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Responding to COVID-19 in Indian Public Health

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Executive summary

The world has been thrown into a panic due to the public health disruption caused by the COVID-19 pandemic that has had unprecedented effects on citizens, businesses, and governments. While the pandemic overwhelmed even the most resilient healthcare systems in developed nations, resource-limited hospitals in developing countries such as India faced further challenges. Healthcare experts from around the globe have perpetually expressed their concerns about containment strategies, and the ability to prevent and manage COVID-19 in India. Current COVID-19 cases in India are being managed primarily in public facilities, while the Indian government has introduced a series of steps to contain its transmission. Considering the dire context, knowledge regarding the pandemic response of resource-limited regions and lessons learned will help strengthen global public healthcare systems. Therefore, this research develops an understanding of the strategies and practices implemented by public hospitals in India in response to COVID-19 and their effect.

This study enquired 13 key executives that represent four public hospitals in four different provinces of India to develop an in-depth understanding of: (i) the challenges hospitals faced during COVID-19; (ii) policies/strategies and practices implemented by the hospital in response to the COVID-19 pandemic; (iii) the impacts of those new practices on the hospital, its staff, and patients, and (iv) the lessons learned by hospital leaders in combating COVID-19. Interview transcripts were analysed using qualitative analytical techniques to reveal critical themes.

The analysis finds eleven key strategies and practices as necessary in combatting such crisis, rates how each aspect in Indian hospitals performed when challenged and accordingly provides recommendations on enhancing each element to better manage similar calamities in the future.

1. **Leadership:** Strong leadership is a key standout in its positive impact during the pandemic, as leaders at all levels have played a significant role in effectively managing hospital operations. Leadership training and related guidance such as human resource management and strategic planning should be promoted among clinicians, to achieve similar benefits in the future.
2. **Shared commitment and teamwork:** Most staff members have taken on increased responsibilities that have been sustained through strong collaboration with team members with the clear shared objective of serving patients. Introducing procedures, structures, and educational programmes to maintain and further foster the levels of collaboration displayed during the pandemic must take priority.
3. **COVID-19 taskforces and core groups in the hospital:** Dedicated taskforces which were formed to address COVID-19 specific issues have been very effective. These core groups must continue to

be developed and supported to operate in standard environments, while also continuing to upskill so that in future crises, they can rise to the occasion even more rapidly and effectively.

4. **Anticipation and planning:** The anticipation of issues, forward planning, and leadership vision helped the hospitals prepare in advance for many of the challenges of the pandemic. Given the importance of preparation for healthcare disruptions such as pandemics, training on planning, as well as execution of those plans, may help hospitals better respond to future healthcare crises.
5. **Changes to the hospital structures and processes:** Changes to the hospital, including physical changes and process changes (e.g. new SOPs), were required to separate infected or potentially infected patients from the others. In the future design of hospitals, careful consideration must be given to building in more space and redundancy, and more flexibility to enable particular areas to be isolated so that infectious patients can be quarantined more effectively.
6. **Government support:** The Indian government has made many strong decisions in taking care of its populace during the pandemic, particularly given its challenging position as a developing economy. Despite the positive intentions and strategies, greater resource allocation and efforts to more effectively distribute provisions among the general public are needed to enhance the country's resilience in the face of the pandemic.
7. **Education and training:** Education and training have been effective to some extent and staff have followed SOPs when treating COVID-19 patients. However, this has not always been adequate, as over 5% of staff have been infected. Educating and training the frontline medical staff, not just on clinical aspects relevant to a public health crisis, but also on the operational and occupational health and safety (OHS) aspects, is critical to ensure that staff are as prepared as possible.
8. **Practices adopted in hospitals to stop the spread of the virus:** New testing procedures, SOPs and PPE protocols appear to be relatively robust and have been sufficient to an extent. While most hospitals had an SOP for adverse scenarios, this global pandemic exposed the lack of preparedness of the healthcare system for a crisis of this magnitude.
9. **Technology adoption:** Digital technologies have played an essential role in the education of healthcare staff, in enabling staff to connect, communicate, and share information. However, instead of using public domains (i.e., WhatsApp, Skype), hospitals must exploit more sophisticated digital solutions to make their operations safer, more efficient, and more service-oriented.
10. **Support for employees:** While hospital leaders clearly identify the need to support their employees who are physically and mentally fatigued from working through the pandemic, the lack of resources has significantly impacted their ability to do so effectively. Support and care for employees must be built into future crisis planning and SOPs.
11. **Logistics and procurement:** A significant aspects of hospital operations that have unfortunately been challenged during the pandemic, mainly due to external factors such as supply chain disruptions and lack of adequate supplies for the extraordinary demand. The critical lesson learned is that effective supply chain management is essential for healthcare systems to operate at full

capacity. Training in logistics/procurement and strategic planning should be ramped up, and digitalisation of supply chains should be introduced to build more resilient healthcare systems.

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1. Introduction

The world has been thrown into a panic due to the public health disruption caused by the COVID-19 pandemic. The pandemic has had unprecedented effects on citizens, healthcare organisations, businesses, governments, and economies (Leite, Lindsay, & Kumar, 2020). The outbreak of this previously unknown disease originated from Wuhan, the capital city of the Hubei province, China, in late 2019. COVID-19 is characterised by respiratory symptoms such as cough, fever and shortness of breath (Demirhan, 2020). This highly infectious virus suppresses the body's immune system so that the virus can replicate in the respiratory tissues and organs. Elderly individuals and those with pre-existing comorbidities are, therefore, more vulnerable to the severe effects of COVID-19 due to their already compromised immune responses (Asyary & Veruswati, 2020).

The number of cases of COVID-19 increased rapidly, with the virus spreading to other Chinese cities and countries around the world (Lee et al., 2020). By 25th March 2020, the disease had rapidly spread from Wuhan to 196 countries (Gupta, Banerjee, & Das, 2020). The World Health Organisation (WHO), the specialised agency of the United Nations responsible for international public health and for the coordination of global efforts to manage the impacts of the outbreak, declared COVID-19 as a global pandemic on 11th March 2020 (Verma, Saini, Gandhi, Dash, & Koya, 2020). To combat the pandemic, isolation, quarantine, social distancing, and community containment measures rapidly became the new normal (Hopman, Allegranzi, & Mehtar, 2020). Studies suggest that it may take longer than a decade for the world to recover from the overwhelming degree of devastation caused by the pandemic, societally and economically, and that it may drastically compromise the global 2030 Sustainable Development Agenda (SDG) (Djalante et al., 2020).

In the interim, the implications of the virus have driven healthcare systems beyond capacity (Lee et al., 2020). The influx of patients infected by COVID-19 has caused increased demand and outstripped the capacity of healthcare organisations to manage infectious patients (Leite et al., 2020). At the beginning of this unanticipated situation, hospitals faced substantial resource constraints within their operations (Demirhan, 2020). Frontline medical staff were exposed to particularly precarious and stressful circumstances in dealing with urgent care needs which were amplified by the demands for vigilance regarding infection control at all times, escalated patient volumes, clinical ambivalence, and insufficient access to personal protective equipment (PPE) (Krystal & McNeil, 2020). While the pandemic overwhelmed even the most resilient healthcare systems in developed nations, resource-limited hospitals in developing countries faced further challenges (Hopman et al., 2020).

India, the second-most populous country in the world with over 1.3 billion nationals, is one of the developing countries that is reported to have been severely impacted by the COVID-19 pandemic (Ram, Babu, & Prabhakaran, 2020). The first case in India was registered on 30th January 2020 in Kerala in a returned traveller from Wuhan, China (Ghosh, Nundy, & Mallick, 2020). By early March and onwards, it was clear that there was a major outbreak on India's hands (Gupta et al., 2020). The primary concern of community transmission compelled the Ministry of Health (and Family Welfare) (MoH), on 16th March, to propose various interventions such as social distancing to flatten the curve of infection in the community in order to delay the impact of increased demand and prepare healthcare supply chains (Ghosh et al., 2020). As of 12th December 2020, the number of reported cases of COVID-19 infections in India is 9,767,371, the second highest in the world after the USA, with officially confirmed deaths from the disease at 141,772 (worldometers, 2020). There is severe concern about the inadequacy of the number of tests being done to detect COVID-19 and the confirmed number of cases is seen as just the tip of an iceberg (Rai, Shukla, & Dwivedi, 2020). The death toll may be much more significant, with some experts raising doubt over India's COVID-19 mortality data, and arguing that most deaths occur outside of hospitals (Chatterjee, 2020). Healthcare experts from around the globe have expressed their concerns about containment strategies and the ability to manage COVID-19 (Ram et al., 2020). Predictions suggested an alarming situation for India in terms of its public health preparedness (Rai et al., 2020).

The Indian government was quick to recognise the threat of COVID-19 and introduced a series of steps to contain its transmission, and this has been widely lauded (Ram et al., 2020). Protective measures, dedicated and aggressive public awareness campaigns, and countrywide lockdown are some of the mitigation efforts that have been introduced (Ghosh et al., 2020). In an official statement on 30th August 2020, the government stated that the national recovery rate had reached 77 per cent and that the case fatality rate was down to 1.8 per cent due to "*timely and effective clinical management of the patients in critical care*" (MoHFW, 2020, p. 1). Despite this proclamation, it is no secret that India has an overstretched public health care system with a relatively low number of healthcare workers and overwhelmed infrastructure (Dwivedi et al., 2020).

Current COVID-19 cases are being managed primarily in public facilities (Kapoor et al., 2020). While the clinical management of COVID-19 cases in India is similar to that in countries, there are certain differences in resources, strategies and protocols, specifically in public hospitals that look after the healthcare needs of the low-income majority of the general public (Ram et al., 2020). Therefore, how the country's public healthcare system confronted the unforeseen pandemic with limited resources has sparked numerous concerns and inquiries (Dwivedi et al., 2020). Knowledge regarding the pandemic response of resource-limited regions and lessons learned will be helpful in strengthening global public healthcare systems (Hopman et al., 2020). Therefore, this research attempts to develop an understanding

of how Indian public hospitals coped with the challenges of the COVID-19 pandemic by seeking to answer the following research question:

"What new policies/strategies and practices have been implemented by public hospitals in India in response to COVID-19 and how effective have these been?"

This report is organised as follows. The next section reviews the background literature on the impact of the COVID-19 pandemic on healthcare in general, narrowing more specifically to the Indian context. The following section explains the method used to collect and analyse the research data from 13 executives in leadership positions at four leading public hospitals in India. The results come next, followed by a discussion and recommendations. The final section presents concluding remarks of the study.

2. Background Literature

Historically, infectious diseases have been the most significant cause of death of humans (Zhao & Jiang, 2020). The Spanish flu of 1918 has been the most destructive in recent times taking between 25 million and 40 million lives (Zhao & Jiang, 2020). The new infectious disease, COVID-19, has been reported in more than 200 countries and is caused by the SARS-CoV-2 virus (Bahl et al., 2020). Despite enormous effort on the part of governments and health organisations to prevent infections, outbreaks have been widespread including in hospitals, aged care facilities, and prisons (Bahl et al., 2020; Gudi & Tiwari, 2020). Vaccines are not yet widely available as a preventative measure.

As the virus has spread, its effect on global healthcare systems has been profound. The disruptive nature of this novel virus brought an influx of patients into hospitals, causing healthcare organisations with unprecedented constraints in their operations to deal with increased demand and limited capacity (Leite et al., 2020). The enormous demands of the COVID-19 outbreak have challenged both healthcare personnel and the medical supply system (Cao et al., 2020). It is crucial that hospitals are quickly transformed in ways that enable them to effectively treat patients requiring hospitalisation or intensive care, including postponing the treatment of elective patients and making room for patients affected by the pandemic (Demirhan, 2020).

With the influx of suspected and infected patients, the demand for medical supplies and equipment increased, causing further chaos in the healthcare sector (Hopman et al., 2020). While the pandemic disrupted supply chains, one of the critical challenges in managing this health crisis has been the production and distribution of medical devices, surgical supplies and pharmaceuticals to the clinical frontline (Iyengar, Vaishya, Bahl, & Vaish, 2020). Although the requirement for suitable PPE, ventilators, and infection control medication is widely accepted, procuring and distributing such products in healthcare settings has been a universal challenge (Iyengar et al., 2020). This has led to a significant shortfall of essential equipment such as ventilators, medicines including paracetamol and

PPE at the frontline, exposing the fragility in healthcare supply chains (Iyengar et al., 2020). Thus, the lack of sufficient amounts of high-quality medical supplies in the places where they are needed has become a hallmark of the pandemic.

During the COVID-19 pandemic, frontline healthcare workers have had to work under particularly intense stress (Krystal & McNeil, 2020). Frontline healthcare staff have been exposed to the virus as a result of mistakes, or shortages of PPE and inadequate infection control practices (Zhao & Jiang, 2020). It is, therefore, critical to integrate more stringent guidelines and training materials into the routines of health professionals (Huh, 2020). A study addressing challenges in healthcare facilities in the USA during the pandemic also highlights the vital role of the government (Grimm, 2020). Responsibilities of the government include providing tests, supplies and equipment, allocating adequate workforce, maintaining the capacity of facilities, and financial assistance (Grimm, 2020). The pandemic has created an urgent need for coordinated mechanisms to respond to outbreaks across health sectors, and digital health solutions have been identified as promising approaches to address this challenge (Fagherazzi, Goetzinger, Rashid, Aguayo, & Huiart, 2020; Iyengar et al., 2020).

All healthcare facilities across the world have encountered increased numbers of patients, but the mortality rate has been higher in regions where hospital capacity is insufficient for patients with COVID-19 (Demirhan, 2020). This is clearly the case in India, with the availability of 0.55 public hospital beds per 1,000 people. It has been suggested that the availability of total beds, ICU beds, and ventilators is insufficient to handle the large influx of severely ill COVID-19 patients and provide effective, sustained and uninterrupted healthcare (Kapoor et al., 2020). The density of physicians (7.8 per 10,000 population) and nurses (21.1 per 10,000 population) is also low as compared to the world average (Dwivedi et al., 2020).

The government and public hospitals in India have taken many prudent and proactive measures to combat COVID-19 (Dwivedi et al., 2020). New strategies have been implemented in public hospitals, in terms of admission, treatment and discharges, while several hospitals have been designated as COVID-19 hospitals (Ram et al., 2020). As reported by the MoH, 1,919 dedicated COVID-19 hospitals with 173,746 isolation beds, and 21,806 ICU beds were made available to the public by April (Dwivedi et al., 2020). It has been reported that the Indian government and the public healthcare sector has unveiled many strategic measures and practices to overcome the shortcomings in resources and care for a high volume of potentially infected patients. For example, the Indian government has introduced and implemented a series of innovations, including a novel smartphone application for contact tracing and aiding in quarantine and related containment measures (Ram et al., 2020). Hospitals have responded to supply chain disruption by assembling PPE kits in-house, and the Medical Council of India has amended its rules to facilitate telehealth consultations (Dwivedi et al., 2020). The strategies applied to strengthen healthcare systems in India, especially those that have enhanced public health infrastructure and ensured

a regular, well-trained, healthcare workforce is available during the pandemic, can provide a practical model to manage future COVID-19 outbreaks, and future pandemics (Lee et al., 2020).

3. Methodology

This study employed qualitative methods consisting of in-depth interviews conducted with key executives in four Indian public hospitals. Approval for the interview protocol and the research procedure was gained from the Monash University Human Research Ethics Committee prior to data collection. Data collection included 11 semi-structured interviews with executives via virtual meetings (i.e. ZOOM) and two written response from an executive that represent four public hospitals in four different provinces of Indian (See Table 1 below). The objective of the open-ended interview questions was to develop an in-depth understanding of: (i) the challenges hospitals faced during COVID-19; (ii) policies/strategies and practices implemented by the hospital in response to the COVID-19 pandemic; (iii) the impacts of those new practices on the hospital, its staff, and patients, and (iv) the lessons learned by hospital leaders in combating COVID-19. The research team carefully examined the wording of the questions to minimise ambiguity, biases, and misinterpretation. Interviews lasted approximately one hour and were recorded with the permission of interviewees. The interview subjects were all medical doctors, some also being professors. Interviews provided rich data by allowing the interviewer to grasp background information and engage in structured communication.

Table 1: Information about the participants for the interviews.

Hospital	No. of respondents	Participants	Data collection method
H1	4	Director, CEO, Superintendent, Senior Resident (Administration)	Semi-structured interviews
H2	3	Director, CEO, Superintendent	Semi-structured interviews
H3	4	Director, CEO, Superintendent, Senior Resident (Administration)	Semi-structured interviews
H4	2	Superintendent, Senior Resident (Administration)	Lengthy written response

All interviews were conducted in English and professionally transcribed. Both the respondents' names and the name of their institutions were assigned a code to maintain confidentiality. The report follows the tabled (Table 1) codes (H1...H4) to refer to the hospital. The interview transcriptions were thematically analysed using an open coding process typically used in qualitative research. NVivo, a widely used computer-assisted qualitative data analysis software suite, was used to conduct line-by-line coding and to categorise, organise, consolidate, and identify relationships between coded themes and sub-themes. Themes within each hospital were first compared to explore commonalities and validate the convergence of ideas that were raised by different respondents from the same institution. Second, the narrative was compared across hospitals to capture commonalities and differences among hospitals and to understand the particular sentiments and narratives of each hospital. By conducting a robust

analysis process across two levels, the research team was able to secure an in-depth understanding of the practices that Indian hospitals have adopted in response to the COVID-19 pandemic. The analysis identified key themes in the data, which are reported in the following findings section.

4. Findings

This section presents the findings of the study, organised to provide a better understanding of how the Indian public healthcare sector combats COVID-19 under the themes that emerged in the analysis.

4.1. Challenges faced due to COVID-19

All hospitals investigated in this project reported very similar challenges in the COVID-19 pandemic context. The following ten key challenges were reported:

1. Coping with increasing numbers of COVID-19 patients

As a result of beds being prioritised for COVID-19 patients, both routine and emergency clinical work were impacted.

2. Providing adequate attention to isolated patients with reduced staffing

Isolated patients and their families understandably expect regular communication. However, this has been challenging in a context where contact with healthcare workers needs to be minimised. Hospitals have found that providing adequate personal care for patients has been very difficult (H3) and that the expectations of VIPs and politicians who are being treated at the hospital have been particularly challenging (H1).

3. Severe shortages of Personal Protective Equipment (PPE)

Three of the four hospitals reported experiencing severe shortages of PPE for staff, including masks and other protective garments. However, one hospital (H1) was able to avoid any scarcity of PPE by anticipating demand well in advance and making PPE available as it became needed.

4. Limited COVID-19 testing capacity

All hospitals were initially challenged by limited testing capacity, but they have significantly developed their capacity over the course of the pandemic. For instance, H1 initially started with twenty to thirty tests per day. It has since considerably increased its ability to conduct tests and now conducts between five hundred and six hundred tests per day.

5. Staff fearful of working in COVID-19 areas

Staff have experienced significant concern about working in COVID-19 zones in the hospital. At H3, for instance, some nurses and paramedics have declined to work in these areas. The interviewees in this study report that the grounds on which staff have refused to work in COVID-19 areas have in some cases been specific to health concerns, but in other cases there was a more general fear of COVID-19.

6. Inadequate human resources

Two major challenges were highlighted in this respect:

- a. The problems of hiring more staff due to not having the right staff available and administrators not having the authority to hire staff outside existing budgets.
- b. To have the right people with the right skills, at the right place, at the right time is a challenge (H2)

7. Large numbers of doctors and nursing staff becoming infected

Infections among medical and nursing staff have resulted in significant staff shortages. At H1, 5% of staff have become infected with COVID-19. Outbreaks in COVID-negative areas of hospitals have been a substantial challenge. There have been instances where patients initially tested negative on two consecutive tests and were admitted to COVID-negative areas of the hospital. However, they subsequently became symptomatic, resulting in the need to quarantine doctors, nurses and other patients, as occurred at H2. This created concerning staff shortages. As a director at H3 said, *“When our staff get infected, that is a double whammy if one is infected and there are four or five who came in contact with him or her who also need to be quarantined.”* (Director, H3).

8. Budgetary constraints

Financial constraints were reported to be a significant challenge at all four hospitals in the study. Up to three-quarters of the hospital budgets were consumed by COVID-19 and related expenses. As a result, H1 found that non-COVID-related inpatient and outpatient activities such as primary care and surgery were more challenging to manage. Hospital H2 reported reduction in revenue from private patients. Hospitals also reported the high costs of extra expenditure on PPE, N95 masks, and drugs for the treatment of COVID-19 patients.

9. Extreme fatigue of staff

Many healthcare workers have been working un-relentlessly since March 2020, often without leave. Frustrations associated with not being able to provide adequate routine care for other patients (e.g. those requiring surgery or treatment for cancer) have added to the stress experienced by healthcare practitioners. The CEO of Hospital H3 said: *“It could become a challenge to keep our workforce in a state of fighting spirit...”* (CEO, H3).

10. External demands for information from media and government

A most significant challenge faced by leadership has been the constant demand for information by the press and demands from the government for data regarding hospitals' pandemic management. Hospital leaders have found these demands to be tiring, and share concerns that this takes the focus away from critical tasks (H2). Moreover, leaders find that public misinformation and small issues being blown out of proportion can drag their attention in any direction, making it difficult for them to lead their organisations during this challenging time (H2).

4.2. Anticipation and planning

At Hospital H1, the planning process began immediately when COVID-19 came to their attention. They prepared facilities, equipment, and their workforce. A hospital director with a strong vision anticipating possible scenarios has led forward planning on all fronts, and implemented core committees to guide the hospital during the pandemic. However, in the early days of the pandemic, in February and March 2020, when COVID-19 was just starting to hit its region, hospital H1 found it was not adequately organised to cope. Despite the hospital anticipating number of challenges, manufacturers and suppliers were unable to meet demand. As a result, the hospital was short of ICU beds, ventilators, oxygen supplies and other medical products. Logistics became a high priority. In addition, as the hospital was not geared up for COVID-19 testing, they had to ramp up capacity from an initial level of 20 to 30 tests per day to current capacity of between 500 and 600 tests per day. As a result of its planning processes, Hospital H1 has not experienced shortages of PPE. Its CEO believes that their "*anticipation and preparedness*" helped them respond to the pandemic.

Hospital H2 also emphasised the value of preparedness in times of disaster. This hospital created infrastructure exclusively for COVID-19 and put processes in place screening and testing early on, prepared their microbiology department, immediately enacted social distancing practices, placed signage, implemented training programs and began to deliver services via telehealth. They were able to achieve all of this as a result of their anticipating the trajectory of the pandemic and through their continuous communication with doctors, nurses, staff and patients. They believe that disaster management plans are usually only adequate to prepare for smaller-scale disasters, such as cyclones. In the case of a major pandemic not experienced earlier, their planning processes needed to be significantly more robust.

One of the respondents, a medical superintendent in his twenty-fifth year at hospital H3, reported that he had had his fair share of experience of pandemics. This included a pneumonic plague in 2002, the swine flu epidemic, and SARS. As a result of these experiences, he recognises the value of preparedness and guidelines with appropriate steps to take. At hospital H3, the first steps were to monitor the number of cases worldwide, to begin to draw together earlier pandemic experiences, and to assemble a team to focus on how to deal with COVID-19. Preparation covered several areas including how to prevent spread and which hospital services to restrict. The CEO of hospital H3 believes that preparation put them in a stronger position to deal with the pandemic, and credits the vision of their director and the team, including the medical superintendent. Nevertheless, he vows that they will be even better prepared in the future.

Hospital H4 also reports beginning to revise and formulate pandemic readiness policies and strategies when it became evident that COVID-19 had started to spread outside of Wuhan and to neighbouring nations during the first week of January in 2020. This also gave them a head start in their response to the pandemic.

4.3. COVID-19 patient care

Care for COVID-19 patients in India is carried out either in-home isolation (quarantine), at a COVID-19 care centre, or a COVID-positive hospital. The four hospitals in this study treat COVID-positive patients, while those who have mild symptoms and do not require oxygen or are asymptomatic can be housed at a COVID-19 care centre. However, patients prefer home quarantine because of a lack of comfort in such facilities as a result of large numbers of patients. Moreover, the number of beds required would be enormous if all positive patients were to be housed at the care centres (H3). Hospitals are increasing their staffing levels to match demand. Hospital H1 reports hiring more nursing staff, particularly for their ICU.

In general, 500 to 600 patients were tested, per day, by each of the surveyed hospitals during the peak of COVID-19. At the time of the interviews, Hospital H2 had 500 patients in total. Two hundred and ninety of these were COVID-19 patients, and out of these, 55 required ventilators. Ventilation-assistance devices, such as BiPAP or high-flow oxygen delivered by nasal cannula, are used to reduce the use of ventilators, which are in limited supply.

Hospitals developed protocols, specifically SOPs (standard operating procedures), for COVID-19 related activities (e.g., patient care policies, quarantine policies, screening), and trained staff accordingly. Patients admitted to public hospitals were provided treatment free of charge, including where they had to be treated for comorbidities during their treatment for COVID-19. All essential items such as soap, towels, shampoo, razors, hair oils and others were provided free of cost. Dietary needs, as recommended by treating dieticians and according to medical conditions and type of illness, were catered for by the Hospital Dietetics Department, along with juices and fruit. Visitors were not allowed in inpatient areas but were updated about the condition of their family members via video and audio calls.

4.4. Strategies within the hospital in adaptation to COVID-19 challenges

4.4.1. Changes to the hospital structures and processes

As is required of them by the Indian government, all four hospitals have dedicated facilities for COVID-19 patients. Hospital H1 has designated COVID-19 areas and staff rostering and a faculty member is in charge of these areas. Its large trauma centre was transformed into a COVID-19 centre. Policies relating to how patients enter the hospital, how they are cared for, quarantine policies and separate screening of outpatient departments (OPDs) were developed. Security staff screen patients at the entry gate, followed by a second screening step in which patients fill out a form. At this point, the OPD has been divided into two sections so that suspected COVID-19 cases can be treated separately. Suspected cases are managed with care, and with staff using PPE.

Hospital H2 converted the outer part of a building into a screening clinic where patients could be screened, and also dedicated six floors of wards for COVID-19 patient care, setting aside 250 beds.

Hospital H3 was fortunate enough to have a building under construction that they could easily convert into a dedicated COVID-19 hospital with a capacity of 200 beds. Hospital H4 was also able, within a short time span, to convert its trauma centre with over 250 beds into a dedicated COVID-19 centre. This has a capacity of 50 ICU Beds, plus general beds. Another centre was converted into a COVID-19 centre with a capacity of 1,250 beds.

4.4.2. COVID-19 Taskforces and core groups in the hospital

Each hospital has developed unique governance structures and committees to address the challenges of the pandemic.

Hospital H1 has a core committee with representatives from different departments that guides hospital operations. Its incident command centre was being led and overseen by the hospital's top-level leadership. Various other teams have been created during the pandemic, including a logistics team, infection control team, equipment team and biomedical waste management team. These meet daily and report to the core committee. The infection control team includes infection control nurses and infection control officers who were the key leaders of the team who developed and implemented policies. Hospital administrators monitored their progress. A communication team was also employed to bridge the gap between patients, relatives and doctors. A centralised rostering committee was also created, with the hospital shifting from the usual business practice of local rostering by individual departments. The heads of each of these teams were chosen for their expertise in the specific area. All of these teams operated under the incident command centre.

At Hospital H2, the first step that the leadership took was to create two teams/groups. The first, called COVID-19 Working Group, consisted of one person from each department including a hospital administrator, the medical superintendent, a representative from each of general medicine, primary medicine and community medicine respectively, nursing staff, paediatric staff, sterilisation staff, kitchen staff, and others. Virtual meetings were held at least twice a week to facilitate rapid decision-making. The second group, called the COVID-19 Advisory Group, comprised senior staffers in the institution. These individuals were responsible for communicating important information to other faculty members and convincing their faculty for action. One respondent, the Chairman of the hospital infection control committee at Hospital H2, reported that the two groups managed hospital operations collaboratively during the pandemic, and provided the support needed to introduce infection control systems quickly—especially the air conditioning and ventilation systems.

Hospital H3 created nine committees. Each was responsible for overseeing particular aspects of the hospitals' operations, including patients, nursing staff, staff who had been exposed to the virus, and essential workforce issues. The Effects Committee comprised these experts from different departments, and was under the chairmanship of the hospital's Director. This committee met almost every day initially to ensure that they could rapidly respond to issues as they arose.

During February, a COVID-19 Taskforce was created by Hospital H4 to formulate general policies and strategies for the clinical management of patients and staff who became infected with COVID-19, in order to provide the best treatment available. This task force had a large representation with members from all the core clinical departments. This was considered important for them to be able to formulate treatment guidelines based on the best available literature about COVID-19, and the WHO (World Health Organisation) and CDC (Centre for Disease Control) databases. The COVID-19 Taskforce held daily meetings with its expert members to deliberate on issues and develop best-practice policies and strategies. Hospital H4 also deployed and trained paramedics, nurses and other skilled and semi-skilled staff. Procurement of supplies and management of inventory fell under the direct supervision and control of relevant faculty members within the hospitals' administration.

At Hospital H4, the Medical Superintendent guides and supervises hospital administrators and liaises and coordinates with senior officials and clinical teams as and when required. The Medical Superintendent also chairs the Hospital Infection Control Committee (HICC). Hospital H4 also specifically created three committees to facilitate the efficient utilisation of available resources. These were: 1) Human Resource Management Committee (Faculty & Residents); 2) Human Resource Management Committee (Non-faculty & Staff); and 3) Resource Management Committee (Medicine, Equipment and Consumables). These committees have been communicating daily by video conference, mainly via Skype. The hospital leaders collectively believe that these teams have been very effective, that their efforts to deal with COVID-19 are more streamlined and focused. Issues are promptly escalated to the hospital leadership, enabling rapid problem-solving with leadership support. Creating such teams has allowed leaders to have effective communication with the whole of the organisation and provided all staff with the opportunity to speak up and raise issues. Those interviewed believe that their hospitals' core groups, under various labels, and their subsidiary advisory groups, have done an excellent job of planning and improving the situation they have faced by making effective collective decisions and implementing them quickly.

4.4.3. Education and training

Training and continuous professional development was an essential part of all four hospitals' COVID-19 response. For instance, when PPE and other infection control practices were introduced, staff were trained in their use. Every category of staff, from housekeeping and sanitation to nursing, doctors and faculty, were trained frequently, either in small groups or online. It was recognised that staff at all levels needed training in infection control, including updates for previously-trained senior medical staff.

Interviewees at Hospital H1 reported that they had adequate training facilities and staff. Through a continuous development program (CDP), staff were trained in communication, infection control, and counselling regarding COVID-19. Training needs were reported to be well-identified.

Hospitals realised this need for training very early on. Hospital H2 developed an SOP for COVID-19 and trained all staff within a matter of weeks. A dedicated group at Hospital H2 educated staff regarding the use of PPE and other groups also motivated staff. The hospital was careful to take care of the mental health of its staff as there was a significant amount of social stigma surrounding COVID-19. Hospital H2 also ensured psychiatrists were available to talk with people in the hospital and provide them with the information they needed to cope psychologically with the challenges with which they were dealing.

Hospital H3 created a committee dedicated to providing training to all the healthcare workers on how to safely don (put on) and doff (remove) PPE. The committee also circulated educational videos among healthcare workers regarding infection prevention and what precautions to take. Any new staff were also fully trained, with safety being of paramount importance in the pandemic context.

At Hospital H4, classroom-based teaching for professionals was withheld in order to prevent the spread of COVID-19 among residents. This was replaced with online classes using various e-learning platforms. More than 1,500 training & awareness sessions on COVID-19-related infection control practices had been held—for doctors, nurses, paramedics and other staff groups.

4.5. Practices adopted in hospitals to stop the spread of the virus

The hospitals implemented many infection control practices in order to prevent the spread of the virus. Infection control teams created policies, implemented them through training, and the effectiveness of these was monitored by hospital administrators (H1, H4).

Most OPDs operated at reduced capacity to help prevent transmission. Elective surgeries also took a back seat. Emergency care continued as usual, as did chemotherapy and dialysis (H1, H2, H3). Teleconsultation services have substituted many physical outpatient appointments (H1, H2, H3, H4). At Hospital H2, video teleconsultations have also been implemented.

At Hospital H1, dedicated entrances were created for staff and patients. At Hospital H3, security staff did not allow patients to enter the hospital unless they were wearing a mask, and if they were not, masks were provided free of charge. People entering the hospitals were also required to sanitise their hands and have their temperature taken (H3). When patients enter through the gate of a hospital, they are required to fill out a questionnaire and are interviewed by staff who stream them into either the COVID-19 site or the non-COVID site. In the COVID-19 OPD, doctors in PPE screen each patient to determine whether they are potentially infected. Mildly symptomatic or asymptomatic patients are sent home to self-isolate if facilities are available to them. Otherwise, they are admitted to institutional quarantine until the results of tests are returned (H1, H2). Patients presenting to the emergency department are initially screened and transferred to the “*suspected cases area*”. If the result of their test is positive, patients are shifted to the COVID-19 positive area (H1, H3, H4).

Hospitals have changed the physical organisation of their wards in order to maintain sufficient distance between beds. Hospital H4, for instance, admits patients to no more than four beds in a cubicle for six.

They have also worked to reduce crowding of wards by restricting access to outsiders as patient attendants (H4). Hospitals have also ensured that adequate soap solution for hand hygiene is available on wards (H4), and that high touch surfaces are regularly disinfected, and patient trolleys are disinfected when patients are transferred (H1, H3, H4). Hand hygiene practices among healthcare workers are monitored, and interventions are instituted to improve adherence (H4).

Departmental Contact Tracing Teams (DCTTs) have been deployed by hospitals to carry out contact tracing and infection control measures (H2, H4). If outbreaks occur, they move to seal the whole area to isolate infected people (H1).

Hospitals with residential complexes for staff have also used separate complexes, for residents, nursing officers and the faculty, to minimise the risk of transmission (H1, H3). As well as this, hospitals have provided adequate PPE to all staff, including security staff. Earlier in the pandemic, large numbers of staff were becoming infected—as a result, PPE use was enforced, and staff were fined for non-compliance (H1, H2, H4). At Hospital H1, around five to six per cent of staff became infected, and 200 staff had to be quarantined. A Rs 500 fine for not wearing a mask has therefore been introduced there, and every case of an infected staff member is analysed to determine whether the staff member was adhering to hospital procedure. A Rs 200 fine has been introduced at Hospital 2 where more than 650 staff had been infected at the time of the interview.

4.6. Support for employees

Interviewees noted that there had been mixed reactions from staff in response to the challenges of the pandemic (H2). Some staff have been prepared and willing to come forward to contribute, others have needed to be motivated, and yet others have been withdrawn. However, interviewees reported that no staff have left due to COVID-19 because hospital administrators have done their best to look after their workforces (H1).

An interviewee at Hospital H1 reported that all staff are given adequate rest after their shifts, and even during shifts. This has been enabled by the availability of backup medical forces (H1). The hospital has also increased basic amenities for staff, including newly installed TVs in their duty rooms, larger duty rooms, separate duty rooms for staff looking after COVID-19 patients, and refreshment facilities such as coffee and tea.

Hospitals have also provided facilities for staff to shower and change before returning home after their shifts, and most have provided bus services for staff to travel home (H1, H2, H3). Some have provided accommodation for staff working on COVID-19 wards (H3). At Hospital H3, however, the requirements for accommodation became so great that it was not financially viable to provide accommodation for all, as this required paying for hotels and hostels.

Centralised rostering committees played a key role in human resource planning to ensure the maintenance of services and management of outbreaks (H1). For instance, as it is very difficult to wear

full PPE for a full eight-hour shift, double staffing rosters meant that shift changes could occur every four hours. This meant that staff only needed to wear full PPE for half of their usual shifts, and were allocated work that did not require full PPE for the other half (H1). Another human resource strategy included hiring new security staff. Hospital H1 employed 600 security staff, to keep medical staff safer, to manage patients, and to provide extra emotional and technical support. Hospitals have also provided incentives to increase motivation, especially of lower-tier workers (H2). Hospital H1 has introduced meal coupons to show their appreciation for the cooperation of staff. Staff members have also been hailed as “Corona Winners”, and workers returning to work after quarantine have been honoured by senior authorities. The CEO of Hospital H3 is planning to provide staff with certificates of commendation for their work. At Hospital H2, the director records an interview fortnightly, and sends it to the press and posts it on social media to raise awareness about the work of healthcare staff, and motivation among workers.

Isolation facilities have also been provided. At Hospital H4, an isolation facility with a capacity of 22 private rooms was allocated for employees who were diagnosed with COVID-19, meaning that employees could be treated optimally. Moreover, hospitals are committed to providing PPE to the standards required to keep their staff safe (H3).

Hospitals have also provided psychiatric support to help motivate staff and overcome the stigma associated with COVID-19 through support, education, and counselling (H2). As many staff are fearful of working in COVID-19 areas, they are provided counselling on stress management and motivation to cope with their fears (H3).

4.7. Logistics and procurement

Logistics and procurement functions in hospitals emerged as essential domains in the combat against the challenges of the COVID-19 pandemic. All respondents discussed logistics as playing a critical role in supplying medical devices and medication for hospitals.

Establishing the logistics team was one of the primary tasks that Hospital H1 undertook in the formation of the core COVID-19 task force. According to its Director, Hospital H1 has a well-organised department for streamlined demand planning and procurement. He believes that purchasing for COVID-19 was “very well handled” (Director, H1). Despite manufacturers and suppliers being unable to supply to meet demand, due to its strong planning function, Hospital H1 did not experience a shortage of PPE or other equipment, as many other hospitals have experienced. Their CEO revealed that the first month of COVID-19 challenged their supply chain—it was difficult to get medical supplies, and products were more expensive. For example, a product previously worth Rs 50 was sold for Rs 500. A full set of PPE was Rs 2,500, but they had no choice but to buy at a higher price. Notably, the health minister approved hospitals to purchase essential goods at the market rate. However, prices have since come down, and

hospitals are no longer in crisis. The government has also created an e-market which has simplified procurement.

Hospital H2 did not face a severe shortage of PPE or other necessary materials either as they ordered these from the government in the initial stages of the pandemic, and the government continued to supply PPE reliably. A respondent at Hospital H2 also revealed that there is a black market of goods operating in the region which they must be cautious of to avoid in the procurement process. While the hospital maintained its stocks, for the most part, lockdowns and associated transportation shut-downs did impact deliveries. The supply chain at Hospital H2 has not yet been digitised, but they are in the process of exploring how to implement a robust hospital information system and a laboratory information system.

In contrast, Hospital H3 found logistics management and the procurement of PPE challenging. As a result, the CEO personally monitors the procurement function. They are working hard to secure adequate supplies of consumables and surgical protective gear, for which at present, India is self-sufficient due to ramping up its domestic production. Hospital H3 took the conscious decision to build sufficient stock of essential medication for at least three months. This has become an advantage. However, not having had the level of preparedness of the other hospitals initially, as well as a lack of government support, seems to have resulted in their suffering shortages of PPE. At that time, India was not carrying out domestic PPE or sanitiser production, and securing these supplies was the most significant challenge H3 had faced.

The procurement of supplies and management of inventories at Hospital H4 were under the direct supervision and control of top-level hospital administrators, with the medical superintendent guiding and supervising the process. The procurement of PPEs and other equipment, including ventilators, were made through a centralised purchasing system. Through channels developed during the pandemic, user departments sent their requirements after they had been scrutinised by area experts, and following the advice of senior management. Items were received in central stores and distributed to user departments through requests raised online. This allowed for better management of inventories and transparency in the flow of supplies. All of these activities were under the strict control of top management who maintained an "eagle eye" overall procurement activity in order to ensure uninterrupted supplies of consumables and medicines for timely administration to COVID-19 patients. Initially, little attention was paid to the procurement of equipment such as PPE and ventilators, as the hospital had sufficient ventilators in its ICU units and surgical stores were adequate to cope with the demand for PPE in the initial few weeks. However, with the increasing number of cases, the hospital decided to convert its trauma centre into a dedicated COVID-19 hospital. With this came the need to increase the number of ICU beds with ventilatory support, and so the decision was made to set up a centralised store for procurement and distribution of PPE to all COVID and non-COVID patient care areas. Their current robust procurement system has played a vital role in maintaining adequate and timely supply of PPE.

4.8. Leadership

The Director of H1 has been hailed as a visionary for his role in anticipating, planning, guiding, supporting, motivating and providing solutions to pandemic problems. He is reported by interviewees to have been a key factor in the hospital's successful response to COVID-19: "His wisdom made us self-reliant to cope with the situation" (Administrator, H1). He had the ability to delegate duties to suitable people, to develop a strong team who were able to coordinate, problem-solve, who respected one another and who led by example in the dynamic context. Some of the key leadership qualities that have helped Hospital H1 better address the COVID-19 pandemic and achieve better preparedness and take strong action have been change management, previous experience in similar situations, the ability to motivate and encourage the team, and being a visionary to anticipate and plan well in advance. As the superintendent at Hospital H1 said, "*Institute which has a good leadership can do much better than other mediocre institutes*". It was noted that the fact that their leader was a clinician was advantageous, as clinicians better understand healthcare demands and can judge which newer technologies can be incorporated into systems. The CEO at Hospital H1 believes that an important leadership trait is the ability to share knowledge among the team. The director believes that the most critical aspect of leadership in such situations is leading by example—at the COVID-19 frontline. The second is "*to maintain the cool*", as such conditions are challenging and frustrating for all, and the third is the ability to motivate and encourage staff.

The CEO of Hospital H2 believes that he is blessed to have a fantastic team. The most important leadership aspect displayed by the superintendent was his most efficient utilisation of available resources. The director highlighted teamwork, encouraging subordinates to contribute, providing the freedom to operate, encouraging innovative ideas and trust as critical aspects of leadership. However, the interviewees at Hospital H2 felt that no particular person stood out as the prominent leadership figure during the pandemic—they worked as a team.

At Hospital H3, the planning and foresight of the director and the team, including the medical superintendent, have been "*very crucial*" aspects of their leadership. The leadership of the hospital administration, various departments and senior faculty members, are credited for their effort. The chief director has led the effects committee, supported through senior leaders of the institution, enabling them to face the "*catastrophe*". Interviewees considered leading by example to be very important, along with the ability to make urgent decisions. The outstanding hospital director knew that he had to be proactive and keep up-to-date with the latest information in order to deliver "*situational leadership in a fast-changing scenario*". Similarly, at Hospital H4, the dynamic leadership of the Director & CEO were identified as significant factors behind their success in dealing with the pandemic.

Overall, leading by example emerges as a particularly important leadership behaviour in high-risk, dynamic and demanding situations. Many other generic leadership qualities, including foresight,

planning, motivation, teamwork, and delegation, also emerged as vital. Notably, many respondents believed that having a clinician (in particular, a doctor) leader in the pandemic context is advantageous.

4.8.1. Shared commitment and teamwork

As reported in section 4.4.2, a key strategy used by hospitals was to form COVID-19 task forces, core groups and specific teams with particular responsibilities. All hospital leaders were very optimistic about the role played by individuals as part of a team to achieve collective objectives. *"Of course, a good team always make the leaders look better, vice versa"* (Director, H1). The leadership shown by volunteers, NGOs and social organisations that came forward to lend a hand in different ways also contributed to facing the COVID-19 challenge. While policies, guidelines, SOPs and strategies have yielded good results and were perceived to be necessary, all leaders identified shared commitment, teamwork, dedication and enthusiasm of staff as significant factors behind their success. This included not only the administrators, doctors, and nurses, but also sanitary workers, aids, security guards and other *"lower category"* workers.

4.9. Government support

The central government supported all hospitals, as well as the Ministry of Health and local state governments, and all interviewees believed that these groups had done a *"wonderful job"*. Some ways in which the government supported the hospitals are:

1. When the COVID-19 pandemic hit, the central government provided immediate support to hospitals with additional budget support (H1, H3).
2. The government helped hospitals to set up testing labs and provided testing kits (H1).
3. The Ministry of Health formulated policies to help hospitals combat and control the pandemic, and communicated this through digital mediums (e.g., WhatsApp) (H1).
4. State executives facilitated meetings over digital media (e.g., Skype) to inform new policy and share knowledge among hospitals and with other authorities such as the district magistrate and police, and even with other countries such as Bangladesh (H1, H2).
5. The central government introduced a new policy to ramp up telehealth services when OPD services were restricted (H1, H2, H3).
6. The government provided space for institutional quarantine. If someone is identified as a mildly symptomatic or asymptomatic carrier of the virus, the hospital refers them to institutional quarantine (H1, H4).
7. The government has also provided significant amounts of hotel accommodation for staff who travel long distances to work so that they do not have to return home daily (H1, H4).

8. When procurement was difficult, the health minister sanctioned buying essential products at market rates, and the government mobilised procurement and transportation and created an E-market to facilitate procurement (H1, H2).

It became evident through interviews that Hospital H1, in particular, has managed to gain a great deal of support from the central government—much more so than the other three facilities. It appeared that this was associated with its robust and visionary leadership.

4.9.1. Other external support

As well as the government support outlined above, hospitals drew on other forms of external support or contributed to sharing support externally. For instance, foreign videos and teaching material were translated into local languages and distributed among staff at Hospital H1. Hospital H2 created a movie on COVID-19 preparedness and sent this to the media. Interviewees at Hospital H2 also spoke of the frequent availability of webinars by specialists from other hospitals all over the country, especially in neighbouring states, which helped to disseminate current best practices among medical professionals. Finally, volunteers, NGOs and social organisations supported all hospitals in different ways.

4.10. Technology adoption

As a result of COVID-19, the use of technology, and more specifically, the utilisation of digital platforms, has been accelerated. Currently, the meetings are rarely conducted face-to-face, instead undertaken via digital platforms such as Skype or WhatsApp in all hospitals.

Telemedicine or other teleconsultation services, where patients are consulted over the phone, have substituted physical consultations since March 2020. Patients who have access to a smartphone can also have telehealth appointments via video conferencing, in some cases (i.e., WhatsApp). Prescriptions and other manuscripts can now be exchanged through the telemedicine portal or emailed to patients. Within the hospitals, mobile tablets have been provided to all departments exclusively for teleconsultation use. While hospitals have had telemedicine in place for some time (e.g. Hospital H3 for over fifteen years), the pandemic has accelerated its uptake and increased the adoption of new technologies (e.g. Hospital 2 has updated their video telemedicine system).

Technologies have also been used to help disseminate information among professionals and to the public. For instance, videos have been circulated among staff and even sent to the media to increase awareness of particular infection control issues. Digital platforms such as WhatsApp have also been used to circulate videos and other messages. Common email groups for nurses and doctors were created to distribute circulars, meeting minutes and other important information. Staff training and professional collaboration to learn from one another have moved online in the form of online classes and webinars. At Hospital H3, smartphones and iPads or other mobile tablets have been provided to staff at the frontline to communicate with leaders to facilitate rapid problem-solving.

Although many advances have been made as explained above, not all technology is being used to its full potential yet. For instance, while Hospital H3 has a robust electronic medical records system, interviewees believe that there is greater scope to use this technology more effectively.

4.11. The impact of adopted strategies and practices

A key impact of the strategies adopted by hospitals has been a culture change in hospitals. At Hospital H1, the overarching culture has transformed such that staff now *"just love to work"*. While there was initially staff who were hesitant to enter the COVID-19 areas, through counselling and training, they have overcome their fears and are *"working very hard"* and are better able to coordinate their work. The guidance of the leadership and their willingness to help resolve the problems of their staff has helped enormously to improve the workplace culture during pandemic situations. The entire experience has changed behaviours such that staff are now very determined, understanding and collaborative.

Collective decisions of teams have been *"very effective"* in tackling COVID-19. Entire teams have shared responsibilities and problem-solving, resulting in the minimal need for issues to be escalated. This has allowed leadership to spearhead the higher-level problems and implement continuous improvement work. As part of the cultural transformation, digital transformation has improved efficacy, staff communication, and the reach of the hospital to patients.

Overall, study participants felt that all of the efforts that have gone into formulating strategies and policies to combat the effects of the virus to date has been very fruitful. The superintendent of Hospital H2, for example, rated his hospital's effort as 8 out of 10. Despite this, he understood that they need to continue their efforts and the fight for some time. Overall, the policies, guidelines, SOPs and strategies have yielded promising results and have been found to be productive. New work practices have positively affected patients, and even though infection rates are very high, the healthcare services have managed to keep mortality rates low. It was revealed that *"the patients are also quite satisfied with the care they get here"*. Local community apparently appreciate that the hospitals have performed beyond their capacity, as well as the dedication of the staff. It was also reiterated that they are continually improving: *"We get finer and finer"*.

However, outcomes have not always been favourable, particularly when it comes to PPE use by staff. Despite repeated education, leaders have found that as time went by (e.g., about four months into the pandemic), staff began to become complacent, and were observed to be moving through the hospital without masks and incorrectly using PPE. As a result, hospitals implemented penalties for staff members (Rs 200-500 depending on the hospital) who were not wearing masks.

Overall, teamwork and leadership were identified as critical success factors during the pandemic. At the same time, government support, anticipation and planning, logistics and procurement, education and training, and technology adoption were also deemed essential.

4.12. Lessons learned

A number of important lessons have been learned by the hospitals studied in this project. These are:

1. Working in teams and sharing responsibilities has significant advantages in disaster situations.
2. Leadership was a critical success factor in pandemic management.
3. Quick decision-making and rapid implementation of decisions are critical in disaster contexts.
4. Vision is needed to anticipate potential problems and solutions. Advance planning is critical so that by the time needs arise, adequate resources are available. Hospitals need to anticipate disasters and be prepared for worst-case scenarios. This is the case for the next pandemic or epidemic, as well as for other kinds of disasters. In particular, robust disaster management plans which take into account the possibility of prolonged disasters are necessary.
5. Hospitals must have areas earmarked for expansion of capacity so that new or re-purposed facilities can be created and begin operating rapidly in the case of sudden increases in demand. This may be in the form of a standalone hospital or a different section for addressing infectious diseases such as COVID-19. Disaster reserve also applies in terms of medicines, equipment, and potential staff.
6. Hospital leadership need to ensure that they are skilled in communication, workforce management, supply chain management, coordination, and technology. The management of medical equipment is also critically important.
7. The ability to learn from mistakes is critical if errors are made, it is essential to be willing to go back and change things, not to be afraid to admit that better decisions could have been made, and to say, *"let's go and do it this way"*.
8. Hygiene practices need to be better embedded in the day-to-day life of citizens and hospital staff. The community needs to be educated about infectious diseases and how the social stigma around diseases can be counterproductive for society.
9. Hospitals need to be equipped with the latest technology, which is a challenge due to the rapidly evolving nature of technology. Instruments and equipment need to be regularly updated.
10. More generous knowledge sharing is needed among hospitals to learn from each other and improve.
11. Training and education are critically important, and training in logistics and strategic planning should be prioritised. Hospitals need to train *and* retrain hospital staff on an ongoing basis and staff need to accept the need for such ongoing training.

12. Protocols, SOPs, committees, and teamwork are essential to improve performance. These all need to be continually revised and embedded in everyday practices. Accreditations must be kept updated in line with protocols.
13. The quality of medical care and nursing provided must be high. Their work needs to be carried out with love, compassion, empathy and sincerity in challenging times. As a result, stress management, counselling, and motivation of staff are vital when they are facing a challenging situation in which they are likely to be fearful.
14. Formally researching best practice for COVID-19 response is necessary.

5. Discussion

The findings reveal eleven crucial strategies and practices each hospital has adopted in response to the COVID-19 pandemic (see Table 2). While each of these strategies is important, the impact these have had on hospital operations and their patients depends on the extent to which these are performed in practice, and this varies significantly with context. Based on the data captured in this project, Table 2 provides a numerical rating of the impact of each strategy/practice on the response to the pandemic in public hospitals included in this study. On a scale of 1 to 5, 1 represents the least impactful and 5 the most impactful.

Table 2: Strategies and practices adopted by hospitals and their impact on hospitals (1 represents the least impactful and 5 the most impactful)

Strategies and practices	The impact				
	1	2	3	4	5
1. Anticipation and planning	1	2	3	4	5
2. Changes to hospital structures and processes	1	2	3	4	5
3. COVID-19 taskforces and core groups in the hospital	1	2	3	4	5
4. Education and training	1	2	3	4	5
5. Practices adopted in hospitals to stop the spread of the virus	1	2	3	4	5
6. Support for employees	1	2	3	4	5
7. Logistics and procurement	1	2	3	4	5
8. Leadership	1	2	3	4	5
9. Shared commitment and teamwork	1	2	3	4	5
10. Government support	1	2	3	4	5
11. Technology adoption	1	2	3	4	5

5.1. Recommendations

1. Anticipation and planning: rated 4/5

The anticipation of issues, forward planning, and leadership vision helped the hospitals prepare in advance for many of the challenges of the pandemic. However, not everything went to plan at all times, as external factors such as supply chain disruption and the consequent lack of supplies for the emergent requirements hindered successful crisis management. Given the importance of preparation for healthcare disruptions such as pandemics, the development of visionary leaders and training on planning, as well as execution of those plans, including project management training, may help hospitals better respond to future healthcare crises.

2. Changes to the hospital structures and processes: rated 4/5

Changes to the hospital, including physical changes and process changes (e.g. new SOPs), were required to separate infected or potentially infected patients from the others, for instance at the entrance to healthcare facilities, and within hospitals. This has worked well in many cases. However, the lack of infrastructure resources has meant that completely isolating COVID-19 wards (i.e., in separate buildings) have been intricate in some cases. In the future design of hospitals, careful consideration must be given to building in more space and redundancy, and more flexibility to enable particular areas to be isolated so that infectious patients can be quarantined more effectively. This will help to minimise the impacts and limitations on OPD services and surgeries that we have seen during this pandemic.

3. COVID-19 taskforces and core groups in the hospital: rated 5/5

Despite limited resources and operating under pressure, specific teams which were formed to address COVID-19 specific issues have been very effective. These dedicated taskforces have done a fantastic job of both sharing and effectively distributing responsibilities for certain aspects of the COVID-19 response, allowing top-level leaders to focus on higher-level tasks. These task forces and core groups must continue to be developed and supported to operate in standard environments, while also continuing to upskill so that in future crises they can rise to the occasion even more rapidly and effectively.

4. Education and training: rated 3/5

Education and training have been, to some extent effective, and staff have followed SOPs when treating COVID-19 patients. However, this has not always been adequate to effect behavioural change. This is evident, for example, in staff not adhering to PPE procedures, to such an extent that hospitals have imposed fines to alter staff behaviour. Educating and training the frontline medical staff, not just on clinical aspects relevant to a public health crisis, but also the operational and occupational health and safety (OHS) aspects, is critical to ensure that staff are as prepared as possible.

5. Practices adopted in hospitals to stop the spread of the virus: rated 3/5

New testing procedures, SOPs and PPE protocols appear to be relatively robust and have been sufficient to an extent. However, the practical application of such practices by staff is, as mentioned above, still inconsistent. As a result, many staff members (over 5%) are still getting infected. SOPs in crises, like pandemics, need to be prepared in advance of crises and be part of usual practice. While most hospitals had an SOP for adverse scenarios, this global pandemic exposed the lack of preparedness of the healthcare system for a crisis of this magnitude.

6. Support for employees: rated 2/5

Hospital leaders interviewed in this study clearly identify the need to support their employees who are physically and mentally fatigued from working through the pandemic. They have made some effort to support staff, but overall, the lack of resources has significantly impacted their ability to do so effectively. For example, hospitals have not always been able to provide ongoing accommodation to all employees treating COVID-19 patients. In addition, psychological support appears fragmented and sporadic. Frontline employees are the lifeblood of crises, but without adequate support, they will become mentally and physically exhausted from working under such conditions. Their support and care must, therefore, be built into future crisis planning and SOPs. We suggest that reward and punishment regimes, while appropriate to the Indian context, need some reconsideration.

7. Logistics and procurement: rated 1/5

Logistics and procurement are significant aspects of hospital operations that have unfortunately been challenged during the pandemic, mainly due to external factors such as supply chain disruptions and lack of adequate supplies for the extraordinary demand. Most essential supplies were short when they were most needed and had to be purchased at a higher price. This challenge raises questions about the responsiveness and resilience of healthcare supply chains. Procurement and logistics functions were able to recover mainly through government support, as well as ramping up the manufacturing sector in India. The pandemic compelled top management to oversee logistics operations, highlighting the importance of healthcare supply chain management. The critical lesson learned is that effective supply chain management is essential for healthcare systems to operate at full capacity. Training in logistics/procurement and strategic planning should be ramped up, and digitalisation of supply chains should be introduced to build more resilient healthcare systems.

8. Leadership: rated 5/5

Strong leadership has been a key standout in its positive impact on hospital operations during the pandemic. While many of the external entities on which hospitals depended failed, the leadership of the hospitals in this study rose to the occasion. Top-level executives appear to have done an excellent job of planning and steering their hospitals and in mobilising effective teamwork through a turbulent time.

Leaders at all levels have played a significant role in effectively managing hospital operations. Hospital H1, in particular, benefited from the skill of its director. To achieve similar benefits in the future for all hospitals, leadership is an area that must be strategically developed. Leadership training and related training such as human resource management and strategic planning should be promoted among clinicians, especially given that all top-level executives in Indian public hospitals are medical clinicians.

9. Shared commitment and teamwork: rated 5/5

Shared commitment and teamwork are other main standout factors that significantly contributed to improving hospital operations and the care of patients. According to the respondents in this study, most staff members have taken on increased responsibilities, and morale has been sustained through strong collaboration with team members with the clear shared objective of serving patients. It is also evident that this has been a significant change and raises the important point that there might previously have been a gap in healthcare systems when it comes to shared commitment and teamwork. Where this still exists, it must be addressed with urgency. While the crisis has instigated collaboration and the willingness of staff to take on greater responsibility, these sentiments may fade over time once the crisis is resolved. It should, therefore be a priority to introduce procedures, structures, and educational programmes to maintain and further foster the levels of collaboration displayed during the pandemic.

10. Government support: rated 4/5

The Indian government has made many strong decisions in taking care of its populace during the pandemic, particularly given its challenging position as a developing economy. The government has made changes to the policy, hospital funding, helped with procurement and transportation, provided isolation facilities to COVID-19 patients and infected healthcare personnel, and provided testing facilities. The impact of such efforts has, however, been hampered by the country's large population and limited resources. Despite the positive intentions and strategies of both local and state governments, greater resource allocation and efforts to more effectively distribute provisions among the general public are needed to enhance the country's resilience in the face of the pandemic.

11. Technology adoption: rated 3/5

Digital technologies have played an essential role in the education of healthcare staff, in enabling staff to connect, communicate, and share information. Notably, hospitals have predominantly opted for freely available platforms (i.e., WhatsApp, Skype) to communicate, rather than more expensive alternatives. Despite not being able to be in physical contact, which is often vital in healthcare, teleconsultation services have replaced many services that are usually delivered face-to-face with much success. However, more sophisticated digital solutions are available, and hospitals must now look to exploit the technologies available to them in order to make their operations safer, more efficient, and more service-

oriented as travel restrictions are removed and these hospitals are once again required to service large population areas.

6. Concluding remarks

This research has examined the strategies and practices implemented by public hospitals in India in response to COVID-19, as well as their effectiveness in the pandemic context. The responses of 13 key senior executives from four public hospitals in India were thematically analysed using qualitative analytic techniques. The findings reported challenges that these hospitals faced and how they have cared for their patients in this challenging context. The report has outlined strategies and practices adopted by hospitals and how these have impacted hospital operations. The hospitals that participated in this study are, however, metropolitan hospitals, and do not represent a rural perspective. It may be the case that rural hospitals face substantially different challenges.

Eleven key factors were identified as essential strategies/practices adopted by hospital leaders. The impact of hospitals adopting those practices has been rated. These key strategies are ranked below in terms of their effect within the pandemic context to date.

1. Leadership: 5/5
2. Shared commitment and teamwork: 5/5
3. COVID-19 taskforces and core groups in the hospital: 5/5
4. Anticipation and planning: 4/5
5. Changes to the hospital structures and processes: 4/5
6. Government support: 4/5
7. Education and training: 3/5
8. Practices adopted in hospitals to stop the spread of the virus: 3/5
9. Technology adoption: 3/5
10. Support for employees: 2/5
11. Logistics and procurement: 1/5

The findings of this report suggest that the most impactful aspects of hospitals' responses to the pandemic have been strong leadership, the formation of dedicated task forces and core groups, and shared commitment and teamwork among hospital staff. Logistics and procurement, as well as support for employees, appear to be critical activities that will require further attention at the hospitals investigated in this study, and likely others hospitals if the healthcare sector in India is to improve its resilience in the face of this pandemic, and future crises. The eleven key strategies (see Figure 1 below) may be taken as recommendations for where hospitals can apply concerted efforts in order to enhance their ability to respond to pandemics and other disasters. Such actions will likely help to improve the overall resilience of healthcare systems.

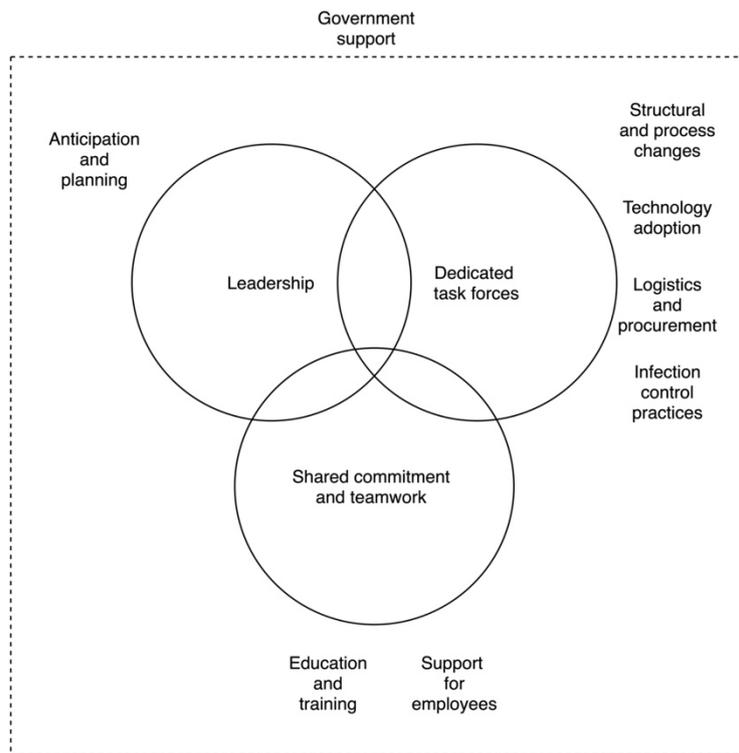


Figure 1: Critical Strategies for Improving Hospital Response to Pandemics

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