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Hospital resilience in responding to the Covid-19 pandemic: investigating the adaptations of a hospital in Rio de Janeiro

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Summary

Health Resilience (RHC) describes the ability of a health system to adjust its functioning 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 unit in the State of Rio de Janeiro adjusted its ordinary processes, based on real work, to correspond to the working conditions imposed by the pandemic, focusing on: Beds, 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 Importance (ESPIN). The first death from COVID-19 in the country was confirmed on March 17, 2020. On June 21, 2020, the country had already recorded 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 context demands. 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 offering concepts and tools to assist in the treatment of complexity characteristics present in health systems and services. Hospitals are expected to always be 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 plans and procedures related to disasters 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 capabilities for developing contingency plans, communication, training and education, intensive care, developing operational procedures, and promoting mental well-being, among others.

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

> the ability of the healthcare 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 necessary operations under expected and unexpected conditions (CLAY-WILLIAMS, BRAITHWAITE, 2019)

RHC inherits the principles of ER, so some important points about health resilience are the focus on daily work, because it generally goes well; the interpretation of health systems as complex socio-technical systems; looking 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 successful 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 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 finding solutions for performance variability, focusing on the elimination, mitigation or transfer of occupational and operational risks, improved communication, care for workers' mental health and operational effectiveness. . All processes described in this article took place between 03/16/2020 and 08/02/2020. The unit's emergency plan was activated on 03/16/2020 to help define 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 beds in the inpatient unit (IU) and 35 beds in the Intensive Care Unit (ICU) (1.94 times greater than in previous years, in which the maximum quantity reached 18 ICU beds) and had a maximum number of 15 deaths in a period of one week (2.5 times greater 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 posed by the situation, the team changed the way it operates. The line of communication maintained its characteristics, however face-to-face meetings were restricted or suspended due to the risk of contamination and the operation began to use 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; Work safety engineer; occupational doctor; hospital infection control committee coordinator (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 on the spreadsheet were updated and, when necessary, new demands were added.

A daily tool that was essential for discussing what worked and possible problems in the operation was the Safety Huddle. This tool uses short and frequent meetings, in which teams

can efficiently manage any concerns and identify possible failures. The main objective is to detect operational risks 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 maintaining distance between participants. The actions defined by the corporate area were sent to management, which, in turn, transmitted the information during the Safety Huddle, electronic mail and physical folder with the most recent technical notes.

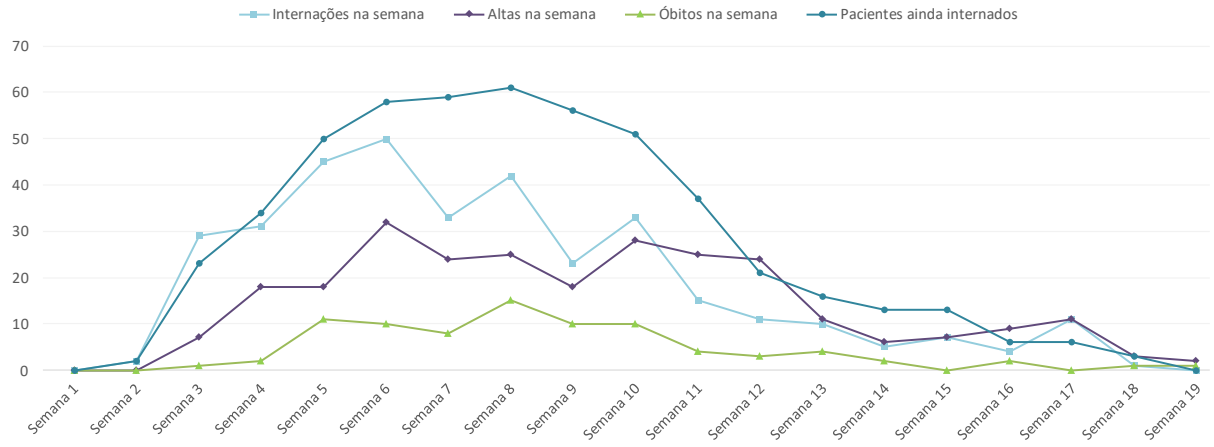
The work of Occupational Safety and CCIH using security cameras to check the adequacy of the sectors in the attire and removal of individual and collective protective equipment, waste management and hand hygiene, was essential due to the limited time available and limited number of people in the areas.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

The adaptations carried out were organized into four axes: bed management, human resources, inputs, and infrastructure and internal flows. Finally, these transformations were analyzed in 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 demand for care experienced by the hospital, which, obviously, was an influencing factor in the adaptations made.

3 Results

The numbers 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: Own elaboration, 2023

3.1 Bed Management

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

Per pandemic period - Weeks 3 to 12: after vacating, the hospital already configured as a Covid Hub, we increased the number of beds to 32 ICU beds and 32 UI beds. The Emergency beds were intended for assistance; and contingency, for respiratory symptomatic patients 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 already falling data, we returned to the reality of week 4. In this way, we began 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 simultaneously until the total demobilization of the allocated beds, as did the UI.

3.2 Human Resources

Pre-pandemic period - Week 1 and 2: following the guidelines in the technical notes, contact and suspected employees were removed with monitoring from occupational medicine.

Faced with the need to hire labor in a short space of time and with an increased quantity, the format of the hiring process was modified, giving it greater agility.

Pre-pandemic period - weeks 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 assistance. Positive cases were monitored with medical support from Occupational Medicine and psychological support from psychologists. The unit used the home office strategy, with corporate support, for administrative employees who were part of the established risk group, in institutional technical notes based on current legislation applicable to healthcare environments. During the period, the days of absence of medical professionals (PJ) who were suspected or confirmed cases were not taken into account.

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

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

a) Training / Meetings: due to the pandemic situation itself, training and meetings had to be adjusted or canceled, according to institutional technical notes based on current legislation applicable to healthcare environments. Most of the training and meetings were carried out via video, security cameras were used to verify compliance with the new flows and procedures implemented in the areas. Videos from security cameras provided the possibility of Occupational Safety sectors. CCIH can check hours of footage in a short time using the video acceleration feature.
b) Occupational Medicine: monitoring of employees was carried out daily with reports sent to management in which employees on leave were informed. Occupational medicine carried out daily contact for guidance and rescue of human resources, which were scarce at the time, as well as clinical monitoring.
c) Psychology: psychological support actions were carried out with employees with different strategies aimed at containing fear and effective exhaustion due to the sensitivity of teams in both the corporate and institutional sectors. Anxiety and depression assessments were carried out on employees working in cases of potential suicide risk and we had motivational group actions such as messages and photos of family members at meal locations with the aim of reducing the impact of anxiety.

3.3 Inputs

Pre-pandemic period - Week 1 and 2: work was carried out with the corporate team with programming for the purchase and stock 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, a collaborator was allocated dedicated to the custody, control and provision of personal protective equipment (PPE). It was necessary to adjust the period of use of the N95 protective masks. Due to high consumption and scarcity on the market, following technical guidelines from the Ministry of Health and the Department of Health, the useful life of the material was changed by up to 14 days. There was difficulty in initially acquiring Face Shield masks, but without impact on the operation due to corporate supply and loans. The physical PPE delivery forms remained in the Covid cohort sectors, avoiding cross-flow of employees in administrative areas, providing agility and security to the process.

3.4 Infrastructure and Internal Flows

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

One of the extremely important documents to 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 catastrophes 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, considering the safety of employees, service providers, patients, companions , visitors and the installation. Phenomena (catastrophes or disasters) of sufficient magnitude to require external assistance 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; between 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 was observed between the established protocols and the demands of reality; 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, respiratory symptomatic patients were separated from other patients, employees and suppliers, ensuring adequate care and safety. As shown in Figure 3, a flow for deaths was established, with the rental of containers for storing bodies given the estimated number of deaths in this phase. It was necessary to allocate two refrigerated containers in the hospital 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 using radio communicators, which greatly facilitated integration. It was necessary to wait for the body to be prepared following the protocol for handling post-mortem bodies and use an ambulance to move the deaths, as the containers were located 50 meters outside the unit.

There was a concern about not exchanging deaths, both on the part of the unit and the funeral services, as it could generate contamination and dissatisfaction on the part of 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 they were stored. Whenever the CAF was called to collect a death from the funeral service, the employee checked which container the death was in.

Per pandemic period - weeks 3 to 12: there was a need to adjust to adequately accommodate respiratory symptomatic patients due to the current demand. The second floor of the IU was restructured to receive cases that required intravenous medications 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 critically ill patients diagnosed with suspected or confirmed COVID. This 5-bed unit served as a contingency for IU patients who required ICU care, but had difficulty finding beds.

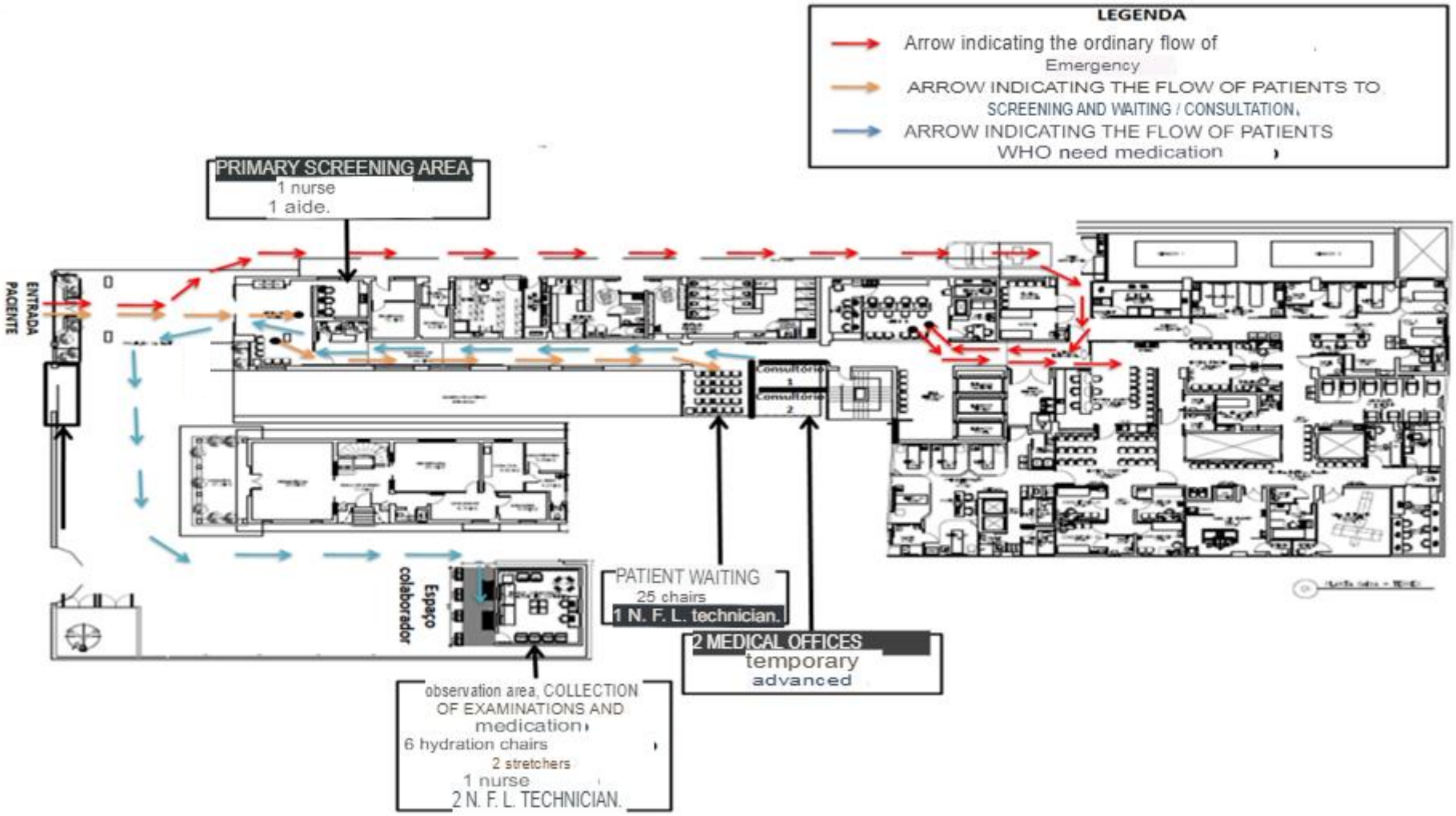
4 Discussion

The response to the demands generated by the pandemic highlighted the number of changes that can occur quickly within a work system to keep its functions operational. Such changes can provide insights 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 studied health system.

The communication aspect is fundamental 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 recommend 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 quick communication, allowing better anticipation and response to situations (BARTMAN, MERANDI, et al., 2021).

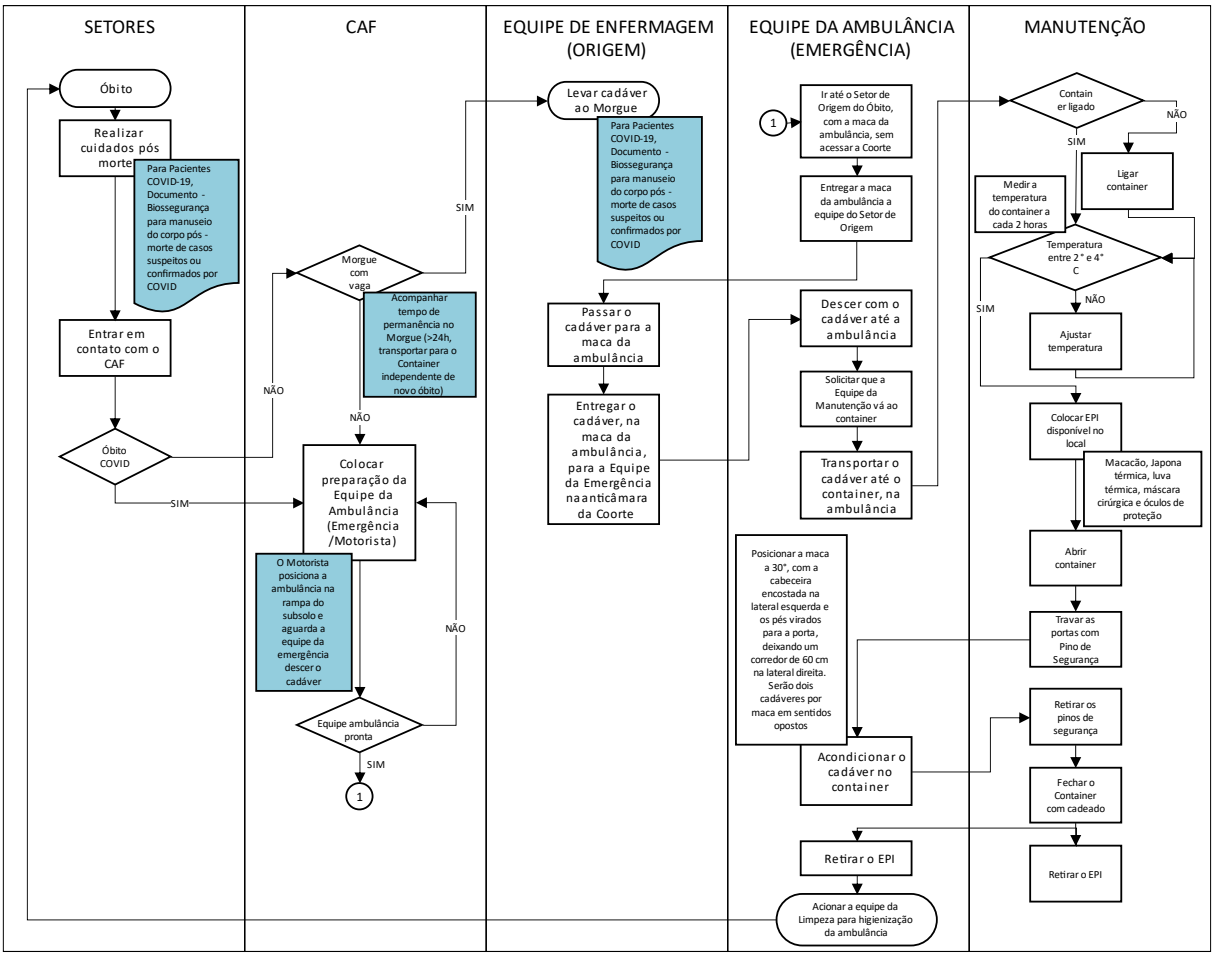
As described in the results, the high demand for ICU beds impacted the workflow and physical arrangement of the hospital. An adaptation, previously not considered, was necessary to guarantee the necessary isolation measures and at the same time maintain the provision of care. When discussing ICU infrastructure 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 carried out 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 - Patient flow in the Emergency



Source: Own elaboration, 2023

Figure 3 - Death Flow



Source: Own elaboration, 2023

As described in the results, a concern of the hospital team was to ensure the physical and mental health of workers during this highly demanding period. Emphasis was placed on monitoring 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 recommend that managers and decision makers address these issues in order to guarantee 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 caused an unprecedented change in healthcare systems and that the need for social distancing can affect teams' ability 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 adequate 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 with the flow of information and the timing of this process. Unfortunately, situations such as body swapping and lack of storage capacity are not uncommon in disaster situations like the one we experienced. Therefore, in periods with a greater number of deaths, appropriate procedures need to be implemented to manage the situation. Recommended measures include increasing storage capacity, increasing the team needed to care for the bodies, and adequate training of this team for identification and handling processes respecting the cultural and religious beliefs of patients and their families (MUNASINGHE, MATSUI, 2019). Furthermore, in the case studied, it was of particular importance to implement measures that reduced the risk of contamination.

As mentioned, a situation like the pandemic was not defined in the hospital's emergency plan, forcing adaptation beyond expectations, and a continuous adaptation process within a new context that was constantly emerging. Ambrose et al. (2021) argue that the COVID-19 pandemic created a unique opportunity to study resilience in healthcare and, thus, derive learnings for periods of less demand. Mohtady Ali et al. (2022) also advocate that learning from disaster response efforts and adaptations made can improve resilience when dealing with future critical situations (MOHTADY ALI, RANSE, et al., 2022). Furthermore, the resilience demonstrated during the initial response needs to be understood so that learning can occur 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 became clear 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 important to understand how to improve hospitals' capabilities in identifying 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 must 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 towards this understanding, in order to promote resilient performance in this unit.

A limitation of this study is the difficulty in monitoring the results obtained through indicators. Some data collection processes were suspended due to the reduction in workforce (workers on leave) in the unit and to avoid the movement 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 managers from other units in the network, replicating the response model described in this article. This fact highlights the effectiveness of the transformations implemented, which made the unit stand out among the 12 hospitals in the network, distributed across 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 real demands, adjust their performance, and interpret and apply procedures according to the circumstances. This performance flexibility is essential to guarantee safety and obtain the desired results. Trying to eliminate or restrict this variability in behavior would be counterproductive as it would negatively affect results. Therefore, it is essential to support and encourage the necessary improvisations and performance adjustments, as these are expressions of system resilience (HOLLNAGEL, 2017).

5 Conclusion

This article investigated the changes that occurred in a hospital's work system in response to the COVID-19 pandemic. The study 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 highlight the presence of many of these during typical operation. By analyzing the results in 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 learning 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 preparing technical notes to assist in the management of processes,

unforeseen situations occurred at a much greater speed, resulting in technical notes that were shared only after the activities had already been completed. However, thanks to the daily discussions held during the 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 preparation and response to the Pandemic adopted in the hospital. Even in the face of so many risks and uncertainties, the focus was not 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 could explore how pre-existing cultural, structural, and procedural factors facilitated or hindered resilient performance during this period. Furthermore, it is important to investigate how to use the lessons learned from this critical moment to encourage resilient performance in typical moments, in order to ensure their longevity.

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