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HOSPITAL RESILIENCE IN RESPONSE TO THE COVID-19 PANDEMIC: INVESTIGATING THE ADAPTATIONS OF A HOSPITAL IN RIO DE JANEIRO

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Abstract

Healthcare Resilience (HRE) describes the ability of a healthcare system to adjust its operations before, during, or after events and thus sustain the necessary operations to ensure patient care. The recent COVID-19 pandemic has challenged healthcare systems around the world, demanding great adaptability from managers and frontline workers. This article describes and discusses from a Resilience Engineering perspective how a private hospital in the State of Rio de Janeiro adjusted its regular processes, based on real work, to meet the working conditions imposed by the pandemic, focusing on: Bed Management, Human Resources (Reorganization, safety, and mental health), Supplies, and Infrastructure.

Keywords: Ergonomics; Resilience Engineering; Hospital Care; variability.

1. INTRODUCTION

Brazil was one of the first countries in Latin America to confirm cases of COVID-19. The first cases were confirmed in February 2020, and the disease quickly spread across the country. In March 2020, Brazil declared a Public Health Emergency of National Concern (ESPIN). The first death from COVID-19 in the country was confirmed on March 17, 2020. On June 21, 2020, the country had already registered more than 1 million cases and 50 thousand deaths (CAVALCANTE, CARDOSO-DOS-SANTOS, *et al.*, 2020).

The pandemic scenario put pressure on health systems, forcing them to rethink their activities and protocols to deal with the demands of the context. Health systems are constantly changing internally, as new behaviors emerge to meet the demands of daily patient care (BRAITHWAITE, J, CLAY-WILLIAMS, *et al.*, 2013). Resilience Engineering (RE) has been

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offering concepts and tools to assist in the treatability of complexity characteristics present in health systems and services. Hospitals are expected to be always accessible and functioning and to be able to respond to sudden increases in demand, especially during disasters (MOHTADY ALI, DESHA, *et al.*, 2021). Thus, Mohtady Ali et al. (2021) highlight the need to improve the development of disaster-related plans and procedures and the training of hospital teams, pointing out that Resilience Engineering has been explored as an approach to systematically identify opportunities for improvement in complex operational environments, such as hospitals. Khalil et al. (2022) point out that building resilient hospitals requires strengthening capacities for contingency plan development, communication, training and education, intensive care, development of operational procedures, and promotion of mental well-being, among others.

Health Resilience (HCR) deals with the application of the concepts and methods of Resilience Engineering to the health domain (HOLLNAGEL, BRAITHWAITE, *et al.*, 2013). Formally, the RHC can be defined as:

> the ability of the health system (a clinic, a ward, a hospital, a country) to adjust its functioning before, during, or after events (changes, disturbances, and opportunities) and thus sustain the necessary operations under expected and unexpected conditions (CLAY-WILLIAMS, BRAITHWAITE, 2019)

RHC inherits the principles of RE, so some important points about resilience in health are the focus on daily work, because it usually goes well; the interpretation of health systems as complex sociotechnical systems; the look at work as it actually occurs (*work-as-done*) and not at work as it is assumed or expected to be done (*work-as-imagined*) (BRAITHWAITE, Jeffrey, HOLLNAGEL, 2018). The concept of *work-as-done* is important, as it allows the understanding of the existence of alternative practices that enable the success of care despite the pressures imposed by the system. These alternative solutions are expressions of the system's resilience (HOLLNAGEL, BRAITHWAITE, 2018).

This study aims to capture the changes and adaptive ways of working that emerged during the COVID-19 pandemic in a hospital in the city of Rio de Janeiro. The results report the team's work experiences during this period and are discussed from the perspective of Resilience Engineering. Thus, by framing the changes in the context of resilience engineering, additional suggestions and considerations can be compiled to increase organizational resilience. Analyzing how a system has adapted to disruptive events in the past provides information to assess the system's potential for adaptation in the future, when new variations and challenges occur (WOODS, 2018).

2. METHODOLOGY

This study reports and discusses the transformations promoted in a hospital as a response to the pressures imposed by the COVID-19 pandemic. During this period, the risk management team dedicated itself to seeking solutions to performance variabilities, focusing on the elimination, mitigation or transfer of occupational and operational risks, improved communication, care for workers' mental health and operational effectiveness. All the processes described in this article took place in the period from 03/16/2020 to 08/02/2020. The unit's emergency plan was activated on 03/16/2020 to help with the definitions of mobilization and action. The characteristics of the unit and the tools used in data collection and analysis are described below.

During the Pandemic, the unit focused on in this study had 35 inpatient unit (IU) beds and 35 Intensive Care Unit (ICU) beds (1.94 times higher than in previous years, when the maximum number reached 18 ICU beds) and had a maximum number of 15 deaths in a period of one week (2.5 times higher than the weeks of previous years, in which the maximum number reached 6 deaths per week).

To manage the increase in the number of critically ill patients and the challenges imposed by the situation, the team changed its way of acting. The communication line maintained its characteristics, but face-to-face meetings were restricted or suspended due to the risk of contamination and the operation started to make use of radio communicators with channels defined by processes, namely: Assistance, Emergency, Nutrition, Hygiene and Maintenance.

The multidisciplinary team was composed of an executive director; medical manager; operations manager; nursing manager; care coordinators; pharmacy coordinator; occupational safety engineer; occupational physician; coordinator of the hospital infection control commission (CCIH); nutrition supervisor; clinical engineering supervisor; financial supervisor; maintenance supervisor; quality analyst; service coordinator. All demands were detailed in the form of an action plan, in an Excel spreadsheet, using the 5W2H methodology. In subsequent meetings, the demands in the spreadsheet were updated and, when necessary, new demands were added.

A daily tool that was essential to discuss what worked and possible problems in the operation was the *Safety Huddle*. This tool has, as a means, short and frequent meetings, where teams can efficiently manage any concerns and identify possible failures. The main objective is to detect risks to the operation early, promoting constructive discussions with

multidisciplinary teams and aligning actions for continuous improvements. The tool was used with the help of a video call meeting application, which allowed the distance between participants to be maintained. The actions defined by the corporate area were sent to management, which, in turn, transmitted the information during Safety *Huddle*, e-mail and physical folder with the most recent technical notes.

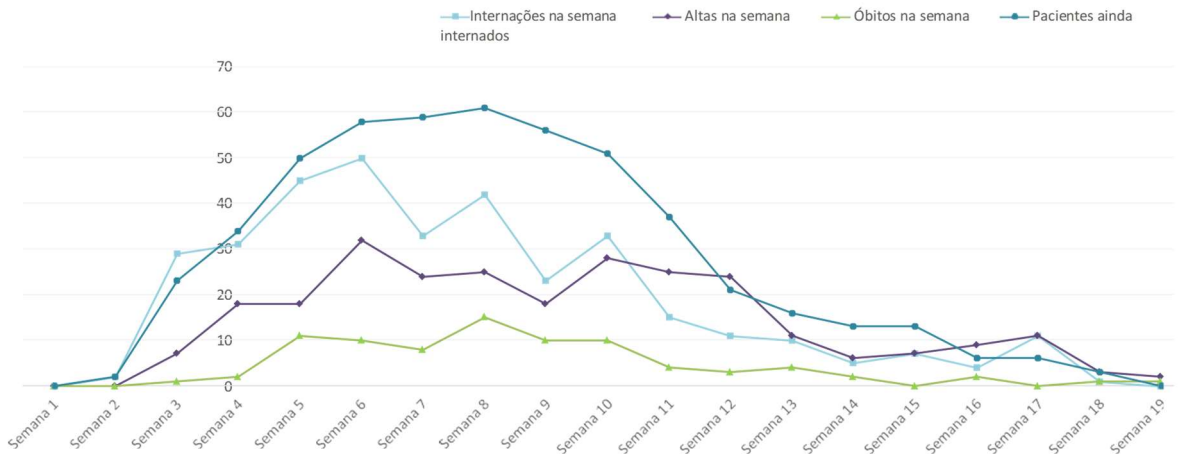
The performance of Occupational Safety and CCIH using security cameras to verify the adequacy of the sectors in the attire and removal of individual and collective protective equipment, waste management and hand hygiene, was essential due to the short time available and the limitation of people in the areas. The videos from security cameras gave the possibility of watching hours of footage in a short time using the video acceleration feature, helping in data collection.

The adaptations made were organized into four axes: bed management, human resources, inputs, and infrastructure and internal flows. Finally, these transformations were analyzed in the light of the literature on resilience in health. The measures adopted are described chronologically in three moments: pre-pandemic, pandemic and post-pandemic. This division is associated with the dynamics of the demand for care experienced by the hospital, which, obviously, was an influencing factor in the adaptations made.

3. FINDINGS

The number of hospitalized patients, hospital discharges, and deaths in the pre-pandemic, pandemic, and post-pandemic periods are shown in Figure 1. The adaptations identified in the four axes are described and discussed below.

Figure 1 - Flow of patients with COVID-19



Source: Prepared by the authors, 2023

3.1. Bed Management

Pre-pandemic period - Weeks 1 and 2: care for suspected outpatients was carried out in the emergency room in an isolation area and promptly transferred to a reference hospital. There was a schedule for the release of the fifth floor of the hospital carrying out internal transfers. The fifth floor was being prepared to receive only COVID patients. In actions ordered with the corporate, external transfers were also carried out according to the profile of patients and elective surgeries were interrupted, facilitating the vacancy of beds and preventing new contaminations.

Per pandemic period - Week 3 to 12: after vacating, the hospital was already configured as a Covid Hub, we expanded the number of beds to 32 ICU beds and 32 IU beds. The Emergency beds were intended for care; and contingency, to patients with respiratory symptoms and confirmed cases. This expansion was carried out gradually according to demand and according to adjustments in human resources and inputs. In week 12, analyzing the data already falling, we return to the reality of week 4. In this way, we started the demobilization of Covid beds.

Post-Pandemic period - Week 13 and 20: In week 18 the hospital admitted its last patient diagnosed with Covid. The ICUs reduced their beds concomitantly until the total demobilization of the intended beds, as well as the UI.

3.2. Human resources

Pre-pandemic period - Week 1 and 2: following the guidelines of the technical notes, the removals of contact and suspected employees were carried out with occupational medicine monitoring. Faced with the need to hire labor in a short period of time and with an increased quantity, the format of the hiring process was modified, giving it greater agility.

Pre-pandemic period - week 3 to 12: the use of diagnostic tests for COVID-19 begins to be carried out to rescue the workforce, a fact that is fundamental for the composition of care. Positive cases were monitored with medical support from Occupational Medicine and psychological support from psychologists. The unit used the home office strategy, with the support of the corporate, for administrative employees who were part of the established risk group, in institutional technical notes based on the current legislation applicable to health

environments. In the period, the days of absence of medical professionals (PJ) who were suspected or confirmed cases were not discounted.

Per pandemic period - week 13 to 20: reduction of *headcount* with the use of talent and redistribution of the workforce according to active beds.

Some other aspects related to human resource management that can be highlighted:

a) Training / Meetings: due to the impediment of the Pandemic situation itself, training and meetings had to be adapted or canceled, according to institutional technical notes based on the current legislation applicable to health environments. Most of the training and meetings were carried out by video, security cameras were used to verify the adequacy to the new flows and procedures implemented in the areas. The videos from the security cameras gave the possibility of the Occupational Safety sectors. CCIH can check hours of footage in a short time using the video acceleration feature.

b) Occupational Medicine: the monitoring of employees was done daily with reports sent to management in which employees on leave were informed. Occupational medicine made daily contact for guidance and rescue of human resources, which were scarce at the time, as well as clinical follow-up.

c) Psychology: psychological support actions were carried out with employees with differentiated strategies aimed at containing fear and effective wear and tear in the face of the sensitivity of the teams both in the corporate and institutional sectors. Anxiety and depression assessments were carried out for employees working in cases of potential suicide risk and we had group motivational actions such as messages and photos of family members at meal places in order to reduce the impact of anxiety.

3.3. Inputs

Pre-pandemic period - Week 1 and 2: the work was carried out with the corporate with the purchase and stock schedule of PPE / Material and Medicines and use of a daily spreadsheet provided by the Pharmacy sector to control PPE / Material and Medicines.

Per pandemic period - week 3 to 12: in the COVID Cohort areas, an employee dedicated to the storage, control and availability of personal protective equipment (PPE) was allocated. It was necessary to adjust the period of use of the N95 protective masks. Due to high consumption

and scarcity in the market, following technical guidelines from the Ministry of Health and the Health Department, the useful life of the material was changed by up to 14 days. There was difficulty in the initial acquisition of Face Shield masks, but without impact on the operation due to corporate supply and loans. The physical PPE delivery sheets remained in the sectors of the Covid cohorts, avoiding cross-flow of employees in the administrative areas, giving agility and security to the process.

3.4. Infrastructure and Internal Flows

The flow before the Pandemic worked with all patients who wandered entering through the same place and patients who arrived using the ambulance, entered through an access on the side of the hospital. The structure had the Emergency sector on the ground floor, on the 1st floor the ICU, on the 2nd, 4th and 5th floors operated the UI sectors and on the 3rd floor the Surgical Center.

One of the extremely important documents for use during changes in structure and flows is the emergency response plan (PAE). Under the common denominator of crisis, we are considering all situations and scenarios that have losses in common. This concept encompasses natural and technological disasters and complex emergencies. The scenarios contemplated in the PAE include the different emergency situations that may occur in the facilities and operations, taking into account the impacts and their possible consequences in the unit and its surroundings, contemplating the safety of employees, service providers, patients, companions, visitors and the facility. Phenomena (catastrophes or disasters) of sufficient magnitude to require external help are also considered in this plan. The PAE of this hospital unit was developed in 2018 by the Occupational Safety Engineer and the Executive Management, listening to workers from different areas. At the time, the unit's PAE considered 28 scenarios such as: fire; lack of electricity; leakage of radioactive material; natural phenomena; among others. However, the plan did not contemplate the scenario of an epidemic/pandemic, requiring the construction of this chapter as situations presented themselves. A misalignment between the established protocols and the demands of reality was observed; the contingency scenarios provided for in the emergency response plan (PAE) did not provide the necessary support for the adversities that arose in this context.

Pre-pandemic period - Weeks 1 and 2: the construction of the epidemics chapter (contingency plan) in the PAE was carried out as the weeks progressed and the new processes were disseminated within the unit. As shown in Figure 2, there was a separation of respiratory

symptomatic patients from other patients, employees, and suppliers, ensuring adequate care and safety. As shown in Figure 3, a flow for death was established, with the rental of containers for the storage of bodies in view of the estimated deaths in this phase. It was necessary to allocate two refrigerated containers in the hospital's parking lot to store COVID deaths. For the containers to be used effectively, it was necessary to align communication between the teams involved. Communication was carried out with radio communicators, which greatly facilitated integration. It was necessary to wait for the preparation of the body following the protocol for handling post-mortem bodies and use an ambulance to move the deaths, since the containers were located 50 meters outside the unit.

There was a concern that there would be no exchange of deaths, both on the part of the unit and the funeral services, as it could generate contamination and dissatisfaction on the part of the families. There were already some reports in the news talking about cases in various regions of Brazil. An application was created that showed in real time the number of deaths and in which container it was stored. Whenever CAF was called for the removal of a Death by the funeral home service, the employee checked which container the death was in.

Per pandemic period - week 3 to 12: there was a need for adjustment to adequately accommodate respiratory symptomatic patients due to the present demand. The second floor of the UI was restructured to receive cases that required intravenous drugs and temporary rest for patients with respiratory symptoms. The sector functioned as an extension of the Emergency sector. In the Emergency sector, beds were created for the care and maintenance of serious patients diagnosed with suspected or confirmed COVID. This 5-bed unit served as a contingency for IU patients who needed ICU care, but with difficulty in finding vacancies.

4. DISCUSSION

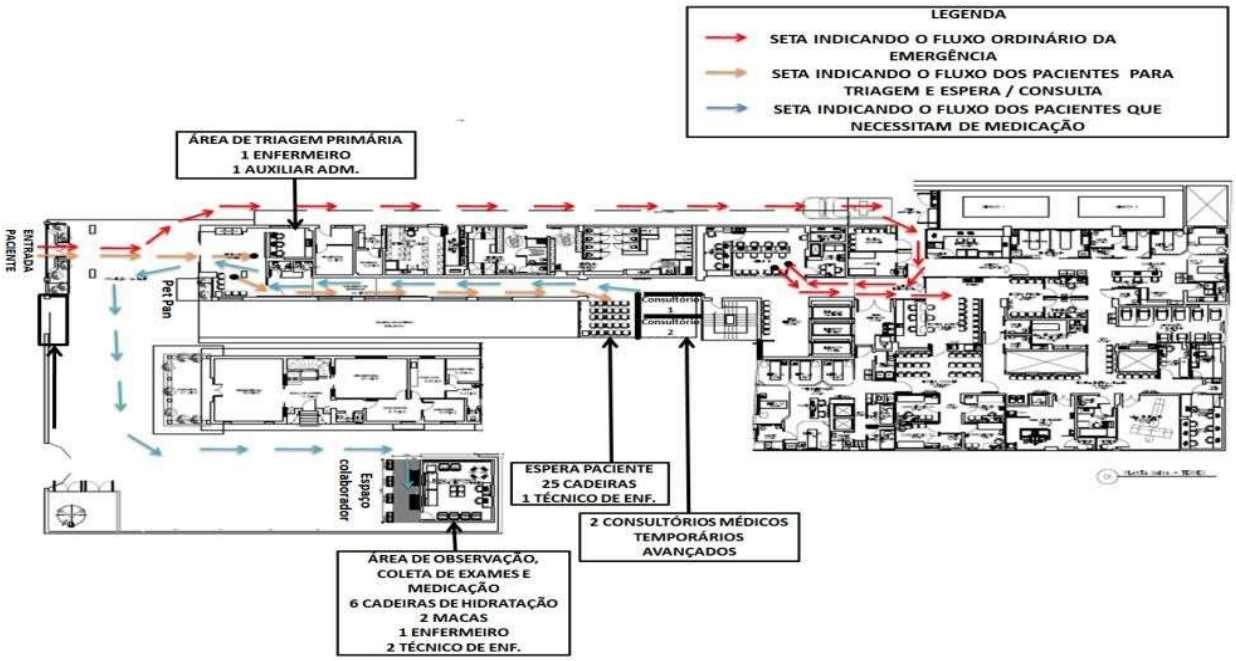
The response to the demands generated by the pandemic has highlighted the amount of changes that can occur quickly within a work system to keep its functions operational. Such changes can provide insight into the development of organizational resilience that may not have been visible otherwise. The theoretical-methodological framework of resilience engineering can provide guidance on ways to increase the potential for resilience in the health system studied.

The communication aspect is critical to resilient performance, supporting anticipation, monitoring, and learning skills. When investigating the development of ways to improve adaptive capacity in a children's hospital, Bartman et al. (2021) point out the need for a new

approach, *Safety-II,* associated with resilience. The authors indicate the practice of *Huddles*, similar to those that supported the development of the transformations described in this article. It is highlighted that this type of meeting facilitates open and fast communication, allowing better anticipation and response to situations (BARTMAN, MERANDI, *et al.*, 2021).

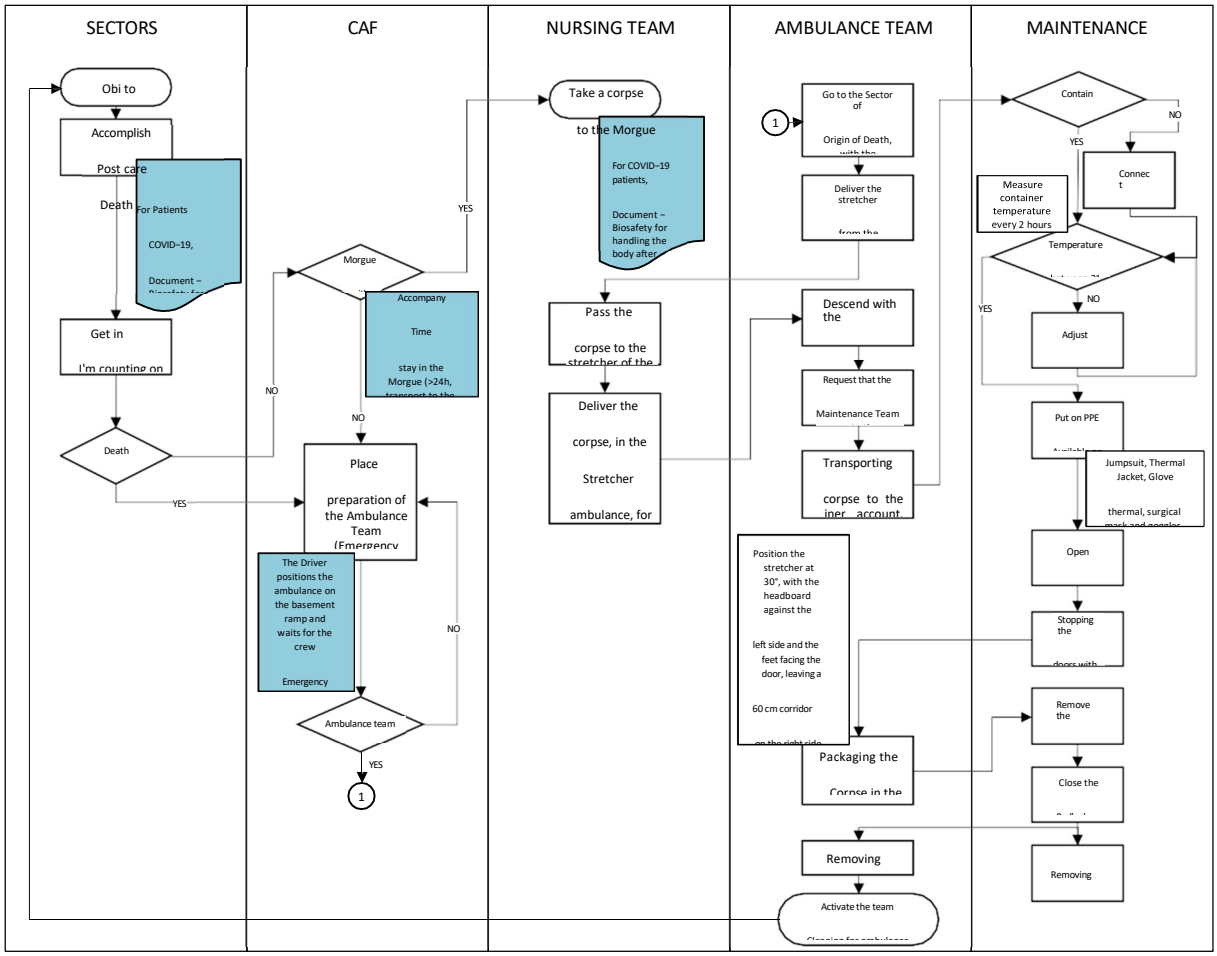
As described in the results, the high demand for ICU beds impacted the hospital's workflow and physical arrangement. An adaptation, hitherto unconsidered, was necessary to ensure the necessary isolation measures and at the same time maintain the provision of care. When discussing ICU infrastructure to improve resilient performance based on an analysis of the pandemic context, Marczyk et al. (2023) point out that hospitals need areas that can function as alternative ICUs and that these areas need to have the necessary structure to support the activities developed in these units. The authors add that these areas need to be designed from a clinical and engineering perspective in order to ensure their functionality. The case study presented by the authors highlights the need for this collaboration to develop the necessary solutions to the demands that arose in the unit during the pandemic.

Figure 2 - Flow of patients in the Emergency Department



Source: Prepared by the authors, 2023

Figure 3 - Death Flow



Source: Prepared by the authors, 2023

As described in the results, one concern of the hospital team was to ensure the physical and mental health of the workers during this period of great demand. Emphasis was placed on the monitoring of workers on leave due to COVID-19 and on psychological support initiatives, in order to reduce cases of anxiety and other problems. In an integrative review on adaptations to disasters and the construction of resilient hospitals, Mohtady Ali et al. (2022) point out that, in disaster situations, several factors affect the physical and mental well-being (fear, isolation, frustration, workload, among others) of hospital teams. The authors indicate that managers and decision-makers address these issues in order to ensure the integrity of the team, because,

although not all factors are avoidable, they can be managed. Ambrose et al. (2021) explain that the pandemic has brought about an unprecedented change in health systems and that the need for social distancing can affect the ability of teams to socialize and support each other. Stress and the risk of psychological disorders, such as Post-Traumatic Stress Disorder, threaten workers' ability to maintain their routine activities. Thus, resilience is essential for teams to recover and move forward to provide appropriate care to patients (AMBROSE, LAYNE, *et al.*, 2021).

Another highlight in the adaptations made is the death management process. As described, an application was created to assist in the flow of information and the times of this process. Unfortunately, situations such as the exchange of bodies and lack of storage capacity are not uncommon in disaster situations such as the one experienced. Therefore, in periods with a higher number of deaths, appropriate procedures need to be put in place to manage the situation. Recommended measures include increasing storage capacity, increasing the staff needed to care for the bodies, and adequate training of this staff for identification and manipulation processes respecting the cultural and religious beliefs of patients and their families (MUNASINGHE, MATSUI, 2019). In addition, in the case studied, it was of particular importance to implement measures that would reduce the risk of contamination.

As mentioned, a situation like the pandemic was not defined in the hospital's emergency plan, forcing an adaptation beyond its expectations, and a continuous adaptation process within a new context that was constantly emerging. Ambrose et al. (2021) argue that the COVID-19 pandemic has created a unique opportunity to study resilience in health and thus derive learnings for periods of lower demand. Mohtady Ali et al. (2022) also advocate that learning from disaster response efforts and adaptations can improve resilience when dealing with future critical situations (MOHTADY ALI, RANSE, *et al.*, 2022). In addition, the resilience demonstrated during the initial response needs to be understood so that learning can take place to ensure a transition to organizational resilience that is not a result of the individual resilience of groups of workers (CARMAN, EVANS, *et al.*, 2021). In the face of the pandemic, it has become evident that clinical staff can learn quickly and incorporate successful reactions. During disasters, immediate response is facilitated. However, the longevity of organizational memory remains a challenge. It is also necessary to understand how to improve the capacities of hospitals to identify obstacles that challenge the organizational learning process (MOHTADY ALI, RANSE, *et al.*, 2022). According to (MOHTADY ALI, DESHA, *et al.*, 2021), in a review on approaches to building resilient hospitals, one of the main factors to be considered in the

development, dissemination, communication, and implementation of disaster preparedness plans is dynamism, that is, plans should be regularly reviewed and flexible according to the assessment of emerging needs, allowing managers to modify their plans according to the type and impact of the disaster to increase efficiency. This study is a first step in this understanding, in order to promote resilient performance in this unit.

One limitation of this study is the difficulty in monitoring the results obtained by means of indicators. Some processes for data collection were suspended due to the reduction of manpower (workers on leave) in the unit and to avoid the circulation of administrative workers in COVID sectors. However, some members of the response team were sent to São Paulo, where the pandemic was more advanced, to support the managers of other units in the network, replicating the response model described in this article. This fact shows the effectiveness of the transformations implemented, which made the unit stand out among the 12 hospitals in the network, distributed in 6 Brazilian states.

It should be noted that systems work due to people's ability to adapt to situations. Frontline workers have the ability to recognize actual demands, adjust their performance, and interpret and apply procedures according to circumstances. This flexibility of performance is essential to ensure safety and the achievement of the desired results. Trying to eliminate or restrict this variability in behavior would be counterproductive, as it would negatively affect the results. Therefore, it is essential to support and encourage the necessary improvisations and performance adjustments, as these are expressions of the system's resilience (HOLLNAGEL, 2017).

5. CONCLUSION

A This article investigated the changes that occurred in the work system of a hospital as a response to the COVID-19 pandemic. The study's findings reinforce the perception of the need for operational adjustments to deal with the challenges imposed by the pandemic on health care units. However, we emphasize the presence of many of these during typical operation. By analyzing the results in the light of the concepts proposed by Resilience Engineering, it was possible to identify how the adaptations favored the maintenance of activities during a critical period, thus obtaining lessons about this system and about hospital units in general.

During the period of combating the pandemic, it became clear that ordinary structures and processes were not adequate to deal with the new reality. Although there were corporate committees dedicated to the preparation of technical notes to assist in the management of

processes, unforeseen situations occurred at a much faster speed, resulting in technical notes that were shared only after the activities had already been completed. However, thanks to the daily discussions held during Safety *Huddle*, the teams were able to present what adjustments were necessary to ensure the success of the activities.

The Resilience Engineering approach helped to understand the preparedness and response to the Pandemic adopted in the hospital. Even in the face of so many risks and uncertainties, the focus has not fallen on failures, but on successes. The result obtained reflects the seriousness and determination with which local professionals faced this crisis.

As a future research effort, one can explore how pre-existing cultural, structural, and procedural factors facilitated or hindered resilient performance during this period. In addition, it is important to investigate how to use the lessons learned from this critical moment to foster resilient performance in typical moments, seeking to give them continuity.

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