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October 26, 2021

# Resilience, Safety and Health: Reflections about Covid-19' assistance

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**Abstract.** There are growing concerns about how healthcare systems can adapt in times of crisis. The overarching challenge lies in how resilience engineering could be used to analyze and improve the performance of healthcare systems concerning the Covid-19. This study aims to describe the relationship between resilience potentials and health and safety aspects and its consequences on quality and resilience in healthcare systems. This study has a quantitative methodological approach using a survey with the Resilience Analysis Grid as an approach to analyzing organizational resilience based on the idea that four potential (responding, monitoring, learning and anticipating) influence patient safety, occupational health and safety and resilient system performance. As for this study results, anticipating and monitoring, overall resilience and occupational health and safety are the variables that need more attention in healthcare systems. This study has a dyad of contributions, as a practice, evaluate the resilience in a pandemic time, and as theoretical, the identification of the importance of resilience four potential connections in healthcare systems.

**Keywords:** Healthcare, Covid-19; Resilience Engineering, Human Factors, Ergonomics.

## 1 Introduction

Living in times of pandemic, as experienced since 2020 due to Covid-19, is a humanity old challenge. However, the Covid-19 pandemic occurs in a scenario of unprecedented interconnection between people, organizations and ecosystems [1]. Management skills in all segments of public and private institutions are being challenged and the healthcare systems were affected the most.

In the front line to deal with the disease, these institutions needed to quickly reorganize their practices, aiming at the services efficiency and, above all, the protection of its employees and patients. Elective surgeries needed to be canceled, areas for patients of different pathologies were transformed into exclusive beds for Covid-19 patients, employees were relocated from their previous sectors for exclusive care to these patients and the emergency hiring of many others needed to be done. In addition to the difficulties commonly experienced in the healthcare sector, such as emergency department overcrowding, scarcity of fundamental resources, high demand for personal protective equipment (PPE) and its real availability are a contributing factor to the installation of chaos in this system [2][3].

Atypical situations such as the one currently experienced requests individual and organizational resilience, focused on the greater good: the population assistance. The term resilience presents different concepts in different areas of knowledge. In general, it is related to the materials, individuals, organizations, and systems ability to adapt. In safety management, resilience is perceived as “the system’s ability to adjust their functioning before, during, or after changes and disturbances, so that the system can maintain the necessary operations, under expected and unexpected conditions” [4].

In this way, the discipline of Resilience Engineering (RE) aims to develop methods, techniques and tools to help complex socio-technical systems (CSTS), such as healthcare systems [5], to keep their operations safe and productive [6]. Resilience is a CSTC characteristic, enabling the CSTS to cope with its variability [5], and is even more necessary at a pandemic time like the one presented by Covid-19. Science-based approaches that consider human cognition and behavior in complex work systems are required to improve pandemic management [7].

Resilience is not something that the organization has, but something that it does [4]. Thus, for the organization to perform resiliently, four potentials (abilities) are essential: the ability to respond to system variability; the ability to monitor such variability, both in the system itself and in the external environment, identifying the need or not to activate the ability to respond; the ability to anticipate comprises knowing what to expect, anticipating possible threats and opportunities; and, finally, the ability to learn from past events. In this perspective, resilience cannot be measured from the count of results (e.g., number of accidents or incidents), but from its ability to respond, monitor, anticipate and learn from a situation [4] [8].

Still from the perspective of RE, analyzing the four potentials helps to understand the differences between the work-as-imagined (e.g., work policies and procedures) and the work-as-done (effectively performed by the workers). Thus, studying resilience in healthcare systems is essential to understand how healthcare systems are able to carry out their activities and to analyze or identify improvements opportunities in their processes [9] [10] [11].

Considering that more than 2 million people lost their lives as consequence of Covid-19 (as of 04 February 2021) [12] and that the world still struggles to control the disease, to understand how the frontline healthcare workers perceive the resilience potentials performance by their hospitals while assisting Covid-19 can be a significant indication of how the organization faces the challenges, manifested in health, safety and performance conditions.

Thus, the aim of this study is to identify the relationship between resilience potentials and occupational health and safety, patient safety and overall systems resilience in hospitals during the Covid-19 Pandemic, from the workers' point-of-view.

## 2 Method

This study is part of a main study, entitled “Organizational Resilience evaluation during COVID-19 pandemic: a study in the healthcare sector”, approved by the Ethics Committee of the responsible institution (CAAE 32774620.0.0000.5346). The ethical precepts were respected in all phases of the study.

The study presented in this chapter is characterized as descriptive, with a quantitative approach, since it is concerned to describe a phenomenon in a specific context [13] (resilience during COVID-19 in the healthcare sector).

A survey was applied remotely to a snowball convenience sample. Invitations to participate in the study were sent through email and social media to potential participants, who could also invite other potential participants. The inclusion criteria for this study was: healthcare workers, working in Brazilian hospitals during the COVID-19 pandemic.

The questionnaire presented two categories of questions, the first one related to the participants and their hospital characterization (profession, hospital city, private or public hospital, hospital area) and the second one related to the resilience' four potential and based on the Resilience Analysis Grid (RAG), using 5-point likert scale [14]. RAG is focused on analyzing the resilience of an organization in everyday work based on how the organization responds, monitors, learns and anticipates in everyday activities [15]. The potential to respond is related to knowing what to do; the potential to monitor, knowing what to look for; the potential to learn, knowing what has happened; and the potential to anticipate, knowing what to expect [14]. No application of RAG in times of pandemic has been reported in the literature (yet).

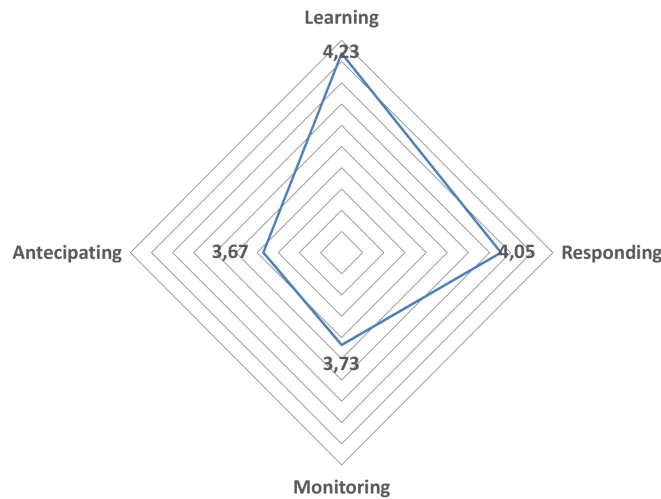
The data collection occurred during the months of June, July and August of 2020. A total of 111 valid responses were obtained. 8% of the participants work in a private hospital, 62% in a public one and 30% in private/public one. 40% works in the Intensive Care Unit, 9% in the Emergency Department and 13% in the patient ward, 39% other hospital units. And 47% of the participants are nurses, 10% doctors, 14% physical/respiratory therapists, 5% others.

The data obtained were treated with simple descriptive statistics (mean) and multivariate statistics (Pearson's correlation). Pearson's analysis was used to study the relationship among the overall resilience of the system, the patient safety and the occupational health and safety. The measure of Pearson's correlation coefficient provides information on how closeness two variables are. All significance values are two-tailed [16].

### 3 Results and discussion

#### 3.1 The four potential

It is widely known in the field of resilience engineering that the four potentials are highly interconnected, being difficult and sometimes impossible to separate them [17]. Through the analysis of the questions' average of each potential individually, the radar graphic (Fig. 1) clearly shows that learning and responding are the ones highlighted by the institutions. In turn, monitoring and anticipating are the potentials that should require more efforts to increase, as they scored the lowest by the respondents. Next paragraphs will discuss the role played by each potential on the systems resilience when facing the COVID-19 pandemic.



**Fig. 1.** Resilience four potentials radar chart diagram.

The learning potential is defined as the knowledge acquired from positive as well as negative aspects of a scenario [18][14]. Learning was the highest scored potential by respondents ( $M=4,23$ ), which could be seen as a general aspect of this pandemic, as institutions, assistance, and even societal practices have been moving forward while taking into account the knowledge acquainted with desired and undesired outcomes.

Clinical workers agreed that lessons learned through negative ( $M=4,35$ ) and positive experiences ( $M=4,43$ ) in the past contribute to the promotion of patient safety as well as dealing with the pandemic as a whole, those questions being the top-ranked ones. On the other hand, the questions with the lowest scores were the ones regarding the contributions of learning from past situations for the occupational health and safety and health of workers who take care of infected patients ( $M=4,08$ ), and for the flexibility of the built environment in order to attend the increased demand ( $M=4,00$ ).

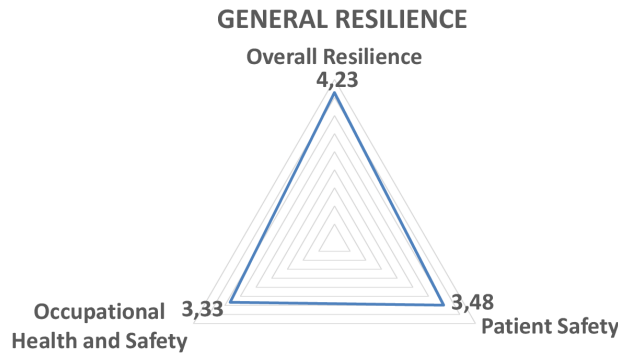
The potential to respond to problems is a healthcare workers' qualification and so could be expected to be well recognized in professional practice [14][19]. Therefore, in this survey, it was highly scored when it comes to the creation and undertaking of safety measures for Covid-19 patients by the institutions (M=4,41). Covid-19 is a highly contagious disease, so promptly acting to save the patient's life is related to the responding potential and consequently the patient's safety. However, this very same potential was not quite well ranked regarding its overall evaluation (M=4,05) and efficiency when coping with infected patients' demands, such as the built environment conditions (M= 3,78). The potential to respond does not have the highest impact in the general resilience, although it significantly contributes (M=4,05).

The potential to anticipate could involve foreseeing emerging problems or opportunities [14][19]. The questions covered to analyze how workers evaluate this potential in their institutions scored the lowest among the four resilience potentials (M=3,67). It seems that the anticipation of challenge scenarios is not a strategic practice incorporated in the healthcare systems. Within the anticipate potential, the top-ranked item was the one related to the contribution of reliable and updated information (M=3,90), the same as for the previous potential to monitor. On the other hand, the lowest rated item was the institutions' capacity of anticipating situations that impact on Covid-19 patients' safety (M=3,50).

Regarding the unforeseen, unknown and danger nature of this pandemic, the results indicate that the majority of healthcare organizations involved in this study are mainly concerned to quickly acquire the necessary clinical expertise and safety practices to adapt the evidence to their fields, where the need for responding the contextual demand is characterized by the increasing number of Covid-19 patients. Anderson [19] study aimed to develop a framework to guide future research into resilient processes, effects and interventions at all scales of healthcare activities. They have also found similar links with the results from the survey undertaken in this study, as they pointed out that anticipating task outcomes is an ability tightly connected to monitoring task performance.

### **3.2 Overall resilience, patient safety, and occupational health and safety**

Finally, discussing how the general resilience score (Fig. 2), it can be stated that respondents strongly agreed that their institutions are resilient (M=4,13). Regarding safety, participants do not totally agree they are safe (M= 3,33) as well as Covid-19 patients (M=3,48), specifically speaking of chances of accidents, errors, and occupational diseases.



**Fig. 2.** Overall resilience, occupational health and safety, patient safety relations - radar chart diagram.

As for the four resilience potentials, they should be highly interconnected, reflecting directed in workers and patient safety [17]. As the resilience four potentials are promising and could provide means for thinking about how healthcare systems can be supported [21], they need to be present to compose the system's resilience, even with different intensities. The results obtained through Pearson's correlation presented the interaction between general resilience, patient safety, and occupational health and safety. The variables resilience (overall) and patient safety were highly correlated ( $r = .680$ ,  $p < .001$ ), while resilience (overall) and occupational health and safety were less correlated ( $r = .600$ ,  $p < .001$ ) compared to each other. Patient safety and occupational health and safety ( $r = .764$ ,  $p < .001$ ) were highly correlated. As safety can be treated as an emergent property resulting from the interactions among the aspects of a system, it acknowledged that safety means moving beyond human error and examining the deeper, system factors that affect clinical work in healthcare organizations [22] [23]. Also, it shows that when workers perceive their work environment as a safe place, they considered that patients are safe as well.

The four potentials are necessary and must be performed interconnected for supporting the system's resilience, as indicated by the result. Besides that, the resilience performance contributes to the patient safety and the occupational health and safety. Understanding the manifestation of resilience through the correlation of the four resilience potentials helps to understand the effectiveness of practices [23] used during the pandemic period, contributing to its dissemination. These results also suggest that organizations are not aware of emerging issues regarding their own systems, while they are taking into account external information regarding the Covid-19 pandemic, such as the recommendations of the World Health Organization.

## 4 Conclusions

Bringing up Resilience Engineering theory for safety in times of Covid-19, this paper suggests an approach to measuring resilience by means of RAG, a questionnaire-based tool based on the four cornerstones of resilience. The outcome-based on our

data collected concludes that during the period of pandemic coping, institutions do not have enough time and resources to shed light on the monitoring and anticipating potentials, as they are dealing with Covid-19 by learning and responding to disruptions. The practice of following-up updated Evidenced Based Medicine (EBM) can be one hypothesis for these results, as workers from all organizational levels are constantly monitoring the Covid-19 unfolding, being aware of new procedures available. Anderson et al., 2020 have stated that “learning from previous experience of what works for a patient problem is linked to responding to future patients” (Anderson et al., 2020). To reinforce the potentials to monitor and anticipate is required a deeper understanding of the emerging phenomena, which can be seen as an outcome from the learning and responding potentials. Despite showing and discussing the results of the survey undertaken in this study, findings are unclear and deserve a detailed investigation by future research, including interviews and a mixed-method approach.

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