing law and order … But now, social welfare is our additional focus … (PF1, FGD3)

To a greater extent various campaigns were effective because of widespread awareness generation by social media. Media scrutinised different administrative data, integrating and debating expert opinion, and acted as a corrective force to the government.

… We witnessed epidemiology, public health, mathematical models being discussed in and out of medical circles in all media platforms. Medical personnel acquired an epidemiological perspective, so did common people. (DO 2, FGD2)

The information technology department simplified the surveillance and data management by developing platforms for contact tracing and surveillance, mobile application (named GoK Direct) to ensure the real-time transfer of information related to COVID-19, providing trained human resources and integrating data from various departments.

People’s participation
Community participation saw many appreciable facets in Kerala from participating in government sensitisation campaigns to innovative community-level approaches and control measures. Through several groups like ‘Jagratha Samithi’ (means alertness committee and are ward level committees formed by volunteers), people came forward by themselves and took the responsibility. Social surveillance measures from the public acted as a third eye and helped the health workers in ensuring quarantine. The response from the community was quick and effective, and special strategies to ensure food delivery and medical provisions were possible largely due to the people’s participation.

We started a help desk for Non-Resident Indians to meet their medical needs, which later expanded to non-medical needs too, a project with zero budget and finally distributed around 48 lakh materials by volunteers … It’s like sleeping cells we just need to activate it … it’s not easy to find such systems in other parts of India. (SCE 3, FGD1)

Health system preparedness
Previous experiences
… Both the Nipah outbreak and two flood experiences in successive years, 2018, 2019 and the successful prevention of outbreaks of infectious disease following the disasters, taught the health fraternity that more than the individual doctor/nurse skill, the system is more important and should be in place … (DPM 1, FGD2)

By late January, even when the first case of COVID-19 was identified in the country from a Wuhan returnee under quarantine in Kerala, the state had established Corona Control Cell, and protocols were set in place. This pre-emptive response was possible from the previous experiences of managing an outbreak.

The experience with Nipah brought several guidelines in place for infection control including the establishment of an outbreak monitoring unit and regular training to all health workers through link nurses. It familiarised the health workers with triage, red channel, and personal protective equipment.

Evidence-based action
Even before the first case of COVID-19 was reported in the country, the health system of Kerala was preparing with abundant measures. Evidence-based guidelines and evolving protocols to accommodate the emerging evidence made the process more scientific.

Kerala was a step ahead in including people coming from Middle East countries in the surveillance network, even before WHO included those countries. We couldn’t allow even 1% error considering the high population density in the state. (SCE 5, FGD1)

Contact tracing of each positive patient with route maps and their risk stratification by the surveillance team at the district level helped in widening the surveillance network. Call centres were enabled to provide round-the-clock support. Guidelines for quarantine, testing and treatment were established. If the institutional medical board had difficulty in decision-making, they can refer to the district or state medical board. District Programme Management and Support Units acted as dedicated real-time management structures for coordinating admission, referrals and impatient facilities across government and private sectors.

In our state, protocols are flexible, the institutional medical board is endowed with the power of decision making in COVID management. They should document it. There is currently no COVID 19 expert in the world. (State medical board member, IDI1)

The state announced several campaigns like ‘break the chain campaign’ and ‘SMS campaign-Soap-mask-social distancing’ for better penetration of preventive strategies to the grassroots level. Reverse quarantine was an important strategy post lockdown to protect the vulnerable from infection. Considering the evolution of disease spread along with the socio-cultural aspects, region-specific strategies for the containment zones were devised.

Upscaling of facilities and services
The rate-limiting element in terms of resources was the availability of personal protective equipment and prompt measures were undertaken to attain self-sufficiency. The increased demand for masks and sanitisers was well handled by initiating locally sustainable production, including N-95 masks.

Health system preparedness was ensured at all three levels of healthcare. At primary and secondary levels, protocols were set for respiratory triage, and all staff
were provided training on infection prevention and control. A good example of institutional preparedness demonstrated by the state was the setting up of tiers of COVID-19 management centres including the COVID-19 hospitals, COVID-19 Second Line Treatment Centres, COVID-19 First-Line Treatment Centres (CFLTCs, dedicated centres to isolate and manage asymptomatic and mild cases) and COVID-19 care centres (centres for institutional quarantine). The disaster management authority with the help of LSGDs identified infrastructure in the form of buildings like schools, colleges, auditoriums and so on to establish these facilities. Increased demand for human resources was met by fastening the appointment of doctors through Kerala public service commission, appointing the freshly passed out batch of medical graduates in CFLTCs, and making a contract-based appointment through National Health Mission. Facilities for intensive care in the tertiary care centres were revamped. Daily district-wise forecasting of cases was done to plan for resource management. The private health institutions were well informed and their cooperation was ensured. Telemedicine facilities were established to reduce patient contact (for COVID-19 and non-COVID-19 services) with the hospitals. Walk-In Kiosk for sample collection and mobile testing units were established.

**Challenges**

**Victim of initial success**

… It’s called prevention paradox when people start seeing a very low number of cases around, they might think all measures were unnecessary … (SCE 2, FGD1)

The low number of cases and deaths in the initial phase has given a false sense of security and complacency among people. People failed to recognise the seriousness of the situation when all services were provided free of cost.

… People started believing that they won’t get infected and when asymptomatic individuals became positive for the disease, they even denied their infections. … The involvement of religious leaders and peoples’ representatives have helped in tranquilizing people and obliterating their misconceptions … (PF5, FGD3)

… At the end of it, how much ever we enforce and give Information Education Communication, it is people who need to self-restraint … so we need to shift the focus from enforcing for a short duration to a behavioural change ingrained in the society … (State police official, IDI2)

**Limited resources**

As the healthcare mechanisms focused on COVID-19, the non-COVID-19 care was affected and the restriction of movement and lack of conveyance reduced the access to even available facilities. This was tackled to a great extent by telemedicine facilities, home delivery of drugs for chronic ailments and designating COVID-19 hospitals enabling non-COVID-19 care to run smoothly in other hospitals.

The challenge of human resource scarcity cropped up when few of the existing workforce was diagnosed with the disease and many were quarantined.

… When one among us became COVID positive for the first time, around 19 officers were primary contacts and all had to go for quarantine, later we started following the duty shift practices as per the advice of public health experts, and when the second case was detected among officers, there were only 4 primary contacts … (PF2, FGD3)

There was discordance in communication at the state level and between the state and districts. With the evolving evidence, the guidelines were frequently modified without addressing the capacity and resources at lower levels. The lack of proactive actions and failure to understand the urgency of the situation by some sectors overburdened the existing system.

**DISCUSSION**

Kerala’s experience with COVID-19 puts forth lessons to transcribe and assimilate, not only for the state and the nation but also on a global perspective. The trajectory of Kerala’s development is distinguished by the primacy of the social sector and the Kerala model of healthcare is often described as ‘good health based on social justice and equity’.14 15 The state has held up this basic principle in every health scenario and the ‘humane’ nature of Kerala’s COVID-19 control has received wide global appreciation.16

Kerala has marched far ahead of other states of India in health indicators decades back with its organised healthcare.15 17 During this pandemic, with the effective containment strategies, Kerala had become the front runner in India’s initial fight against COVID-19.18 19 The state has witnessed several viral outbreaks in the past, and the experiences thus gained paved the way to the expeditious response from the state in exercising strategies focusing on the prevention of the spread of infection rather than on curative care. When the impact of the pandemic especially the lockdown devastated the social sphere of already famished societies of other states, Kerala was well prepared to extend special care and uninterrupted food supply to all including migrant labourers and destitute.14 20 21

In a pandemic situation, every government department and the non-government institute has a responsibility to the society and is pivotal for the well-balanced functioning of the system.22 In a state where more than 60% of the population depends on the private healthcare system, an epidemic response from surveillance to management mandates private sector involvement.23 The early initiative of the government to establish public–private partnerships ensured adequate manpower and material resources in the COVID-19 response. However,
beyond the system, the backbone of Kerala’s COVID-19 control strategy was community participation and the social capital was well harnessed by the state at the time of crisis. In a state like Kerala with a high proportion of religious diversity, the religious/community leaders played an inevitable role in alleviating anxiety and ensuring safety measures. The use of local governance structures and community health networks in implementing dynamic policy made Kerala distinct from other states in the country, another example being Odisha. The long experience with disaster in the state of Odisha had led to the repurposing of crisis prevention measures engaging a vast network of local institutions during the pandemic. Unlike Odisha, Kerala is not historically known for frequent natural calamities; however, in the recent past, the state has been facing several disasters in quick succession. The well-organised local self-governance of the state was further fine-tuned towards emergency preparedness and outbreak response and had facilitated a quick response during the pandemic. The time and effort of the community became the major resource of the state, unlike other successful global models. While Germany had a well-prepared health infrastructure in advance which could cater the intensive care even during the peak of the outbreak, many other European counterparts had to adapt to other spaces in the hospital to accommodate the critically ill. As in Kerala, community care facilities were organised by repurposing large spaces like conference halls, schools and so on in countries like Hong Kong, Singapore, South Korea and the UK.

The state had its own challenges, foremost being the high number of expatriates and high population density. This was tackled to a large extend by the coordinated activities of various departments by providing essential services via social welfare programmes, ensuring effective surveillance and stringent measures for reverse quarantine. This mechanism where each sector knows their capabilities and the ability to channelise those resources to function together helped in overcoming many challenges.

Limitation
Officials working in the immigration department and the state coordinate national operations were not included in the study. Further, the possibility of a positive bias in highlighting the efficiency of the system cannot be excluded as the majority of the respondents were within the government system. Every possible effort was made to avoid this bias through probing questions ensuring documentation of all dimensions.

CONCLUSION
With the easing of restrictions and resuming of routine life, every nation is at a threat of rise in COVID-19 cases. It is of high priority to revisit the successful strategies from different nations to appraise the lessons learnt and to identify the challenges to help future planning. The present study is a much-needed treatise to provide a balanced perspective on the intricacies of epidemic management in a low/middle-income country. Kerala puts forth a model of evidence-based actions through a robust public health system with good community participation and intersectoral collaboration build on existing social capital. As the future of COVID-19 remains unknown, it is never late for any evidence-based innovative strategies and interventions to be cautiously implemented.

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Acknowledgements
We acknowledge all our participants for their cooperation amidst the pandemic situation. We thank Professor Indu P S, Head of Department of Community Medicine, Government Medical College, Thiruvananthapuram for the guidance.

Contributors
KCP, AR and TSNA had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. KCP, AR, TSNA and SC contributed to the plan and design of the study, KCP, AR, TSNA, SC, GS, and MJV developed the interview guide. KCP, AR, MMS,ANKKN, SC, GS and MJV led the data collection and performed the data analyses. All authors participated in the interpretation of the results. KCP, AR, SC and TSNA drafted the manuscript. SC, GS,MJN, MMS,ANKKN, ARK, SV and TSNA contributed to the critical revision of the manuscript for important intellectual content and approved the final version of the manuscript.

Funding
The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests
Author TSNA is a member of the state expert committee group, a scientific group that helps the state to assimilate available scientific evidence on COVID-19 and provide evidence-based opinions on prevention and control of the COVID-19 pandemic. Author ARK is a member of the state expert committee group, state rapid response team with a role to assess and formulate responses to infectious diseases of public health importance, and state medical board providing evidence-based opinions on patient management to the institutional level medical boards during the pandemic. Author SV is joint secretary to the Government of Kerala in the department of Health and Family Welfare, TSNA was involved in the plan and design of this study, interpretation of the results, drafting, and critical revision of the manuscript. ARK and SV were involved in the interpretation of the results and critical revision of the manuscript.

Patient and public involvement
Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication
Not required.

Ethics approval
Ethics clearance for the study proposal was obtained from the Institutional Ethics Committee (Human) at Government Medical College, Thiruvananthapuram, Kerala, India (HEC.No.03/65/2020/MCT). Free and informed consent was obtained from all study participants.

Provenance and peer review
Not commissioned; externally peer reviewed.

Data availability statement
Data are available upon reasonable request. The data underlying this article cannot be shared publicly due to the privacy of the participants. Data will be shared at reasonable request to the corresponding author.

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REFERENCES


Correction: Strategies and challenges in Kerala’s response to the initial phase of COVID-19 pandemic: a qualitative descriptive study


This article was previously published with an error.

The competing interests statement has been updated to:
Author TSNA is a member of the state expert committee group, a scientific group that helps the state to assimilate available scientific evidence on COVID-19 and provide evidence-based opinions on prevention and control of the COVID-19 pandemic. Author ARK is a member of the state expert committee group, state rapid response team with a role to assess and formulate responses to infectious diseases of public health importance, and state medical board providing evidence-based opinions on patient management to the institutional level medical boards during the pandemic. Author SV is joint secretary to the Government of Kerala in the department of Health and Family Welfare. TSNA was involved in the plan and design of this study, interpretation of the results, drafting, and critical revision of the manuscript. ARK and SV were involved in the interpretation of the results and critical revision of the manuscript.

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BMJ Open 2022;12:e051410corr1. doi:10.1136/bmjopen-2021-051410corr1