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Original Article

To Explore the Positive Adaptive and Transformative Changes in the Health System and Community During the COVID-19 Pandemic in Puducherry

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ABSTRACT

Background and Aim: The COVID-19 pandemic placed substantial pressure on health systems, but it also created opportunities for positive organisational change. While most studies from India have focused on challenges, limited evidence describes the beneficial adaptations that strengthened routine systems during the pandemic. This study aimed to explore the positive adaptive and transformative changes in the health system and community during COVID-19 in Puducherry. **Methods:** A qualitative study was conducted using a phenomenological approach. Eight key informant interviews and three focus group discussions were carried out across primary, secondary and tertiary care facilities in Puducherry in 2021. Participants were purposively selected using maximum variation sampling. Data were collected using semi-structured guides mapped to health system building blocks, audio-recorded, transcribed verbatim and analysed using a hybrid inductive–deductive approach guided by the Health Systems Dynamics Framework. Themes were validated through investigator triangulation and participant confirmation. **Results:** Ten major thematic areas emerged: leadership and governance, human resources, infrastructure and supplies, financing, knowledge and information, service delivery, population behaviour, context, values and principles, and outcomes. Participants described stronger leadership presence, improved teamwork, rapid decision-making and effective intersectoral collaboration. Infrastructure and digital platforms expanded quickly, including oxygen plants, diagnostics, telemedicine and digital documentation. Service delivery became flexible through home-based care, teleconsultation and vaccination outreach. Community trust in government services improved, and adherence to preventive behaviours increased. **Conclusion:** The COVID-19 pandemic impelled positive changes in Puducherry's health system, including stronger leadership, better coordination, improved infrastructure, digitalisation, and increased community engagement. Sustaining these improvements can strengthen routine services and emergency preparedness.

Keywords: COVID-19, Health system strengthening, Leadership, Positive adaptations, Puducherry, Qualitative research.

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INTRODUCTION

The COVID-19 pandemic placed an extraordinary burden on health systems across the world. Countries were required to strengthen surveillance, reorganise service delivery, mobilise resources rapidly and ensure continuity of essential healthcare under uncertain conditions. Many low- and middle-income countries faced challenges related to shortages of human resources, inadequate infrastructure, limited diagnostic capacity, and disruptions in routine care.[1,2] Although several studies have highlighted the difficulties faced during the pandemic, fewer studies have focused on the positive adaptations and system-level improvements that emerged during this period. Understanding such positive changes is important because they offer practical lessons for routine health system strengthening and preparedness for future public health emergencies.

Public health emergencies often accelerate improvements in governance, communication and teamwork. International reviews have documented that flexible decision-making, transparent communication, rapid problem-solving and strong political commitment played major roles in shaping effective pandemic responses.[3,4] Strengthened collaboration between sectors, improved flow of information, and decentralised management approaches also supported system performance

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in several countries.[5] These experiences show that crises can stimulate organisational learning and innovation within health systems.

Globally, the pandemic led to expansion of diagnostic networks, oxygen generation capacity, telemedicine services and digital information systems. Studies have reported that rapid adoption of digital tools supported continuity of care, improved reporting and enhanced coordination between facilities.[6,7] In many settings, the crisis also promoted closer teamwork, skill enhancement and improved public trust in health services. A systematic review reported that increased motivation, resilience and adaptability among health workers were important contributors to system functioning during COVID-19.[8]

In India, the pandemic prompted major changes across all levels of the health system. There was significant scaling up of RT-PCR and rapid antigen testing facilities, strengthening of emergency transport, establishment of oxygen plants, expansion of intensive care beds and wider adoption of telemedicine platforms.[9,10] Several states implemented decentralised surveillance, door-to-door follow-up, home-based care for mild cases and extensive vaccination outreach. Studies have shown that community health workers, frontline surveillance teams and intersectoral coordination played crucial roles in India's pandemic response.[11] However, most published evidence has focused on challenges such as fear, misinformation, service disruption and workforce shortages. Limited qualitative literature has examined the positive adaptive or transformative changes that occurred within Indian health systems during COVID-19.

The recording of the views of healthcare providers and community members provides essential information about the way the system operated during crisis conditions and displays the practices that were beneficial. The qualitative research carried within various contexts has shown that insight into the frontline experiences is valuable in the process of determining effective solutions that can be used to strengthen coordination, improve communication channels, restructure service delivery and nurture the wellness of the health workforce in the event of a health crisis in the community.[12-14]

It is on this basis the current research project aimed to examine the adaptive and transformative changes that were positive and that occurred in the health system and the community during the COVID-19 pandemic in Puducherry. The discovery of such changes should contribute to the future preparedness planning and the promotion of the inclusion of positive practices into standard health system operation.

MATERIALS AND METHODS

Study Design

This qualitative study followed a phenomenological approach to explore the experiences and perceived system-level changes during the COVID-19 pandemic. The approach was selected to obtain a detailed description of the participants lived experiences. The study adhered to the Consolidated Criteria for Reporting Qualitative Research (COREQ) guidelines.[15] Credibility was ensured through participant validation at the end of interviews and discussions. Dependability was maintained by independent coding by two researchers. Prolonged engagement with the data occurred over an 8-9-month analytic period. Field notes and analytic memos formed the audit trail. Ethics approval was obtained from the Institutional Ethics Committee (JIP/IEC/2021/102). Written informed consent was obtained from all participants.

Study Setting

The study was conducted in Puducherry district of the Union Territory of Puducherry, located on the eastern coast of South India. The district has a population of approximately 9.5 lakh, with about 70% residing in urban areas. The public health system includes 56 Sub-centres, 32 Primary Health Centres and 2 Community Health Centres. Puducherry has a well-established primary healthcare structure with strong coverage of maternal, child and non-communicable disease services. During COVID-19, the region implemented early testing, systematic field surveillance, home-isolation monitoring, teleconsultation services and mass vaccination campaigns. Closely aligned activity between the public health departments, the medical colleges, the district administration, and the community volunteers was another issue that the union territory witnessed because of the COVID-19 pandemic, leading to some remarkable changes in the mechanism of governance, teamwork, digitalisation and the provision of essential services.

Study Participants and Sampling

Eight Key Informant Interviews (KIIs) and three Focus Group Discussions (FGDs) were conducted. Purposive sampling with maximum variation was used to include participants from primary, secondary and tertiary levels of care.[16] Participants included medical officers, nursing supervisors, district-level administrative staff, faculty from medical colleges, pharmacy managers, and district health officials. Three FGDs were conducted one each at a PHC, CHC and tertiary facility. Data saturation determined the final sample size. Data were collected during 2021.

Study Tool

Semi-structured interview and FGD guides were developed based on the World Health Organization's six health system building blocks: service delivery, health workforce, health information systems, access to essential medicines and products, financing and leadership/governance.[17] The guides were reviewed by the study investigators.

Data Collection Procedure

KIIs and FGDs were conducted at locations convenient to participants, such as health facilities and anganwadi centres. All interviews were conducted by investigators trained in qualitative methods. Written informed consent was obtained prior to data collection. With permission, interviews were audio-recorded, and field notes were taken. Privacy was ensured by restricting the presence of non-participants. Audio recordings were transcribed within 3-4 days. At the end of each interview, key points were summarised to the participants for validation. Data were anonymised and stored securely in password-protected files.

Statistical Analysis of Data

Data analysis proceeded concurrently with data collection. A phenomenological approach was used. A hybrid inductive-deductive coding process was followed. Open codes were generated inductively and grouped into categories. Themes were developed using the Health Systems Dynamics Framework, which outlines system components and their interactions.[18] Two researchers independently coded the transcripts, and discrepancies were resolved through discussion. Statements served as the unit of analysis.

RESULTS

The results are organised using the Health Systems Dynamics Framework (Figure 1), with themes arranged across its ten domains, including values, context, governance, system inputs and service delivery components.

Values and Principles

The response was based on equity and universal access (Table 1). There was a shift towards making sure that every household that was affected was addressed regardless of socioeconomic and geographic variations (Table 1). According to one ANM, "we made sure that no one was left without a visit to their house." Social harmony and the prevention of tensions at the community level also affected decision-making in this period (Table 1).

Context

Corporate Social Responsibility funding provided the health system with support in acquiring necessary supplies fast, which would have otherwise taken years through routine channels (Table 1). Fear and stigma characterised the initial stages of the pandemic (Table 1). Patients were often unwilling to be taken in ambulances to isolation wards. An ASHA employee remarked, "When people saw the ambulance they would hide or flee." Health workers had problems mobilising patients, and some service departments were initially reluctant to interact with affected families (Table 1). These worries gradually reduced as citizens became more informed. Misinformation circulated widely on social media, even as official updates were also shared on the same platforms (Table 1). The use of traditional remedies and AYUSH practices became common. Participants noted that frequent infectious ailments and road accidents had reduced, explained by lockdown restrictions and preventive practices (Table 1). There was a major impact on livelihoods, particularly for those dependent on transport and tourism (Table 1). The teenagers felt more confusion, more screen time and emotional strain. A

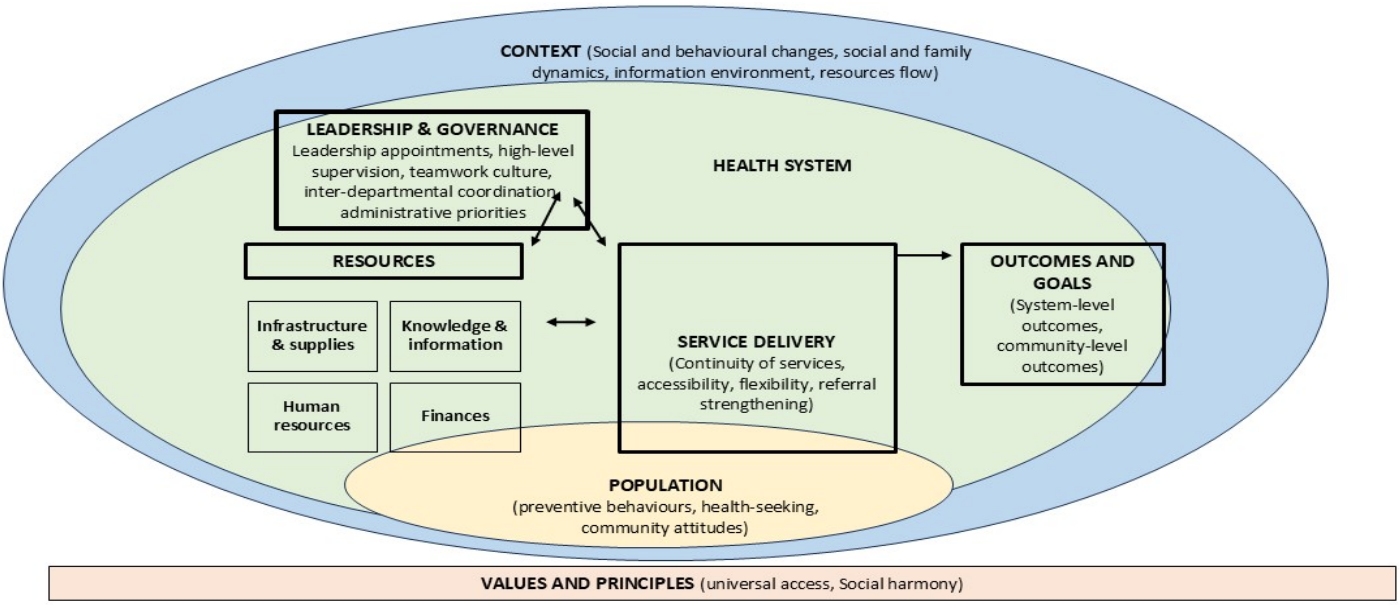

Figure 1: Health systems dynamics framework showing the adaptive and transformative changes of the health system during the COVID-19 pandemic.

temporary decrease in alcohol consumption was reported due to limited availability (Table 1).

Leadership and Governance

Enhanced leadership came out as one of the salient factors towards health system resilience in the COVID-19 pandemic (Table 2). District- and state-level authorities were directly involved in supervising service delivery activities, leading to better monitoring and efficiency (Table 2). Long-standing vacancies were filled, and newly appointed leaders were considered active and efficient (Table 2). Teamwork was strongly promoted, with leaders open to feedback and recognising the value of different cadres (Table2). One nurse added, "Frequent appraisal increased our levels of service." A pharmacist stated that leaders listened and gave autonomy in pharmacy decisions. Field-level support was timely, with medical officers responding instantly to issues during surveillance and mobilisation (Table 2). Inter-institutional and inter-departmental cooperation increased, making decision-making faster (Table 2). Focus on patient satisfaction increased, with complaint boxes and helplines overseen by senior authorities (Table 2). Routine administrative procedures were sometimes postponed due to prioritisation of COVID-19 efforts (Table 2). Participants believed this governance improvements helped them cope with operational complexities (Table 2).

Outcomes and Goals

Participants highlighted efficient pandemic management, high vaccination coverage and strong community engagement as major outcomes (Table 2). The improved connection between community and health facilities increased trust in government services (Table 2). A new tertiary care hospital rapidly strengthened its facilities and gained social trust. A medical officer noted that even senior officials and ministers felt well cared for. Frontline workers made regular home visits, fostering household relationships (Table 2). According to a health assistant, "people said half their sickness was cured once we came to them." These engagements increased trust and satisfaction across socioeconomic groups (Table 2).

Knowledge and Information

Online training emerged as a key mode of capacity-building (Table 3). Participants appreciated its convenience and accessibility, though it had limitations for clinical skills (Table 3). Healthcare workers developed enhanced skills in communication, emergency care, holistic patient management, ventilator use, hospital administration and infection control (Table 3). Digital literacy improved alongside adoption of digital documentation (Table 3). Training opportunities increased for undergraduate and postgraduate students in private institutions, though surgical training experienced temporary disruptions (Table 3).

Human Resources

Healthcare workers received increased respect from the community, relatives and government departments (Table 3). A health assistant shared, "Officials recognised us in their offices and appreciated our COVID work." Regular field visits by senior authorities strengthened morale (Table 3). Staff reported greater attention to self-care, including hydration and breathing exercises (Table 3). Vacant posts, especially in support services, were filled (Table 3). Teamwork improved with better rapport between cadres, empathetic work environments and cross-training (Table 3). A laboratory technician noted, "We helped each other in field work, swab collection and so essential services never stopped." Familiarity with community needs increased due to intensive field engagement, contributing to job satisfaction (Table 3). A few participants described negative experiences, including blame from community members after adverse outcomes (Table 3).

Table 1: Context and values & principles.

Theme	Category	Codes
Context	Social & behavioral changes	Alcoholism reduced; Fear and stigma decreased over time; Other disease burden decreased
	Social and family dynamics	Importance given to family and social connections; Livelihood and education were affected
	Information environment	Social media influence; Spread of misinformation
	Resource flow	CSR fund flow supported rapid procurement
Values & Principles	Universal access	Equity-focused response; Universal household coverage
	Social harmony	Consideration of community tensions; Prevention of social conflict

CSR: Corporate social responsibility

Population

The community embraced healthier preventive practices such as regular handwashing, mask use and better diet (Table 4). These behavioural changes were easily adopted by children (Table 4). Appreciation of health workers increased, with recovered patients donating water filters and protective gear. One nurse recalled patients returning to thank them and donate items (Table 4). A small proportion of households were not cooperative with home isolation surveillance or vaccination (Table 4). Some individuals were convinced to vaccinate due to mandatory certificates for travel, education or work (Table 4).

Service Delivery

The pandemic did not stop essential services (Table 4). Primary health centres ensured continuity of non-communicable disease care, with long-term medication supplies and doorstep delivery for those unable to travel (Table 4). Field workers monitored home-isolated patients daily and assisted in referral where needed (Table 4). Clinics, home visits, outreach and community campaigns supported vaccination services (Table 4). One ANM recalled holding late-night vaccination marathons at the beach road (Table 4). Telemedicine services expanded significantly to support home management and coordination between peripheral

Table 2: Leadership & governance and outcomes & goals.

Theme	Category	Codes
Leadership & Governance	Leadership appointments	Filling long-standing vacancies; Appointment of efficient leaders
	High-level supervision	Direct supervision of service delivery; Rapid response to field-level issues
	Teamwork culture	Leaders receptive to feedback; Respect for roles; Encouraged teamwork
	Inter-departmental coordination	Collaboration across institutions; Faster multi-sectoral decision-making
	Administrative priorities	Prioritised materials management; Patient satisfaction; Delays in routine administration
Outcomes & Goals	System-level outcomes	Efficient pandemic management; High vaccination coverage
	Community-level outcomes	Increased trust in government services; Improved patient satisfaction; Stronger community–facility linkage

Table 3: Human resources and knowledge & information.

Theme	Category	Codes
Human Resources	Professional recognition	Staff respected; Boosted morale
	Workforce wellbeing	Improved self-care; Better safety practices; Supportive families; Fear reduced
	Workforce dynamics	Improved teamwork; Better rapport with seniors; Considerate work environment
	Capacity enhancement	Cross-training; Learning appraisal/feedback processes; Recognition of key roles
	Staffing improvements	Vacant posts filled; Altruistic work by healthcare staff
Knowledge & Information	Online training	Convenience; Limitations in clinical teaching
	Skill development	Communication; Emergency care; Ventilator use; Infection control; Hospital management
	Digital capability	Increased digital use; Updated information access; Digital records initiated
	Training environment	Improved UG/PG training; Intern skill focus; Surgical training disruption
	System connectivity	Improved links with other facilities

Table 4: Service delivery, infrastructure & supplies, finances, population.

Theme	Category	Codes
Service Delivery	Continuity of services	Essential services maintained; Long-duration NCD drug supply
	Accessibility	24×7 home visits; Telemedicine care; Doorstep services; Vaccination marathons
	Flexibility	Preventive efforts enhanced; Contact tracing; AYUSH integration; Traditional remedies
	Referral strengthening	Improved referral pathways; Rapid communication
Infrastructure & Supplies	System strengthening	RT-PCR establishment; Digitalisation; ICU & oxygen expansion; Infection control improvement
	Support services	Cold chain upgraded; Patient-support services improved; Better waste management
	Inventory management	Closer monitoring; Anticipatory planning
Finances	Donation channels	Increased donations; Simplified pathways; CSR support
	Financial processes	Strengthened Ayushman Bharat claims; Digital purchases (GeM)
Population	Preventive behaviours	Mask use; Handwashing; Healthy diet
	Health-seeking	Better early care-seeking, especially among children
	Community attitudes	Gratitude; Donations; Some hesitancy; Few non-cooperative households

and tertiary centres (Table 4). The nursing workforce reported that PPE made direct care difficult due to restricted facial expression and non-verbal communication (Table 4). Traditional remedies were widely used, and AYUSH practitioners contributed to service delivery (Table 4). Referral systems improved through digital communication channels (Table 4). Emergency and test result communication was provided almost 24 hr a day (Table 4).

Health Financing

Financial processes were streamlined during the pandemic (Table 4). Donation pathways were simplified, enabling contributions from CSR funds, NGOs, alumni groups and the public (Table 4). A nursing in-charge commented, "Whatever we listed on the website, people bought and gave." Ayushman Bharat claim processes strengthened, particularly in private medical colleges empanelled for COVID-19 care (Table 4). Digital procurement through the Government e-Marketplace became more widely adopted, improving purchase efficiency (Table 4).

Infrastructure and Supplies

Diagnostic capacity expanded rapidly, including establishment of RT-PCR facilities (Table 4). An administrator noted, "Without COVID, we would not have got RT-PCR this soon." Digitalisation of records increased, with computers installed across facilities (Table 4). Handwashing stations were prioritised, and cold chain infrastructure for vaccination was upgraded (Table 4). Intensive care and oxygen generation capacity increased, alongside improvements in biomedical waste management and patient-support services (Table 4). Inventory management became more robust as staff anticipated requirements and closely monitored stock levels (Table 4). A pharmacist noted, "COVID was like a refresher in inventory control; we had to plan continuously as the situation kept changing."

DISCUSSION

This qualitative research investigated the beneficial developments which took place in the health system and community under the COVID-19 conditions in Puducherry. It discovered that there were improvements in leadership, workforce coordination, infrastructure, digitalisation, service delivery, and community behaviour. The participants explained that the pandemic introduced the feeling of urgency, which led to an increase in teamwork, quicker decision-making, and increased acceptance of preventative measures. These adjustments assisted the system to become more effective on reacting to the needs of the pandemic.

One of the key findings was stronger leadership. Senior officials were often mentioned by the participants as more visible, supportive, and accessible during the pandemic. The frequent reviewing sessions, quick communication and solving of problems in a short time made the field teams to work with a clear understanding and confidence. Other regions of India and other countries also reported similar amounts of progress in governance during COVID-19, with proactive leadership helping lead to improved coordination and mobilisation of resources.[2,3] The response was also empowered by the faster administrative activities like filling of vacant positions and the provision of supplies in appropriate time in our study.

The health workforce was found to have changed their attitudes and behaviour substantially. Collaboration was elevated, and employees helped each other to go through tough times. Most of the participants added that their morale went up when the masses and the top authority appreciated them. This observation aligns with the works of other environments, which found out that the motivation was supported by the public awareness and institutional factors in preserving motivation throughout the pandemic.[5] We also discovered that healthcare workers have acquired new skills; specifically, the skills of infection control, oxygen therapy, and digital documentation. It has been demonstrated that COVID-19 increased the rate of skills development and led health workers to embrace new practices.[13]

Another significant change was digitalisation. The respondents have reported greater consumption of telemedicine, online conferences, online registers, and WhatsApp messages. This lowered administration and enhanced communication between the facilities. The same patterns were recorded in India and other parts of the world where digital tools were rapidly embraced as a measure to ensure continuity of care in case of lockdown.[10] In our research, the healthcare workers were more at ease with the digital platforms as time passed and this assisted them to offer timely advice to their patients and to field teams.

Infrastructure and supplies were also improved due to the pandemic. Within a relatively brief time, oxygen plants, testing centres, intensive care beds and emergency transport services were increased. Most of the participants said that the system was more emergency care ready. It has been observed in a number of Indian states and other countries[19] that such quick fortification of infrastructure has been reported during COVID-19. Moreover, the processes of the supply chain were made more organised. Stock information and closer monitoring were in real-time, which prevented shortages. This compares to the results in other emergencies in the field of public health when emergencies resulted in improved management of logistics.[20]

Practices of service delivery were transformed significantly. Tele-consultation, home delivery of medicines, and extended field support and vaccination outreach were useful in supporting the necessary services. The respondents believed that these measures enhanced patient satisfaction and eliminated unnecessary visits to hospitals. Other regions also reported similar innovations in service delivery during COVID-19, particularly in continuation of care of chronic diseases.[21] The system was also assisted by the involvement of the AYUSH practitioners, private hospitals, and volunteers during peak periods.

There were various positive behavioural changes experienced in the community. The subjects noted that individuals wore masks, practiced hand hygiene, and sought early treatment more often than previously. They also believed that the diseases transmitted by mosquitos and respiratory diseases decreased during these times. Other regions of India have also reported similar declines in common communicable diseases as a result of popularize the preventive practices.[6] The confidence in government health establishments also increased, with the society having the experience of the prompt responsiveness of field teams and vaccination programs.

The pandemic provided conditions of improved communication between the levels of the health system. News on guidelines and protocols were disseminated to the frontline workers faster. The participants were more certain they were more knowledgeable to handle patients. In other works, the enhancement of communication and regular updates have led to a decrease in the level of confusion in the pandemic and facilitated a coordinated response.[9]

Although several positive changes were reported in our study, some difficulties were discussed by the participants as well. Communication was complicated since using PPE, and health workers struggled to offer emotional support to patients. A common communication problem with PPE has been reported.[22] The participants also stated that there were misconceptions about COVID-19 among some members of the community and they were reluctant to seek care or vaccination. These fears were comparable to other studies conducted in India that stated fear, rumours and vaccine hesitancy as widespread obstacles during the pandemic.[23]

Overall, the pandemic made the conditions in which a quick adaptation and cooperation within the system were promoted. The recent gains in leadership, infrastructure, teamwork, digitalisation, and service delivery are indications of the ability of the system to learn and adapt in case of a crisis. Most of these transformations are feasible and they can be maintained by proper policy encouragement. Even though our research concentrated on positive changes, they are lessons to be learned when strengthening the health system on everyday basis and the next emergency preparedness.

Limitations of the Study

This study was conducted in a single district, which may limit transferability to regions with different governance or resources. Because it focused only on positive changes, it may not capture the full spectrum of challenges faced during the pandemic. Participant accounts may also have been influenced by the emotional context of crisis work. Nevertheless, representation from diverse cadres and system levels strengthens the credibility of the findings.

CONCLUSION

The COVID-19 pandemic stimulated several positive developments in Puducherry's health system. Enhancements in leadership, workforce coordination, infrastructure, digitalisation,

and service delivery supported effective pandemic response. Communities adopted improved preventive behaviours and reported greater trust in government services. These shifts demonstrate adaptive system capacity. Continued support and integration of successful practices will be essential to sustain these gains.

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CONFLICT OF INTEREST

Authors declare no conflict of interest.

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ABBREVIATIONS

COVID-19: Coronavirus Disease 2019; **PHC:** Primary Health Centre; **CHC:** Community Health Centre; **KII:** Key Informant Interview; **FGD:** Focus Group Discussion; **COREQ:** Consolidated Criteria for Reporting Qualitative Research; **WHO:** World Health Organization; **RT-PCR:** Reverse Transcription Polymerase Chain Reaction; **ANM:** Auxiliary Nurse Midwife; **ASHA:** Accredited Social Health Activist; **AYUSH:** Ayurveda, Yoga & Naturopathy, Unani, Siddha and Homoeopathy; **PPE:** Personal Protective Equipment; **CSR:** Corporate Social Responsibility; **NCD:** Non-Communicable Disease; **IEC:** Institutional Ethics Committee.

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