Received: 20 December 2023 | Revised: 11 April 2024 | Accepted: 29 May 2024

DOI: 10.1002/hfm.21045

RESEARCH ARTICLE

WILEY

Resources for action and organizational resilience in times of COVID-19: A study in health care

Angela Weber Righi[1] | Priscila Wachs[2] | Natália Ransolin[3] | Vanessa Becker Bertoni[4]

[1]Department of Production and Systems Engineering, Technology Center, Federal University of Santa Maria, Santa Maria, Brazil

[2]PPGAd, Business Postgraduation Program, Business School, Pontifical Catholic University of Rio Grande do Sul, Porto Alegre, Brazil

[3]AIHI/MQ, Australian Institute of Health Innovation, Macquarie University, Sydney, Australia

[4]Gatton College of Business and Economics, University of Kentucky, USA, Lexington, Kentucky, USA

Correspondence

Angela Weber Righi, Department of Production and Systems Engineering, Technology Center, Federal University of Santa Maria, 1000 Roraima Ave., Santa Maria, Brazil.
Email: angela.w.righi@ufsm.br

Abstract

The COVID-19 pandemic challenged health care organizations to cope with major disruptions, especially in the first waves. Several investigations were undertaken to understand how to support resilience during similar unexpected events. In this study, we attempted to unveil the resilient performance of health care organizations during the first waves of the COVID-19 pandemic from the viewpoint of resources for action. Thus, the research objectives are twofold: (i) to evaluate organizational resilience in facing COVID-19 by hospitals in Brazil and (ii) to evaluate the relationship between resources for action and resilient performance. Firstly, an online survey was sent to front-line health care workers, resulting in 111 responses. Then, a questerview was undertaken through online interviews with some participants of the previous phase. Resources for action were interpreted as five aspects supporting decision-making in health care organizations: information and communication; team, equipment, and tools; standard operating procedure (SOP); training; and built environment. Each resource was then unfolded based on the four potentials for resilient performance (i.e., anticipate, monitor, respond and learn). Respondents strongly agreed that their institutions are resilient ($M = 4.15$; standard deviation [SD] = 0.91). The potentials to learn ($M = 4.23$; SD = 0.96) and respond ($M = 4.08$; SD = 1.02) stood out, followed by monitoring ($M = 3.85$; SD = 1.07) and anticipating ($M = 3.70$; SD = 1.11). Although some differences stand out, findings corroborate with the joint performance of the resources for action to support resilience performance. Information and communication were the most present among the resources for action ($M = 4.20$). Making resources for action visible is a strategy for designing resilient systems, as it can be considered a bridge linking different resilience levels (micro, meso, and macro). Suggestions for future studies point out the need to promote the development and evaluation of resources for action in health care institutions.

KEYWORDS

COVID-19, organizational resilience, resilient health care, resources for action

1 | INTRODUCTION

The pandemic context experienced since 2020 has deepened reflections in different fields of knowledge, especially those related to crisis management and its unfolding. In Brazil, as in other places worldwide, the spread of COVID-19 has proven to be a complex and challenging scenario, characterized by successive waves of infections that have significantly impacted the health care system and society. The first wave extended from February 23 to July 25, 2020, when 7677 weekly deaths were reported. The second wave, longer and more lethal, occurred between November 8, 2020, and April 10, 2021, which ended with triple the number of deaths: 21,141 deaths in 1 week. The third wave was the shortest, from December 26, 2021, to May 21, 2022, in which 6246 deaths occurred (Brasil, 2024; Moura et al., 2022). From the beginning of the pandemic in 2020 until December 15, 2023, there were 708,237 deaths registered in Brazil due to COVID-19 (Brasil, 2024), making clear the extent to which the pandemic tested the capacity of the health system to respond, highlighting weaknesses and demanding emergency adjustments, signaling the need for adaptive and integrated approaches to face future pandemic challenges.

The field addressed by Human Factors and Ergonomics, especially Resilience Engineering (Hollnagel et al., 2006), aligns synergistically with the moment experienced since it is concerned with analyzing and designing systems to perform resiliently in the face of challenges. During COVID-19, management skills in all segments of public and private institutions were challenged, with health systems being the most affected (Bertoni et al., 2021a). Therefore, the challenges faced worldwide during the first COVID-19 waves are worth investigating to support health care organizations on how to perform during further disruptions that are likely to happen (Keenan, 2020; Santos, 2021; Stucky et al., 2021). Through the lens of resilience engineering, resilient performance in health care services is a concept that fits this study in terms of unveiling the mechanisms organizations need to take into account to enable the system's survival when coping with disturbances (Braithwaite, 2018; Wiig and O'Hara, 2021). Resilient Health care is defined as "the ability of the health system to adjust its functioning before, during, or after changes and disturbances so that it can sustain necessary performance under expected and unexpected conditions" (Hollnagel et al., 2013, p. xxv) and has contributed to the understanding of how systems can perform their activities and seek improvements in their processes (Braithwaite, 2018; Clay-Williams et al., 2015; Ellis et al., 2019). Since COVID-19 is a public health issue, a broader concept of "health systems resilience" contributes to the study of this phenomenon (Haldane & Morgan, 2021); health system resilience is the capacity of the health systems to adapt in the face of daily challenges, as the sudden increase of patients demand (e.g., COVID-19), maintaining, at the same time, the service's functions, safety, quality, and availability (Jatobá & Carvalho, 2022), and to reduce vulnerability across and beyond the system (Haldane & De Foo, Abdalla, et al., 2021).

Four potentials that support a resilient organization are highlighted by Hollnagel (2011); those are known as resilience potentials: the ability to monitor, related to what to look for; the ability to respond, usually activated by the ability to monitor and related to knowing what to do; the ability to learn increases the knowledge about past events and gives inputs for the other three potentials; and the ability to anticipate, knowing what to expect (Hollnagel, 2011). Those four potentials can be used as a reference to assess the system's resilience throughout the Resilience Analysis Grid (RAG). In this way, RAG is focused on analyzing an organization's resilience in everyday work based on how the organization responds, monitors, learns, and anticipates everyday activities (Patriarca et al., 2018) and in challenging and disruptive situations. Other approaches were developed to analyze resilience: Anderson et al. (2020) presented an Integrated Resilience Attributes Framework with a focus on health (situated resilience, structural resilience, and systemic resilience), relating them to the four resilience potentials (respond, anticipate, monitor, learn), bringing new perspectives to the understanding of the organizational aspects of this set. Other studies brought a quantitative approach, such as Sun et al. (2024), using a cascading failure propagation model, and Nakhal Akel et al. (2023), using Fuzzy Logic.

Considering that resilience is not something the organization possesses but something it does (Hollnagel et al., 2006), understanding how resilient performance is developed is fundamental for continuous improvement. The investigation of this phenomenon seems to be a gap still present in studies in the area (Anderson et al., 2020; Juvet et al., 2021; Patriarca et al., 2018; Righi et al., 2015), in which a major contribution regarding strategies and resources used for resilient performance is not discussed to any significant extent.

The present research follows this open-ended path, seeking to identify and interpret the different resources for action that supported the resilient performance of these organizations during the pandemic period. The term resource for action has been employed within the safety literature, linked to Cognitive Systems Engineering (Hollnagel & Woods, 2005) and Distributed Cognition (Wright et al., 2000). Resources for action are objects of cognition that can be grounded and used as input to a decision-making process, a source of information to accomplish a task (Wright et al., 1998). For example, standard operating procedures (SOPs) are among several sources of information to support professionals in developing an action considering the particularities of the context (Dekker, 2003; McCarthy et al., 1997; Wright & McCarthy, 2003). Carim et al. (2016), in research with aviation, and Wachs and Saurin (2018), in a study with health care, used the perspective of SOP as a resource for action and discussed its implications considering aspects of resilience.

Thus, resources for action, such as sources of information, contribute to resilient performance in daily work or crises. However, when typical routines need to be performed in atypical ways, as in the case of the COVID-19 pandemic, organizations and people need to find new resources or new ways to use familiar resources to create or adapt ways of acting (Mark & Semaan, 2008). Feldman (2004) showed that when organizational practices change, the meanings of resources for people also change, influencing how they are used. Therefore, resources for action are malleable, with situational function and meaning (Mark & Semaan, 2008).

Based on these premises, this research presents two complementary objectives. The first is to evaluate organizational resilience in

facing COVID-19 in Brazilian hospitals. The second is to evaluate the relationship between resources for action (e.g., procedures and training) and resilient performance. These objectives seek to answer the research question: how do resources for action support the resilient performance of hospitals in coping with COVID-19? It is understood that this analysis provides subsidies for daily work and future crises, aligned with organizational learning, one of the pillars of resilient performance. A RAG was developed to study the influence of the resources for action on the system's resilience performance.

2 | RESOURCES FOR ACTION

According to Carim et al. (2016, p. 148), a resource for action is "one among many other resources that provide support for operators to deal with or avoid local constraints." Such a definition is complemented by Wachs and Saurin (2018), who approached resources for action as those resources available or triggered by the operator to assist them in executing the activity. Within this perspective and understanding resources for action as sources of information for decision-making, this study understands that this term can extend into different objects of cognition, such as information and communication; team, equipment and tools; SOP; training; and built environment. Table 1 presents the extended concept of resources for action.

3 | RESEARCH METHOD

The present research is characterized as a descriptive exploratory study with a combined approach, which used two main techniques for data collection: (i) survey, through online questionnaires, and (ii) questerview, through online interviews, using the questions from questionnaire to guide the interview. The study was approved by the Ethics Committee of the Federal University of Santa Maria, Brazil (CAAE 32774620.0.0000.5346), with ethical precepts respected in all its phases, such as voluntary participation and confidentiality about respondents and hospital names. Partial results of this research were published by Bertoni et al. (2021a, 2021b).

Regarding the quantitative approach, a survey was carried out remotely from June to August 2020, during the peak of the first wave in Brazil. A survey was applied 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 possible participants. The inclusion criteria for this study were health care workers working in Brazilian hospitals during the COVID-19 pandemic.

The questionnaire started presenting the study, the researchers, and the informed consent, followed by 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 (Appendix A) related to the four resilience potentials and based on the RAG (Hollnagel, 2011). At the end, an open question was presented, inviting the participants to share some examples and to participate in the interview.

In this way, each resilience potential was analyzed concerning six major categories in this research, hereafter named resources for action: (i) training; (ii) SOP (standard operational procedure, protocols, flows); (iii) communication; (iv) resources (people, equipment and material); (v) built environment; and (vi) resilience potential efficiency (Appendix A). The questions for each category and resilience potential were presented as a sentence, and the participants should answer their degree of agreement, using the 5-point Likert

TABLE 1 Examples of resources for action.

Resource for action	Concept
Standard operating procedures (SOP)	The SOP category encompasses procedures, plans, protocols, checklists and flows that guide decision-making and actions. It should be noted that SOP, understood by authors such as Hollnagel (2017) as work-as-imagined, will never be able to anticipate and address all possible conditions, especially in complex sociotechnical systems (Clay-Willaims et al., 2015), but they improve the repertoire of activities. The operator retrieves a sequence of actions and uses them for that course of action (Attfield et al., 2018).
Training	Training also improves the repertoire for decision-making. Training, combined with other approaches, supports operators to identify and fill gaps in procedures. This argument stems from the understanding of the gap between work-as-imagined and work-as-done and that SOPs are insufficient to deal with all conditions of possibility (Dekker, 2003).
Information and communication	Information is crucial to dealing with challenging situations, and communication acts as an agent in the sources of information for decision-making and anticipation of the course of action (Wright et al., 1998). Information is not available in one place only; it is in external artifacts (e.g., SOPs, reports), external to the individual and present in dialogs, and internally (e.g., individual's memory) (Fields et al., 1997).
Team, equipment and tools	Teamwork, equipment, and tools are important in generating information for recognizing and diagnosing some anomalies and activating the repertoire for decision-making.
Built environment	The built environment is comprised of man-made physical structures and artifacts that support particular types of activities (Hassler & Kohler, 2014; Hollnagel, 2014). In other words, the built environment is a technical system that provides physical resources for action.

TABLE 2 Example of the questions for the SOP resource.

Potential	Related question
Responding	Your institution's procedures (SOP, protocols, flows) support responding to the demands of infected patients.
Monitoring	Your institution's procedures (SOP, protocols, flows) support monitoring the institution's status in the face of the pandemic.
Anticipating	Your institution's procedures (SOP, protocols, flows) support anticipating your response to demands.
Learning	Your institution's procedures (SOP, protocols, flows) are designed considering situations and lessons experienced (inside and outside the institution).

Abbreviations: SOP, standard operating procedure.

scale—from "totally disagree" (1) to "totally agree" (5) (Hollnagel, 2011). Table 2 shows examples of the questions for collecting data about the SOP resource.

The data obtained with the questionnaire were treated with simple descriptive statistics (mean and standard deviation). They were used to analyze respondents' agreement with the proposed questions, reflecting their perceptions regarding the context. The values ranged from 1 to 5, with increasing values reflecting higher agreement with the statement.

The qualitative approach used the questerview technique (Adamson et al., 2004). To this end, the online questionnaire applied in the previous step was used as a reference to conduct the interview. In this technique, the interviewees are asked to fill out a questionnaire consisting of standardized questions related to the subject under study. Subsequently, these questions and the respective answers obtained are used as a script for conducting the interview. The answers help understand the respondents' perception of the researched topic (Adamson et al., 2004), giving meaning and depth to the quantitative data.

The online interviews were conducted with one participant at a time and two researchers during June and July 2021, between COVID-19 waves in Brazil. Five interviews were carried out with health professionals (a doctor, a physiotherapist, two nurses, and a nursing technician) who answered the online survey and made themselves available to participate in the interview, informing their interest in the questionnaire. The interviews were recorded and later transcribed. A thematic analysis of the qualitative data (interview transcriptions and open-ended questions) was carried out following the analysis steps recommended by Pope (2000): familiarization, identifying themes, coding, charting, and mapping and interpretation. Familiarization involves reading the text previously and then reading it for coding, charting, mapping, and interpretation. The themes were defined upfront, being the resource for action categories and how they support the resilience performance according to the four potentials.

4 | RESULTS AND DISCUSSIONS

4.1 | Resilience and potentials

A total of 111 valid responses were obtained. Of the total, 62% of the participants work in a public hospital, 30% in a public/private institution, and 8% in a private hospital. Regarding departments, 40% of the participants work in the intensive care unit, 9% in the emergency department, 13% in the patient ward, and 39% in other hospital units. Among them, 47% of the participants are nurses, 10% doctors, 14% physical/respiratory therapists, and 5% others. Most of the respondents (91%) were from Brazil's South and Southeast regions.

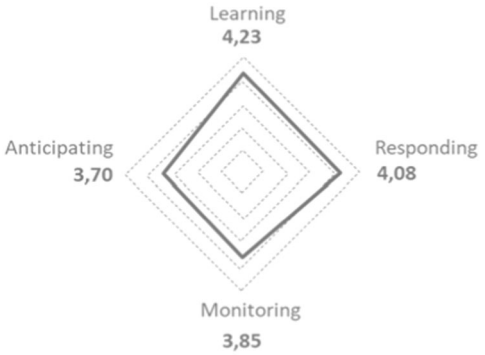

FIGURE 1 Radar chart diagram of the four resilience potentials (adapted from Bertoni et al., 2021a).

One of the assumptions of Resilience Engineering is the understanding that its potentials (anticipate, respond, monitor, and learn) are interdependent, jointly contributing to resilient performance (Hollnagel, 2018). It can be seen in the radar graph (Figure 1), which illustrates the averages of the potentials individually and the proximity of the values obtained, reflecting this characteristic. The detailed results for each resilience potential and resource for actions are presented in Appendix B.

It is worth mentioning that, for each situation experienced, resilient performance manifests in different ways, with the greater or lesser presence of each potential. In the case of the COVID-19 pandemic, in its first year (more precisely at the peak of the first wave in Brazil), the research verified a predominance of the potentials to learn ($M = 4.23$; $SD = 0.96$) and respond ($M = 4.08$; $SD = 1.02$), followed by monitoring ($M = 3.85$; $SD = 1.07$) and anticipating ($M = 3.70$; $SD = 1.11$) potentials.

The learning potential is defined as the knowledge acquired from positive as well as negative aspects of a scenario (Eppich & Cheng, 2015; Hollnagel, 2011). Learning was the highest scored potential by respondents ($M = 4.23$; $SD = 0.96$), 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, learning with desired and undesired outcomes.

Despite the unprecedented and atypical situation experienced by most professionals and institutions, previous experiences proved to be an important contributor to resilient performance, reinforcing the high average of the potential to learn. Lessons learned through positive situations experienced by the team or in other institutions obtained an average of 4.46 (SD = 0.80). Previous negative experiences obtained an average of 4.36 (SD = 0.84) to cope with the pandemic.

Also, a factor presents in coping with COVID-19 that reinforces the learning potential was the use of lessons learned in training to cope with COVID-19 ($M = 4.21$; SD = 0.97). Thus, in addition to the empirical use of previous knowledge and experience to manage the situation brought about by the pandemic, its incorporation into the training that took place concomitantly with the established emergency care was fundamental for the evidenced resilient performance.

The potential to respond to problems is a health care service qualification and could be expected to be well recognized in professional practice (Anderson et al., 2020; Hollnagel, 2011). In this research, response potential had the second highest impact on overall resilience, significantly contributing to resilient performance ($M = 4.08$; SD = 1.02). COVID-19 is a highly contagious disease with severe and lethal consequences, which requires immediate action by all health professionals and systems. Reliable and up-to-date information is available to assist in quick response ($M = 4.14$; SD = 1.03). Likewise, professionals were trained to respond to the demands of infected patients ($M = 4.11$; SD = 0.89)—these were the two highest averages related to the potential to respond arising from the applied questionnaire.

The monitoring potential refers to the ability to detect things that could affect performance and is linked to responding (Anderson et al., 2020; Hollnagel, 2011). In the pandemic context, in which variations in the number of cases and availability of resources were very dynamic, this potential proved challenging. The survey indicated an average of 3.85 (SD = 1.07) regarding the ability to monitor, with reliable and up-to-date information to monitor the status of the institution in the face of the pandemic ($M = 4.29$; SD = 0.98) being the most present aspect, followed by procedures (SOP, protocols, flows) to support this monitoring ($M = 3.97$; SD = 1.00).

The potential to anticipate could involve foreseeing emerging problems or opportunities (Anderson et al., 2020; Hollnagel, 2011). The questions covered to analyze how workers evaluate this potential in their institutions scored the lowest among the four resilience potentials ($M = 3.70$; SD = 1.11). The anticipation of challenge scenarios does not seem to be a strategic practice incorporated into the health care system. Within the anticipated potential, the top-ranked item was related to the contribution of reliable and updated information ($M = 3.93$; SD = 1.17), the same as for monitoring.

Given the results obtained for each potential, it was expected that the respondents' perception of the resilience of their institutions would be positive. The quote of the physician interviewed corroborates this fact: "I think we had situations where we were able to improve several of those aspects. We were able to anticipate in an appropriate way to be prepared for bad events. We were also able to learn, with each bad event, if there were discussions, even if not structured, what could be done differently. Today, we deal with these patients much better than last year. We were able to use these as opportunities to learn. As for the response, I have always found this characteristic of the specialty the strongest point: to respond quickly. In response, we maintain a good standard. The other potentials are weaker, especially anticipation. And I think we improved this in several scenarios during the pandemic, especially anticipation. We didn't see ourselves preparing for the worst before. We were very reactive; with the pandemic, we saw that we would not have time to think about what to do if it happened. Before anticipation seemed like a sign of weakness, we had too much confidence in our response potential" (Interviewee #5).

Thus, considering a general resilience score, it can be stated that respondents strongly agreed that their institutions are resilient ($M = 4.15$; SD = 0.91). Understanding the manifestation of resilience through the correlation of its four potentials helps in understanding the actual effectiveness of the practices (Alders, 2019) used during the pandemic, contributing to its dissemination. These practices are supported by resources for action emerging from the organization's initiatives, such as the training developed and carried out during the crisis.

4.2 | Resource for action for resilient performance

Hollnagel (2011) presents resilience not as a product of the system but as a process, a system capacity. Thus, designing a resilient system implies understanding what makes a system resilient, how to make it resilient, and how to keep it resilient. The author still argues that to promote a resilient performance, it is first necessary to understand the current moment. Different features support resilient performance. In the case of this research, the diversity of resources for action mentioned is important according to the evaluation via RAG. Table 3 presents the contribution of each resource for action in the four resilience potentials.

4.3 | Information and communication

Aspects related to information and communication had the highest mean values for all resilience potentials (Table 3). This fact is pertinent to the moment experienced by COVID-19, with the unprecedented situation of rapid status changes in the face of the disease unfolding and the need for constant changes in work activities to meet the number of patients and their clinical evolution. The quotation of an intensive care physician illustrates this aspect regarding communication: "I think there has even been a breakthrough in communication. Before the pandemic, it was done by

TABLE 3 Resources for action and resilience potentials.

	Respond		Monitor		Anticipate		Learn		
Resources for action	***M***	**SD**	***M***	**SD**	***M***	**SD**	***M***	**SD**	***M***
Information and communication	4.14	1.02	4.29	0.97	3.93	1.17	4.29	0.86	4.20
Team, equipment, and tools	3.98	1.06	3.95	0.91	3.77	1.05	4.18	0.99	3.97
Standard operating procedure	3.96	1.12	3.97	0.99	3.68	1.10	4.13	1.06	3.93
Training	4.11	0.89	3.68	1.09	3.61	1.10	4.21	0.97	3.90
Built environment	3.80	1.06	3.70	1.06	3.63	1.12	4.02	1.04	3.79

Abbreviation: SD, standard deviation.

email and posters, and we thought it was ineffective. During the pandemic, the decisions were very dynamic, such as "Tomorrow we will open a certain number of beds, we will get ventilators, team configuration," and they changed a lot. We based ourselves on WhatsApp groups to follow up on rapid changes. Before, we didn't have a service group on WhatsApp so as not to overload it with information, but an official group was created where only the manager could send messages." (Interviewee #5).

The information given to the professionals involved had different objectives and used different resources. For example, information at the managerial and medical levels was shared via WhatsApp as a direct path to speed up the process. Information at the operational level targeted to professionals in constant activity with patients, for example, came from direct contact with supervisors or official channels, according to reports from a physiotherapist, who indicated direct communication between professionals responsible for assistance with the source (Interviewee #4). Also, the nursing technician (Interviewee #1) reported using email as a main source of information related to changes in procedures or physical alterations performed by the institution during the crisis.

Carayon and Perry (2021) reinforce that the adaptive behaviors of health professionals are beneficial as sources of information on creative ways to meet their work objectives. Therefore, sharing such behaviors is a source of constant learning, reinforcing its average of 4.5 with the potential to learn. Using new communication platforms, such as WhatsApp, brought the necessity of fast communication dissemination for work. This new platform was also used for patient support, and care decisions were made in conjunction with families, with whom new forms of communication were developed to reduce patient isolation, including calls or video conferences. These means were also used for tasks and emotional support from peers (Juvet et al., 2021).

It should also be noted that the variation in the perception of information, with reports of lack and excess at the same time, may also have been a stress factor among professionals in an already conflicting environment due to COVID-19. Juvet et al. (2021) identified in their research with health professionals that the lack of information, unclear information, contradictory instructions, intra and interprofessional communication and cooperation difficulties were considered moderately severe challenges during work, cited as even more difficult than patient care. Communication was evaluated as fundamental for the resilient performance.

4.4 | Team, equipment, and tools

It is known that the COVID-19 pandemic interfered with the organization of health institutions in a way never seen before. Constant changes regarding human resources and equipment needed to be promoted to follow the pandemic status and recommendations. This research reinforces this aspect, as described in the following excerpts, which exemplify changes in (i) physical resources, "The hospital had to use several strategies to increase its service capacity. We went from a scenario with 50 ICU beds to 150 beds. It increased three times, which is not only a question of physical space, but also of the equipment, and mainly human resources such as the intensivist team." (Interviewee #5); and (ii) human resources, "We had many new hires in the hospital, especially in the physical therapy team, which was not so big." (Interviewee #4).

The numerical changes referring to resources for daily practice, such as a smaller number of professionals compared to the number of patients, or even professionals with less experience for the function performed, plus a lack of equipment for the clinic, affected each professional work, individually and as a team. The following excerpt illustrates the change in the individual work pattern of an intensive care physician given the reality experienced: "One practical change was the way of seeing patients. We would examine at the bedside, go to the computer, review history and exams, which took about 45 min to 1 h, and go to the next patient. But doing this for 10 patients, I would see the last one almost at the end of the shift, which is unacceptable because it might be a patient that needs to be seen immediately. And sometimes, because the team lacks experience, the patient is presenting alterations, and the team may not recognize them. So, you can't spend 9 h without seeing that patient. Thus, I changed this way. First, I saw all 10 patients without looking at the exams or anything on the computer, just in the box in a faster way: ventilation and monitoring to see if there was anything abnormal or if there was time to examine calmly. It was something that I particularly changed." (Interviewee #5).

The organization between the teams was also constantly adapted to cope with the demand. Professionals not used to participating in

certain activities are encouraged to join if necessary. For example, they could help the nurse perform patient hygiene procedures if the nursing technician is not available (Interviewee #1). These are new ways of distributing teams and their activities that have been adapted to current needs.

In this way, it is clear how much the resource for action related to professionals and equipment is fundamental for resilient performance and, consequently, on the perception of the resilience of the institution as a whole at the end of the crisis: "Overall, I think the hospital was very resilient. We tripled the ICU beds with ICU teams. The institution and the teams were resilient, able to adapt to the demand and employ different hours than they had been doing, and many people started to dedicate more hours to the ICU. There was an understanding that a different scenario required different actions." (Interviewee #5).

Changes related to professional resources and equipment can be categorized as organizational changes necessary to deal with the crisis (Juvet et al., 2021). Kontogiannis (2021) reinforces that all these changes require new forms of coordination and updating. When a change is disseminated in the system, new roles are assigned, and different forms of communication arise supported by new tools, demonstrating the intrinsic relationship between resources for action and resilient performance.

4.5 | Standard operating procedure (SOP)

Procedures, checklists, and protocols are resources that can support the organization's resilient performance (Dekker, 2014). Considering the SOP scores regarding the potentials, one can see their importance, especially for learning, responding, and monitoring. Regarding the learning potential, based on the experience during the pandemic and the research being published on the subject, learning for the development of new SOPs stands out. This finding is reinforced by the report of a physiotherapist: "Best example is the implementation of the prone procedure for patients, which is a SOP that we didn't have… In general, all of our SOPs are research-based. The prone one was set up based on research, how-to studies, and the experience" (Interviewee #4).

Also, regarding the prone maneuver, it was already described in the literature for patients on mechanical ventilation (Kopterides et al., 2009), but it gained prominence during the pandemic, including its use in awake patients (Touchon et al., 2021), demonstrating the generated learning. The quotation of an intensive care physician illustrates the argument presented: "It already existed with the difference that we prone one patient per month like this, and in the pandemic, 3–4 patients per day […] What was created was a protocol of prone in awake patients. We had never done this before, and there was almost no description of it in the literature. We only prone patients on mechanical ventilators (MV) with severe hypoxemia. There were reports that, even without MV, the patient with O_2 alone would benefit from the prone maneuver. […] There was more training for new employees and the dissemination of the protocol through channels (email, WhatsApp, and service website)" (Interviewee #5). This report highlights, in addition to the procedure as a resource for action, the importance of information/communication and training.

4.6 | Training

Grøtan and Wærø (2016) argued that the organization's resilient performance is influenced by the creative use of different strategies, collaboratively applied by multidisciplinary teams according to the challenges presented. According to the authors, the capacity for resilient performance can be enhanced by training. Training also expands the repertoire of previous experiences, an important resource for action in critical situations (Attfield et al., 2018; Carim et al., 2016).

Regarding resilience potentials, the relationship between anticipation and training can be mentioned. An example was the anticipation about the specifics of PPE and infection control for patient care, with some institutions mobilizing to train professionals on the specifics, even before they received the first COVID-19 case. The excerpt from the nursing technician illustrates this aspect: "They started to worry at around of late February [2020], they already started to keep us alert that there could be patients with COVID and they already started to do training with paramentation, hand washing, hygiene" (Interviewee #1). Additionally, there is a constant monitoring of new strategies developed locally, nationally, or internationally, which require training to be adopted by the institutions.

In addition to the relationship with anticipating and monitoring, training was also important for the responding. The excerpt of an intensive care physician, related to the use of the video laryngoscope for better visualization during the insertion of the tube for mechanical ventilation, illustrates this relationship: "This resource was rarely used, just the anesthesiologists from the operating room knew how to use it, and then, there was a training for that." (Interviewee #5).

4.7 | Built environment

Despite being at the last position in Table 3 ($M = 3.79$), the resource of the built environment plays a key role in the health care system, being reported in the literature as a facilitator of care delivery operations during the COVID-19 pandemic (Dietz et al., 2020; Keenan, 2020; Ransolin et al., 2021). Overall, the resilient potentials linked to this resource were similarly rated: anticipating obtained the lower score ($M = 3.70$) and learning the highest among them ($M = 4.23$). These figures might explain the challenges faced by health care institutions in preparing spaces for receiving infected patients and protecting front-line workers (i.e., anticipating). For example, to mitigate the risks of COVID-19 contamination, caregivers notified the team in charge of the destination hospital unit to free corridors and areas for COVID-19 patient transportation.

Other examples of responses that were adaptations to the built environment included the creation of extra triage and consultation

rooms for suspected patients and the separation of the flows of COVID-19 patients through dedicated elevators and corridors. To avoid the circulation of people, caregivers monitored patient health status through boards displayed at the entrance of patient beds: "There is a board in each patient's bed with their name, if the patient has physio, psycho, pharmacy assistance, the doctor's name, if the patient is under mechanical ventilation, and if exams are required." (Interviewee #4).

Moreover, the lessons learned by the institutions were valued as significant for future design and operations of health care-built environments (i.e., learning). In cases where the nursing station or prescription room did not support the visibility of patient status, caregivers needed to access the bed to see the board, being exposed more than necessary. Then, visibility for monitoring patient status was cited as a factor to be contemplated in designing future built environments. During the pandemic, the dependence between people and spaces highlighted the tight couplings within complex systems. For instance, the extension of physical areas in some health care institutions had implications for the extra capacity of qualified people and equipment.

4.8 | Resources for action as a bridge between micro, meso, and macro levels of resilient health care

Resilient performance should be investigated at different levels within the health services: micro, meso, and macro. The micro level is related to the individual or group level. It is concerned with the relationships between human subjects and contextual, rooted in the sociotechnical and complex systems view. The meso level looks at the organization level, for example, to design an organization to perform resiliently. Berg et al. (2018) defended that resilience should be understood at the hospital unit scale (i.e., micro level), the intersections between two or more hospital units or the whole hospital (i.e., meso level), and the health care network (i.e., macro level) (Berg et al., 2018). The macro level is focused on society and policy-making (Bergström & Dekker, 2014; Berg et al., 2018). In this study, the main focus was at the meso level and, to some extent, the micro level, discussing the resources for action and their contribution to resilient performance. Some examples of the resources were designed previously (e.g., infection control procedures), but some were adapted or developed during the pandemic (e.g., the prone procedure, new physical spaces, staff relocation). Furthermore, Jatobá and Carvalho (2022) reinforced the capacity for collaboration to manage extraordinary situations in interdisciplinary teams as a dominant factor in the resilience of health services, such as the exchange of activities between nursing technicians and nurses due to the scarcity of human resources in certain moments.

Bergström and Dekker (2014) bring the idea that studies oriented at the meso level can contribute to bridging the gap between the micro and macro levels. This study brings the idea that resources for action can be considered bridges that connect the different levels of resilience (micro, meso, and macro), supporting them to perform resiliently. For example, the inclusion of boards at the entrance of patient beds (micro level) to display patient status without circulation of people is a built environment resource for action that helped frontline workers in monitoring the patients. The prone procedure for awake patients developed by the hospital improved the quality of care in face of a high volume of patients, as an SOP resource for action at the meso level.

Regarding the macro level, it is worth highlighting that health systems influenced performance in patient care during the COVID-19 pandemic, especially in the context of this research. Our study covered 62% of public hospitals, 30% of public and private hospitals, and 8% of private hospitals. Thus, 92% of participating hospitals were influenced by the Unified Health System (SUS, Brazil's public health system). According to de Carvalho et al. (2023) and Costa et al. (2021), SUS was negatively affected by the ongoing Federal Government of Brazil's actions, such as disseminating fake news through the media, discouraging social isolation and vaccination, which went against scientifically supported guidelines. These conflicting strategies contributed to high social instability and hospital overload, disrupting the connections between the vital functions of the systems beyond their capacity and rendering them fragile (de Carvalho et al., 2023). Jatobá and Carvalho (2022) highlighted the importance of investments in governance to foster resilient performance in both extreme and regular circumstances, taking into account the constant variability of the context and the political instability typical of Brazil, to consolidate trust among all participating groups within the scope of health services. The importance of learning to design resilient systems was significantly highlighted after the experience with the pandemic (de Carvalho et al., 2023), leading governments to improve their monitoring and anticipation within health systems. For example, the United States elevated the status of the surveillance division of the US Department of Health for this purpose (Stolberg & Weiland, 2022).

5 | CONCLUSIONS

This study sought to identify and interpret the different resources for action that supported resilient performance in health care organizations during the COVID-19 pandemic. Our findings indicate that perceived resilience ($M = 4.15$; $SD = 0.94$) was supported by resources for action, defined here in five main categories (information and communication; team, equipment, and tools; SOP; training; built environment), which contributed significantly to dealing with atypical routines based on new resources or adaptation of existing ones.

The assessment of resilience in its four potentials identified a higher presence of the potential to learn ($M = 4.23$) and respond ($M = 4.08$), followed by monitoring ($M = 3.85$) and anticipation ($M = 3.70$). Concerning the resources for action related to each potential, the proximity of the potential to learn with training was evidenced, mainly due to lessons learned in the training courses for coping with COVID-19, which occurred concurrently with the urgent care provided.

The resource for action related to information and communication was the most present among the resources ($M = 4.20$). The potential to respond was closely related to the resources associated with information and communication, given the importance of having reliable and up-to-date information available for daily practice in such dynamic times. This same characteristic of the resource related to communication proved to be fundamental for the monitoring potential, which was considered challenging in the crisis caused by COVID-19. Similarly, the anticipation potential is identified as a practice not incorporated into health systems, at least considering prolonged crises.

This study sought to give visibility to resources for action since these are aspects in which organizations can intervene to promote resilient performance, mainly through the design or redesign of technologies, artifacts, and strategies aimed at resources for system action. However, the use of different resources for action verified in this study corroborates the idea that resilient performance emerges from daily practice, carried out by human agents in their decisions and actions based on the support given by institutions. Furthermore, resources for action can be considered bridges that connect the different levels of resilience (micro, meso and macro) and the strategies relevant to each level. Therefore, giving them visibility is a way of designing resilient systems.

Still, it is understood that even after the pandemic period has ended, understanding the action resources for resilient performance is important for daily work. Thus, the lessons learned in the pandemic context can be extrapolated to different critical situations, as it is known that it is not just COVID-19 that puts pressure on health systems. Various infectious diseases, environmental disasters, economic restrictions, and political crises are among the many other challenges that health systems face.

Despite the strengths of this study from a combined approach, some limitations can be highlighted. Firstly, the national coverage of the study suggested a higher response than that obtained; it is believed that the limited number of participants is because the quantitative collection period coincided with the first wave of COVID-19 in Brazil, limiting the availability of health professionals for research. Secondly, the predominance of respondents from Brazil's South and Southeast regions is due to the snowball sampling technique. Thirdly, the criteria for including participants as front-line operators (those providing care for COVID-19 patients), as they are the ones who benefit from the resources for action. Lastly, the retrospective study always has some limitations regarding memory since the qualitative approach questions past actions. However, it is believed that the remarkable facts experienced in a crisis such as COVID-19 are not easily forgotten by its participants, and, therefore, the reports obtained are faithful to reality.

It is envisioned that future studies will mainly verify how much the resources for action discussed here were perpetuated in the health institutions and the lessons learned that were incorporated into the daily routines. Another suggestion for further studies is to assess how organizations can systematically promote these resources so that resilient performance finds a favorable environment for its development, with a balance between structural, organizational, and human resources.

ACKNOWLEDGMENTS

The authors are especially grateful to all the health care workers who participated in the study. Open access publishing facilitated by Macquarie University, as part of the Wiley - Macquarie University agreement via the Council of Australian University Librarians.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Research data are not shared.

ORCID

Angela Weber Righi http://orcid.org/0000-0001-5443-4574

REFERENCES

Adamson, J., Gooberman-Hill, R., Woolhead, G., & Donovan, J. (2004). Questerviews: Using questionnaires in qualitative interviews as a method of integrating qualitative and quantitative health services research. *Journal of Health Services Research & Policy*, *9*(3), 139–145. https://doi.org/10.1258/1355819041403268

Alders, M. D. L. (2019). *A reflective process for analyzing organisational resilience to improve the quality of care* (Doctoral dissertation). King's College London.

Anderson, J. E., Ross, A. J., Macrae, C., & Wiig, S. (2020). Defining adaptive capacity in healthcare: A new framework for researching resilient performance. *Applied Ergonomics*, *87*, 103111. https://doi.org/10.1016/j.apergo.2020.103111

Attfield, S., Fields, B., & Baber, C. (2018). A resources model for distributed sensemaking. *Cognition, Technology & Work*, *20*(4), 651–664. https://doi.org/10.1007/s10111-018-0529-4

Berg, S. H., Akerjordet, K., Ekstedt, M., & Aase, K. (2018). Methodological strategies in resilient health care studies: An integrative review. *Safety science*, *110*, 300–312. https://doi.org/10.1016/j.ssci.2018.08.025

Bergström, J., & Dekker, S. W. A. (2014). Bridging the macro and the micro by considering the meso: Reflections on the fractal nature of resilience. *Ecology and Society*, *9*(4), art22. https://www.jstor.org/stable/26269699

Bertoni, V. B., Ransolin, N., Wachs, P., Righi, A. W. (2021a). Resilience, safety and health: Reflections about Covid-19' assistance. In N. L. Black, W. P. Neumann, & I. Noy (Eds.), *Proceedings of the 21st Congress of the International Ergonomics Association (IEA 2021)*. IEA 2021. Lecture Notes in Networks and Systems (Vol. *222*, pp. 239–245). Springer. https://doi.org/10.1007/978-3-030-74611-7_33

Bertoni, V. B., Ransolin, N., Wachs, P., & Righi, A. W. (2021b). Resilient analysis grid: A quantitative approach of healthcare provider's perspective during COVID-19 pandemics. In *9th Symposium on Resilience Engineering* (pp. 1-7).

Braithwaite, J. (2018). Changing how we think about healthcare improvement. *BMJ*, *361*, 1–5. https://doi.org/10.1136/bmj.k2014

Brasil. (2024). Ministério da Saúde (BR), Secretaria de Vigilância em Saúde. *COVID 19 Painel Coronavírus*. http://covid.saude.gov.br/

Carayon, P., & Perry, S. (2021). Human factors and ergonomics systems approach to the COVID-19 healthcare crisis. *International Journal for Quality in Health Care*, *33*(Suppl 1), 1–3. https://doi.org/10.1093/intqhc/mzaa109

Carim, G. C., Saurin, T. A., Havinga, J., Rae, A., Dekker, S. W. A., & Henriqson, É. (2016). Using a procedure doesn't mean following it: A cognitive systems approach to how a cockpit manages emergencies. *Safety Science*, *89*, 147–157. https://doi.org/10.1016/j.ssci.2016.06.008

Clay-Williams, R., Hounsgaard, J., & Hollnagel, E. (2015). Where the rubber meets the road: Using FRAM to align work-as-imagined with

work-as-done when implementing clinical guidelines. *Implementation Science*, *10*(1), 1–8. https://doi.org/10.1186/s13012-015-0317-y

Costa, N., Silva, P., Lago, M., & Jatobá, A. (2021). The institutional capacity of the health sector and the response to COVID-19 in a global perspective. *Ciencia & Saude Coletiva*, *26*, 4645–4654. https://doi.org/10.1590/1413-812320212610.11852021

de Carvalho, P. V. R., Bellas, H., Viana, J., de Castro Nunes, P., Arcuri, R., da Silva Fonseca, V., Carneiro, A. P. M., & Jatobá, A. (2023). Transformative dimensions of resilience and brittleness during health systems' collapse: A case study in Brazil using the functional resonance analysis method. *BMC Health Services Research*, *23*(1), 349. https://doi.org/10.1186/s12913-023-09301-1

Dekker, S. (2003). Failure to adapt or adaptations that fail: Contrasting models on procedures and safety. *Applied Ergonomics*, *34*(3), 233–238. https://doi.org/10.1016/S0003-6870(03)00031-0

Dekker, S. (2014). People as a problem to control. In S. Dekker (Ed.), *Safety differently* (1st ed., pp. 79–114). CRC Press.

Dietz, L., Horve, P. F., Coil, D. A., Fretz, M., Eisen, J. A., & Van Den Wymelenberg, K. (2020). 2019 novel coronavirus (COVID-19) pandemic: Built environment considerations to reduce transmission. *mSystems*, *5*(2), e00245-20. https://doi.org/10.1128/mSystems.00245-20

Ellis, L. A., Churruca, K., Clay-Williams, R., Pomare, C., Austin, E. E., Long, J. C., Grødahl, A., & Braithwaite, J. (2019). Patterns of resilience: A scoping review and bibliometric analysis of resilient health care. *Safety Science*, *118*, 241–257. https://doi.org/10.1016/j.ssci.2019.04.044

Eppich, W., & Cheng, A. (2015). Promoting excellence and reflective learning in simulation (PEARLS): development and rationale for a blended approach to health care simulation debriefing. *Simulation in Healthcare: The Journal of the Society for Simulation in Healthcare*, *10*(2), 106–115. https://doi.org/10.1097/SIH.0000000000000072

Feldman, M. S. (2004). Resources in emerging structures and processes of change. *Organization Science*, *15*(3), 295–309. https://doi.org/10.1287/orsc.1040.0073

Fields, B., Wright, P., & Harrison, M. (1997). Objectives, strategies and resources as design drivers. In S. Howard, J. Hammond, & G. Lindgaard (Eds.), *Human-computer interaction INTERACT'97* (pp. 164–171). Springer.

Grøtan, T. O., & Wærø, I. (2016). Using gaming and resilience engineering principles to energize a situated resilience training of front-end operators and managers. In L. Walls, M. Revie, & T. Bedford (Eds.), *Risk, reliability and safety: Innovating theory and practice* (pp. 2246–2253). CRC Press.

Haldane, V., De Foo, C., Abdalla, S. M., Jung, A. S., Tan, M., Wu, S., Chua, A., Verma, M., Shrestha, P., Singh, S., Perez, T., Tan, S. M., Bartos, M., Mabuchi, S., Bonk, M., McNab, C., Werner, G. K., Panjabi, R., Nordström, A., & Legido-Quigley, H. (2021). Health systems resilience in managing the COVID-19 pandemic: Lessons from 28 countries. *Nature Medicine*, *27*(6), 964–980. https://doi.org/10.1038/s41591-021-01381-y

Haldane, V., & Morgan, G. T. (2021). From resilient to transilient health systems: The deep transformation of health systems in response to the COVID-19 pandemic. *Health Policy and Planning*, *36*(1), 134–135. https://doi.org/10.1093/heapol/czaa169

Hassler, U., & Kohler, N. (2014). Resilience in the built environment. *Building Research & Information*, *42*(2), 119–129. https://doi.org/10.1080/09613218.2014.873593

Hollnagel, E. (2011). The resilience analysis grid. In E. Hollnagel, J. Paries, D. Woods, & J. Wreathall (Eds.), *Resilience engineering in practice: A guidebook*. Ashgate.

Hollnagel, E. (2014). Resilience engineering and the built environment. *Building Research & Information*, *42*(2), 221–228. https://doi.org/10.1080/09613218.2014.862607

Hollnagel, E. (2017). Why is work-as-imagined different from work-as-done? In *Resilient health care* (Vol. 2, pp. 279–294). CRC Press.

Hollnagel, E. (2018). *Safety-II in practice developing the resilience potentials*. Routledge.

Hollnagel, E., Braithwaite, J., & Wears, R. L. (2013). Preface: On the need for resilience in health care. In E. Hollnagel, J. Braithwaite, & R. L. Wears (Eds.), *Resilient health care* (pp. 2-3). Ashgate.

Hollnagel, E., & Woods, D. D. (2005). *Joint cognitive systems: Foundations of cognitive systems engineering*. CRC Press.

Hollnagel, E., Woods, D. D., & Leveson, N. (2006). *Resilience engineering: Concepts and precepts*. Ashgate Publishing.

Jatobá, A., & Carvalho, P. V. R. D. (2022). Resilience in public health: Precepts, concepts, challenges, and perspectives. *Saúde em Debate*, *46*, 130–139. https://doi.org/10.1590/0103-11042022E810I

Juvet, T. M., Corbaz-Kurth, S., Roos, P., Benzakour, L., Cereghetti, S., Moullec, G., Suard, J. C., Vieux, L., Wozniak, H., Pralong, J. A., & Weissbrodt, R. (2021). Adapting to the unexpected: Problematic work situations and resilience strategies in healthcare institutions during the COVID-19 pandemic's first wave. *Safety Science*, *139*, 105277. https://doi.org/10.1016/j.ssci.2021.105277

Keenan, J. M. (2020). COVID, resilience, and the built environment. *Environment Systems and Decisions*, *40*(2), 216–221. https://doi.org/10.1007/s10669-020-09773-0

Kontogiannis, T. (2021). A qualitative model of patterns of resilience and vulnerability in responding to a pandemic outbreak with system dynamics. *Safety Science*, *134*, 105077. https://doi.org/10.1016/j.ssci.2020.105077

Kopterides, P., Siempos, I. I., & Armaganidis, A. (2009). Prone positioning in hypoxemic respiratory failure: Meta-analysis of randomized controlled trials. *Journal of Critical Care*, *24*(1), 89–100. https://doi.org/10.1016/j.jcrc.2007.12.014

Mark, G., & Semaan, B. (2008). Resilience in collaboration: Technology as a resource for new patterns of action. In *Proceedings of the 2008 ACM Conference on Computer Supported Cooperative Work* (pp. 137–146). ACM. https://doi.org/10.1145/1460563.1460585

McCarthy, J. C., Healey, P. G. T., Wright, P. C., & Harrison, M. D. (1997). Accountability of work activity in high-consequence work systems: Human error in context. *International Journal of Human-Computer Studies*, *47*(6), 735–766. https://doi.org/10.1006/ijhc.1997.9997

Moura, E. C., Cortez-Escalante, J., Cavalcante, F. V., Barreto, I. C. H. C., Sanchez, M. N., & Santos, L. M. P. (2022). Covid-19: Temporal evolution and immunization in the three epidemiological waves, Brazil, 2020-2022. *Revista de Saude Publica*, *56*(105), 105. https://doi.org/10.11606/s1518-8787.2022056004907

Nakhal Akel, A. J., Patriarca, R., De Carlo, F., & Leoni, L. (2023). A system-theoretic fuzzy analysis (STheFA) for systemic safety assessment. *Process Safety and Environmental Protection*, *177*, 1181–1196. https://doi.org/10.1016/j.psep.2023.07.014

Patriarca, R., Di Gravio, G., Costantino, F., Falegnami, A., & Bilotta, F. (2018). An analytic framework to assess organizational resilience. *Safety and Health at Work*, *9*(3), 265–276. https://doi.org/10.1016/j.shaw.2017.10.005

Pope, C. (2000). Qualitative research in healthcare: Analysing qualitative data. *BMJ*, *320*(7227), 114–116. https://doi.org/10.1136/bmj.320.7227.114

Ransolin, N., Marczyk, C. E. S., Gering, R. P., Saurin, T. A., Formoso, C. T., & Grøtan, T. O. (2021). The built environment's influence on resilience of healthcare services: Lessons learnt from the COVID-19 pandemic. In L. F. Alarcon & V. A. González (Eds.), *Proceedings of 29th Annual Conference of the International Group for Lean Construction (IGLC29)* (pp. 613–622). Lima, Peru. https://doi.org/10.24928/2021/0172

Righi, A. W., Saurin, T. A., & Wachs, P. (2015). A systematic literature review of resilience engineering: Research areas and a research agenda proposal. *Reliability Engineering & System Safety*, *141*, 142–152.

Santos, R. (2021). Reengineer healthcare: A human factors and ergonomics framework to improve the socio-technical system. *International Journal for Quality in Health Care*, *33*(Suppl 1), 19–24. https://doi.org/10.1093/intqhc/mzaa087

Stolberg, S. G., & Weiland, N. (2022). The Biden administration is elevating a division of H.H.S. to more broadly oversee pandemic responses. *The New York Times*. http://www.nytimes.com/2022/07/20/us/politics/hhs-aspr-biden.html

Stucky, C. H., Brown, W. J., & Stucky, M. G. (2021). COVID 19: An unprecedented opportunity for nurse practitioners to reform healthcare and advocate for permanent full practice authority. *Nursing Forum*, *56*(No. 1), 222–227. https://doi.org/10.1111/nuf.12515

Sun, H., Yang, M., & Wang, H. (2024). An integrated approach to quantitative resilience assessment in process systems. *Reliability Engineering & System Safety*, *243*, 109878. https://doi.org/10.1016/j.ress.2023.109878

Touchon, F., Trigui, Y., Prud'homme, E., Lefebvre, L., Giraud, A., Dols, A. M., Martinez, S., Bernardi, M., Begne, C., Granier, P., Chanez, P., Forel, J. M., Papazian, L., & Elharrar, X. (2021). Awake prone positioning for hypoxaemic respiratory failure: Past, COVID-19 and perspectives. *European Respiratory Review*, *30*(160), 210022. https://doi.org/10.1183/16000617.0022-2021

Wachs, P., & Saurin, T. A. (2018). Modelling interactions between procedures and resilience skills. *Applied Ergonomics*, *68*, 328–337. https://doi.org/10.1016/j.apergo.2017.12.013

Wiig, S., & O'Hara, J. K. (2021). Resilient and responsive healthcare services and systems: Challenges and opportunities in a changing world. *BMC Health Services Research*, *21*(1), 1037. https://doi.org/10.1186/s12913-021-07087-8

Wright, P. C., Fields, R. E., & Harrison, M. D. (2000). Analyzing human-computer interaction as distributed cognition: The resources model. *Human-Computer Interaction*, *15*(1), 1–41. https://doi.org/10.1207/S15327051HCI1501_01

Wright, P., & McCarthy, J. (2003). Analysis of procedure following as concerned work. In E. Hollnagel (Ed.), *Handbook of cognitive task design* (pp. 679–700). CRC Press.

Wright, P., Pocock, S., & Fields, B. (1998). The prescription and practice of work on the flight deck [Conference presentation]. In *ECCE9*, *Ninth European Conference on Cognitive Ergonomics* (pp. 37–42). Iimerik, Ireland.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Righi, A. W., Wachs, P., Ransolin, N., & Bertoni, V. B. (2024). Resources for action and organizational resilience in times of COVID-19: A study in health care. *Human Factors and Ergonomics in Manufacturing & Service Industries*, 1–11. https://doi.org/10.1002/hfm.21045