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How things changed during the COVID-19 pandemic's first year: A longitudinal, mixed-methods study of organisational resilience processes among healthcare workers

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ABSTRACT

COVID-19 had a huge impact on healthcare systems globally. Institutions, care teams and individuals made considerable efforts to adapt their practices. The present longitudinal, mixed-methods study examined a large sample of healthcare institution employees in Switzerland. Organisational resilience processes were assessed by identifying problematic real-world situations and evaluating how they were managed during three phases of the pandemic's first year. Results highlighted differences between resilience processes across the different types of problematic situations encountered by healthcare workers. Four configurations of organisational resilience were identified depending on teams' performance and ability to adapt over time: "learning from mistakes", "effective development", "new standards" and "hindered resilience". Resilience trajectories differed depending on professional categories, hierarchical status and the problematic situation's perceived severity. Factors promoting or impairing organisational resilience are discussed. Findings highlighted the importance of individuals', teams' and institutions' *meso*- and *micro*-level adaptations and *macro*-level actors' structural actions.

1. Introduction

The COVID-19 pandemic had a huge impact on healthcare systems globally. Usual services were cancelled, normal team functioning was disrupted, institutions faced insufficient staffing and shortages of personal protective equipment (PPE) (Fang et al., 2020; Sarma et al., 2020; Slotkin et al., 2020). These situations and the reorganisations implemented to confront the crisis had significant effects on the concerns and mental well-being of healthcare workers (Kang et al., 2020; Lai et al., 2020). During the pandemic's first wave, healthcare professionals cited organisational changes, interpersonal conflicts and workloads as increasingly problematic situations, among many others (Juvet et al., 2021).

A significant worsening of mental health was observed among

healthcare workers, who felt exhausted by heavy workloads, afraid of being infected with COVID-19 (or infecting others), unable to manage the patients' conditions and morally out of their depth due to ethical dilemmas and violations of their personal moral code (Liu et al., 2020; López Steinmetz et al., 2021). Increased cases of anxiety, depression, symptoms of post-traumatic stress disorder (PTSD) and alcohol misuse were all reported (Lamb et al., 2021). Women, nurses and frontline workers were more at risk of anxiety and depression than men, doctors and secondary-line workers (Batra et al., 2020). Nearly half of healthcare workers experienced burnout during COVID-19 pandemic (Ghahramani et al., 2021). An amalgamation of individual functional impairments can strongly impact a team's ability to adapt and perform. However, when confronted with disruptions in their working environment, teams are also capable of creating self-regulation strategies to

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counter them and mitigate their effects on the organisation's performance and their members' health (Cuvelier & Falzon, 2010; Kruk et al., 2015; Lane & McGrady, 2018). Interestingly, the successful management of stressors can have a protective effect on healthcare workers in future crises. Well managed stressors—such as experiencing changes in work organisation, working on COVID-19 wards, being placed in a totally new context or being forced to take precautionary measures involving wearing PPE—sometimes became factors protective against other sources of adversity (Carmassi et al., 2020; Liu et al., 2020). A team or an institution's capacity to anticipate, adapt, resist, transform itself and recover from a crisis is called organisational resilience (Barasa et al., 2018; Hollnagel, 2017; Ishak & Williams, 2018). Resilient healthcare (RHC) is an emerging concept and a variation—in the healthcare domain—of organisational resilience (Anderson et al., 2020). It refers to a healthcare institution's (e.g. a medical clinic, department or hospital) ability to adapt its operations before, during and after negative events and maintain them under expected or unexpected conditions (Wears et al., 2015). RHC is described as a system capable of flexibility, robustness and adaptation in response to changing circumstances so that performance and safety are maintained (Woods, 2015). It is a promising concept with which to address complex systems' capacities to cope with global disasters, such as the COVID-19 pandemic (Thomas et al., 2020; Wu et al., 2020).

Since the pandemic's onset, numerous studies have been conducted on its effects on healthcare workers at the individual level (Lorente et al., 2021; Roberts et al., 2021a; Roberts et al., 2021b; Santabárbara et al., 2021). However, adopting a multi-level approach, by considering the *meso* level of a hospital or a specific sector, is also essential, since individual behaviours are partially determined by decisions and resources at higher levels (Berg et al., 2018). Besides, even before the pandemic, most studies on this concept relied on a qualitative design. There is a lack of tools for assessing the RHC (Robertson et al., 2016; Whitman et al., 2013), and quantitative or mixed-methods approaches remain scarce (Iflaifel et al., 2020; Kantur, 2015). In this context, our objective was to explore the processes and evolution of RHC at the collective and individual levels. To complement existing qualitative evidence, we adopted an interdisciplinary mixed-methods approach.

2. Conceptual framework

Health systems must have the capacity to provide good quality individual services, while also responding to broader societal health challenges. They must adapt to predictable, long-term stresses caused by an aging population and increasing multimorbidity, but also respond to sudden shocks and extreme changes. The concept of RHC refers to the processes and capacities which a complex healthcare system manages to help it bounce back from everyday contingencies and rarer but larger-scale hazards and to provide quality care while addressing deeper issues (Barasa et al., 2017; Nuzzo et al., 2019; Stephenson, 2010). RHC is a variation on the broader notion of organisational resilience. It belongs to a new approach to the safety and reliability of complex systems, aiming to maintain them in a safe state while allowing them to remain relatively resistant to exceptional events (Amalberti, 2010). The concepts of flexibility, robustness and adaptation to changing circumstances, all to maintain performance and safety, represent its core values (Hollnagel, 2011; Woods, 2015).

Organisational resilience is characterised by four “cornerstones” (Hollnagel, 2013): anticipation, monitoring, response and learning. Anticipation is the proactive approach taken by workers and decision-makers to anticipate disruptions and other challenges to a system. Monitoring consists of scanning, listening, observing, attending and examining the system's functioning across different time scales to understand its current state. It also helps maintain safety and ward off the difficulties inherent in complex systems. Response—acting or reacting, intervening, correcting, adjusting, fine-tuning, exchanging or even making sacrifices to achieve specific goals—is a dynamic feedback

principle allowing work to be performed with continuous improvements. Finally, learning reflects capturing, examining, studying experiences and integrating knowledge for future practice. Indeed, safety is not only defined by the absence of errors or other undesirable events but also by learning from them.

RHC is a promising avenue of research to help understand how complex systems coped with COVID-19 (Thomas et al., 2020; Wu et al., 2020). However, the concept is still new, and few authors have studied it in relation to the pandemic. Its different dimensions are rarely considered as a whole. On the one hand, most research on RHC has been conducted at the micro-level with frontline staff. However, there is evidence that examining this level alone is insufficient to understand the emerging phenomenon of RHC. The *meso* level (e.g. hospital, department, unit.) deserves study, too (Berg et al., 2018). On the other hand, the *hardware* and *software* aspects of complex systems are not always given the same importance. *Hardware* includes the system's physical and organisational infrastructure, products, resources, services and finances (Sheikh et al., 2011). *Software* is concerned with people's skills, values, knowledge, social capital, management skills, planning, leadership and power relations (Barasa et al., 2017; Nuzzo et al., 2019).

Focusing on the *software* highlights the importance of the active role played by every actor. In a time of crisis, the psychological suffering of healthcare workers is likely to decrease the healthcare system's resilience, patient safety and care staff retention (Rangachari & Woods, 2020). However, professionals may also increase their institution's organisational resilience by applying self-regulation strategies that manage disturbances to their activity (Cuvelier & Falzon, 2010; Kruk et al., 2015; Lane & McGrady, 2018). There is a strong relationship between the notion of self-regulation and the concept of “deference toward expertise” (Weick & Sutcliffe, 2001). This approach considers each employee's specific expertise and recognises their skills in identifying the sources of errors and finding appropriate solutions. Applied to RHC, this implies that each healthcare role needs to be considered equally, whatever its hierarchical status.

Finally, although several cohort studies have examined the pandemic's impacts on healthcare workers' mental health (López Steinmetz et al., 2021; Sasaki et al., 2021; Van Steenkiste et al., 2021), we do not know of any longitudinal studies addressing the evolution of organisational resilience processes. Thus, our research project's objective was to explore the evolution of the problematic situations encountered by healthcare workers over several waves of the pandemic as well as the adjustments put in place by the teams, individuals and institutions trying to cope with them. This longitudinal mixed-methods study followed and completed a previous cross-sectional study (reference removed for anonymity). In the quantitative part of the study, we attempted to develop scales with which to measure RHC. This new tool was derived from the “four cornerstones of resilience” framework (Hollnagel, 2013) and considered both the *meso*- and micro-levels of RHC represented by institutions and staff as well as RHC's hardware and software dimensions. To the best of our knowledge, no such tool existed before (Ellis et al., 2019; Iflaifel et al., 2020). The research questions were:

- Which problematic situations did employees in healthcare institutions face in their daily activities during the COVID-19 pandemic's first year?
- What resilience strategies did healthcare workers, teams and institutions adopt to anticipate and adapt to these situations?
- How did these problematic situations and resilience strategies evolve throughout the pandemic in terms of their severity, the stress induced and the efficacy of crisis management?

3. Methods

3.1. Sampling and data collection

In this cohort study, participants completed the same online questionnaire three times. The first survey took place between May and June 2020 (the end of the first wave of the pandemic in Switzerland). The convenience sample consisted mainly of the healthcare, support, front-line and administrative staff at a university hospital in French-speaking Switzerland. The sample was supplemented with employees from other institutions: nursing and educational staff at an institution for disabled persons, caregivers from a regional hospital, nursing staff and students in the nursing sciences from two universities of applied sciences, in-house nursing care instructors working in healthcare institutions in several Swiss cantons and nurses participating in continuing education courses. Individuals who fell into one of the above categories were eligible for inclusion in the sample. In all, 15,272 potential participants were contacted in the first survey. They received an email explaining the study and inviting them to participate. Respondents participated by voluntarily clicking on the link in the email, and they were allowed to complete the questionnaire during their working hours. Participants who completed the first survey were contacted a second time, between June and October 2020 (between the first two waves of the pandemic). Participants who completed the second survey were contacted a third time, between December 2020 and February 2021 (during the second wave). As there was a risk of ending up with too small a sample, we also contacted people who had participated in the first survey, but not in the second. In each survey wave, a reminder email was sent two weeks after the initial contact.

To get as close as possible to their actual work activity, an open-ended question inspired by the validated Working Conditions and Control Questionnaire (Hansez, 2008) asked participants to describe a concrete problematic situation related to the pandemic encountered in their working activities. The respondents also answered several sets of four-point Likert-type questions to assess how their team reacted to this situation. The French version of the Team Emergency Assessment Measure questionnaire (Cooper et al., 2016) was used to evaluate the quality of leadership and teamwork. Specific items were created to measure the processes of anticipation, detection and adaptation to the situation. The effects of these processes and the severity of the situation were assessed using a series of sliders graduated from 0 to 100. The participants were also presented with open-ended text fields to describe the measures put in place within their team or institution. Finally, the questionnaire requested data on sex, institution size, profession and hierarchical status; it took about 25 min to complete. Study data were collected and managed using REDCap (Research Electronic Data Capture), a secure, web-based software platform designed to support data capture for research studies (Harris et al., 2019).

3.2. Data processing

Answers to the open-ended question on problematic situations were categorised to quantify their frequency and study their associations with demographic variables (e.g. profession, hierarchical status). The coding process was described in a previous publication (reference removed for anonymity). For the closed questions, following existing guidelines (Sterne et al., 2009), we verified the characteristics of participants with missing data and performed a multiple imputation procedure—five imputed datasets were created. Scales were developed for organisational resilience processes and for the effects of the problematic situations described, based on factor analyses. We determined the data's suitability using the KMO criterion and the Bartlett test of sphericity. Orthogonal varimax rotations were performed. The items were grouped into scales, and for each scale, a new analysis was conducted to check its consistency and unidimensionality. We considered this objective to be achieved when the first factor had positive factor loadings on all the variables in

the scale, when it had an eigenvalue greater than 1 (Kaiser's rule) and when a drop was observed on the scree plot after the first factor. Internal consistency was assessed using Cronbach's alpha. Scores were computed using values ranging from 1 to 4 for the scales measuring organisational resilience processes and from 1 to 100 for the impact scales. The scales for organisational resilience processes were then submitted to a subsequent factor analysis. We set the number of dimensions to two and built a two-dimensional graphical representation of organisational resilience; factorial scores were computed on these two *meta*-dimensions. Finally, the situations were grouped by performing a two-step cluster analysis of the impact scales. All analyses were conducted using the IBM SPSS Statistics (version 26) and R Core Team software.

4. Results

4.1. Sample

The first survey (T1) was answered by 32.3 % of our potential participants, giving us a sample size of 4,937, of whom 1,290 people described a problematic situation. At survey-two (T2), the questionnaire was answered by 1,503 people, with 363 describing a problematic situation. At survey-three (T3), 1,414 people participated, with 372 describing a problematic situation. The sample comprised 54.9 % nurses, caregivers, and community health assistants; 14.4 % medico-technical, medico-therapeutic or medico-social staff; 12.5 % administrative staff; 9.8 % medical doctors; and 3.1 % logistical, technical, maintenance or catering staff. Nearly 80 % of the participants worked at the university hospital, 5 % in an institution for people with disabilities, and the others in a variety of healthcare institutions.

4.2. Scales

Based on the factor analyses, eight scales were built to assess organisational resilience processes: team performance, pre-existing resources, team leader's performance, anticipation, changes to activities, changes in operating procedures, development of new resources and team cohesiveness. Impact variables were grouped into five scales: satisfaction with the problematic situation's management, risk exposure, skills development, quality control and stress control, and stress. A list of these scales, their constituting variables and their factor loadings can be found in the Supplementary Materials.

4.3. The evolution of problematic situations during the pandemic's first year

The categorisation of participants' responses enabled us to define nine main groups of problematic situations, although some situations fell into several categories (Fig. 1): organisational changes (37.4 % of all the situations described during the whole study period); workload and schedules (28.3 %); conflictual relationships (22.2 %); concerns about care practices and COVID-19 patients' critical situations (20.0 %); emotional burden (fear of contamination, stress, loneliness and guilt) (18.4 %); lack of information, communication and training (14.9 %); difficulties with guidelines and protective measures (11.6 %); lack of COVID-19 PPE and patient care equipment (9.0 %); and teleworking (5.9 %). Twenty-nine subcategories, described in detail in a previous publication (reference removed for anonymity), were also defined. Longitudinal analyses showed a statistically significant ($p < .05$) increase in the subcategories of problems involving "work quantity, duration and understaffing" (T1 9.8 % / T2 15.2 % / T3 15.8 %) and "sick leave, absences and reassignments" (T1 7.4 % / T2 10.1 % / T3 13 %). A statistically significant increase in relative frequency was also found for the category of problematic situations involving "concerns about care practices and COVID-19 patients' critical situations" (T1 18.2 % / T2 17.4 % / T3 30.4 %). Among its subcategories, there was an increase in the difficulties related to patients' critical conditions, deaths and ethical

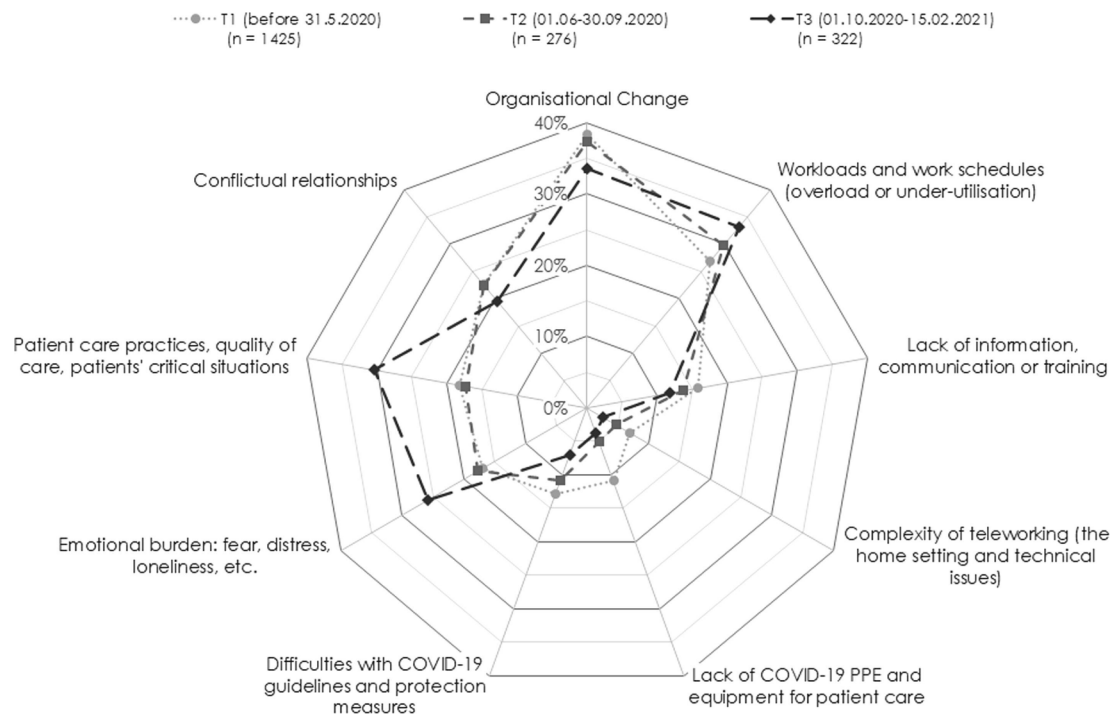


Fig. 1. Spider plot of the frequency of problematic situations in each survey.

problems (T1 9.2 % / T2 7.2 % / T3 18.3 %). The main category of “emotional burden” also significantly increased over time (T1 16.9 % / T2 17.8 % / T3 25.8 %), especially in its subcategories of “fear of being contaminated” (T1 10.4 % / T2 13 % / T3 16.8 %) and “feelings of stress, stigmatisation and guilt” (T1 1.3 % / T2 1.8 % / T3 4.3 %). In contrast, the following main categories significantly decreased over time: difficulties related to COVID-19 guidelines and protection measures (T1 6.9 % / T2 4.7 % / T3 2.5 %), lack of COVID-19 PPE and patient care equipment (T1 10.9 % / T2 5.1 % / T3 3.7 %), and technical problems involving teleworking (T1 6.9 % / T2 4.7 % / T3 2.5 %). No significant difference was found for problems involving organisational changes, except for an increase in the subcategory of “working in a hurry and very rapid changes” (T1 4.5 % / T2 6.2 % / T3 8.1 %).

4.4. Frequency of problematic situations in the different risk clusters

Based on a cluster analysis of our impact scales, we generated five “risk clusters” (groups of problematic situations) depending on their severity, the stress they induced, satisfaction with their management, exposure to risks, how stress was controlled and the development of skills to deal with them (Table 1). Problematic situations from all the categories fell into each of the five clusters but in different proportions. The total number of the most severe and poorly managed problematic situations (cluster 1) increased over the whole period examined, albeit not significantly. Cluster 1 was characterised by a significant overrepresentation of situations related to a lack of information, communication or training, to restricted access to PPE and other material, to difficulties in implementing guidelines and protective measures, to fears of contamination and to conflictual relationships. Severe but satisfactorily managed situations (cluster 2) and more benign, well-managed situations (cluster 5) followed a slight but not statistically significant u-shaped path. Both showed a high prevalence of situations of organisational change; cluster 2 was also characterised by problems of information, communication or training, whereas problems related to teleworking were more frequent in cluster 5. The number of severe but well-managed situations (cluster 4) decreased markedly and significantly between spring and summer of 2020 and rose again slightly in the

winter. Cluster 4 was marked by more situations related to organisational changes. Finally, the more benign but poorly-managed situations (cluster 3) followed an inverted u-shaped path, with a significantly higher proportion of problems in this cluster in the summer. Conflictual relationships were slightly more frequent in this cluster than in the overall sample, and to a very small extent, so were difficulties with teleworking. Overall, about 60 % of the problematic situations were assigned to the three severe clusters (1, 2 and 4), and of these, 12 %–15 % were considered poorly managed (cluster 1).

4.5. Factorial axes of organisational resilience

Using a factor analysis of the resilience scales, we generated two meta-dimensions of organisational resilience, explaining 51.7 % of the variance. The first axis, “anticipation and performance”, related to the dimensions of team performance, pre-existing resources, team cohesiveness, the team leader’s performance, and anticipation (Cronbach’s $\alpha = 0.66$). The second axis, “adaptation and change”, related to the processes of developing new resources, changing operating procedures and changing activities (Cronbach’s $\alpha = 0.59$). All the factor loadings were between 0.71 and 0.83, except anticipation at 0.53 and team leader’s performance at 0.54. By cross-referencing levels of these two axes of organisational resilience, we generated four configurations of organisational resilience, each reflecting a different kind of organisational and collective response (Table 2).

Scatter plots were generated by cross-referencing these two factorial axes. The evolution of different organisational resilience processes over time was described by their evolving positions on these plots, with the median factorial values of the different clusters, professional categories, hierarchical statuses, workloads and types of problematic situations.

4.5.1. The movements of risk clusters between the four configurations of resilience

Each arrow in Fig. 2 depicts the clusters’ evolution between the first, second and third surveys (each point marks a survey). It reveals the overall decrease in “adaptation and change” on the vertical y-axis, including most of the risk clusters after the pandemic’s first wave,

Table 1

Evolution of the risk clusters and associated problematic situations (percentages refer to proportions in each time period).

Clusters of situations	1st wave (T1)	In-between (T2)	2nd wave (T3)	Over-represented problematic situations ($p < .05$)
<i>Cl1 Severe and poorly managed</i> Very severe, risky, stressful, and poorly managed situations, with average stress control and average skill development	11.6 % (165)	13.0 % (36)	14.8 % (48)	Lack of information, communication or training (23.3 % of cluster 1 vs 14.9 % of sample) Access to COVID-19 PPE and equipment for patient care (17.3 % vs 9.0 %) Difficulties with COVID guidelines and protection measures (18.1 % vs 11.6 %) Emotional burden, fear, distress, loneliness, etc. (24.9 % vs 18.4 %), especially fear of contamination by patients or peers Conflictual relationships (34.9 % vs 22.2 %), especially within teams and with the hierarchy
<i>Cl2 Severe but satisfactorily managed</i> Severe, risky and stressful situations, but satisfactorily managed, with good stress control and skill development	31.2 % (445)	29.7 % (82)	31.5 % (102)	Organisational change (39.3 % of cluster 2 vs 37.4 % of sample), especially spatial reorganisation, unusual activities and reorganisation of services, tasks or planning Lack of information, communication or training (17.5 % vs 14.9 %)
<i>Cl3 More benign but poorly managed</i> More benign and moderately stressful situations with lower risks, but more poorly managed, with medium stress control and skills development	18.1 % (258)	29.0 %* (80)	20.4 % (66)	Teleworking settings and technical problems (6.5 % of cluster 3 vs 5.9 % of sample) Conflictual relationships (27.0 % vs 22.2 %), especially within teams and with the hierarchy
<i>Cl4 Severe but well managed</i> Very severe, risky, and stressful situations, but very well managed, with good stress control and skills development	19.6 %* (280)	10.9 % (30)	12.7 % (41)	Organisational change (45.3 % of cluster 4 vs 37.4 % of sample), especially spatial reorganisation, unusual activities, reorganisation of services, tasks or planning, and working in an emergency
<i>Cl5 More benign and well managed</i> More benign, moderately stressful, low risk and satisfactorily managed situations, with medium stress control and skills development	19.4 % (277)	17.4 % (48)	20.7 % (67)	Organisational change (44.5 % of cluster 5 vs 37.4 % of sample), especially unusual activities, reorganisation of services, tasks or planning, and working in an emergency Teleworking settings and technical

Table 1 (continued)

Clusters of situations	1st wave (T1)	In-between (T2)	2nd wave (T3)	Over-represented problematic situations ($p < .05$)
Sum	100 % (1425)	100 % (276)	100 % (324)	problems (12.3 % of cluster 5 vs 5.9 % of sample)

* Significantly different from the other timelines ($p < .05$).

Table 2

Factorial axes of organisational resilience and associated configurations.

	Anticipation and performance < average	Anticipation and performance > average
Adaptation and change > average	<i>Learning through mistakes</i> Teams are not very effective yet but able to innovate and learn.	<i>Effective development</i> Teams are in a phase where they can fully develop their potential.
Adaptation and change < average	<i>Hindered Resilience</i> Teams are less effective and innovative. Their potential for adaptation is exhausted and remains insufficient.	<i>New standards</i> Teams have put in place new ways of working effectively.

followed by a slight overall increase during the second wave, except for problems in the “severe but well managed” risk cluster, whose scores continued to decrease. Concerning the horizontal “anticipation and performance” x-axis, Fig. 2 shows that all the risk clusters had improved by the pandemic’s second wave compared to the first, with a slight decrease or stagnation between the two waves. However, the increase was slight for cluster 2’s “severe but satisfactorily managed” problems and cluster 5’s “more benign and well managed” problems. Cluster 1’s “severe and poorly managed” problems displayed an alarming profile since it stayed among the “hindered resilience” configurations throughout the study period, with especially low anticipation and performance scores.

4.5.2. Evolution of socio-professional groups between the four configurations of organisational resilience

Professional categories².

During the pandemic’s first wave, all the occupational groups had similar values, towards the middle of both the “adaptation and change” and “anticipation and performance” axes; however, subsequently, their trajectories differed. Nurses, healthcare assistants, and auxiliary nurses moved towards the “hindered resilience” configuration and stayed there. Medical doctors evolved from the “effective development” to the “new standards” configuration. Medico-technical, therapeutic and social staff, and administrative staff also moved towards the development of “new standards” configuration, but they passed through the “hindered resilience” configuration between the two waves.

Hierarchical status.

Middle and senior managers scored higher than employees without a hierarchical function along both axes and during the whole period. Their trajectories went from the “effective development” configuration in the first wave to the “new standards” configuration afterwards. Employees without a hierarchical function had a different trajectory and moved from the “learning from mistakes” to the “hindered resilience” configuration, and then to the boundary between the “hindered resilience” and “new standards” configurations.

² Logistical staff were not be considered because of their insufficient number in the sample.

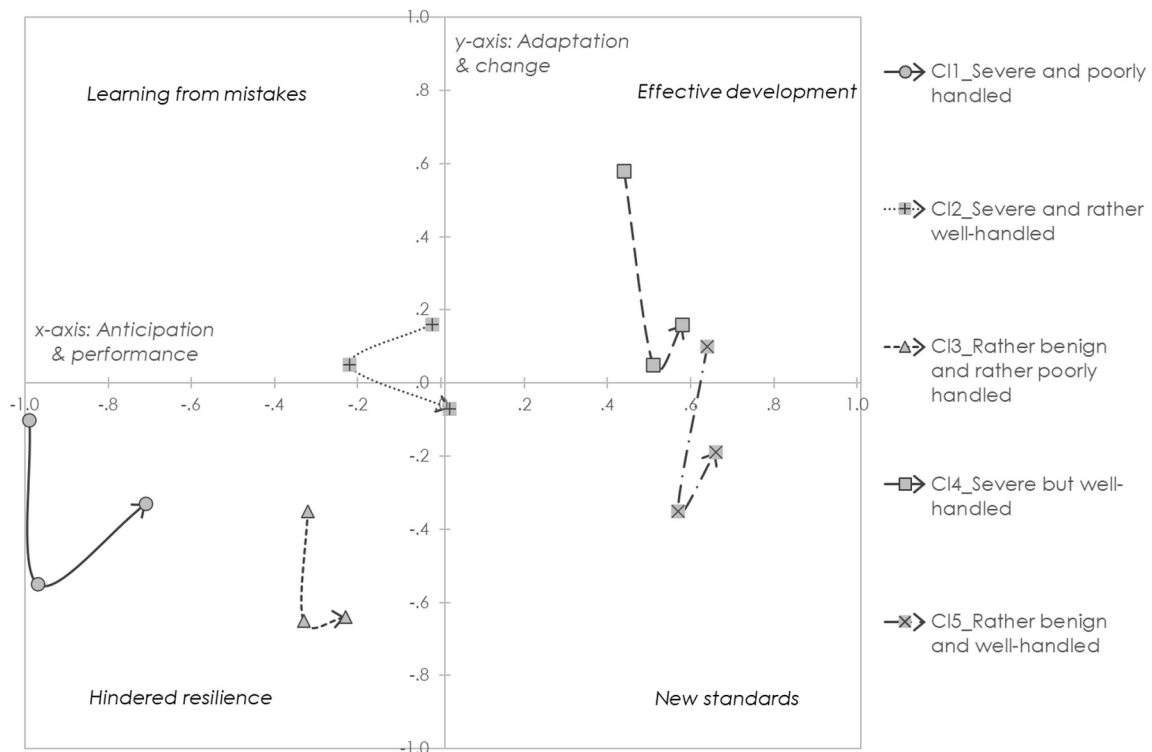


Fig. 2. Evolution of the clusters of problematic situations along the factorial axes of resilience.

4.5.3. Evolution of the problematic situations between the four configurations of organisational resilience

Problematic situations evolved differently along the two axes of resilience (Figs. 3 and 4). Problems with care practices and patients' critical conditions remained in the "new standards" configuration throughout the whole period. However, during the pandemic's second

wave, anticipation and performance decreased. Problems related to teleworking evolved similarly. Difficulties with implementing COVID-19 guidelines and protection measures started in the "learning from mistakes" configuration and moved to the "new standards" configuration. The trajectories of three problematic situations—conflictual relationships, workload and work schedules, and lack of information,

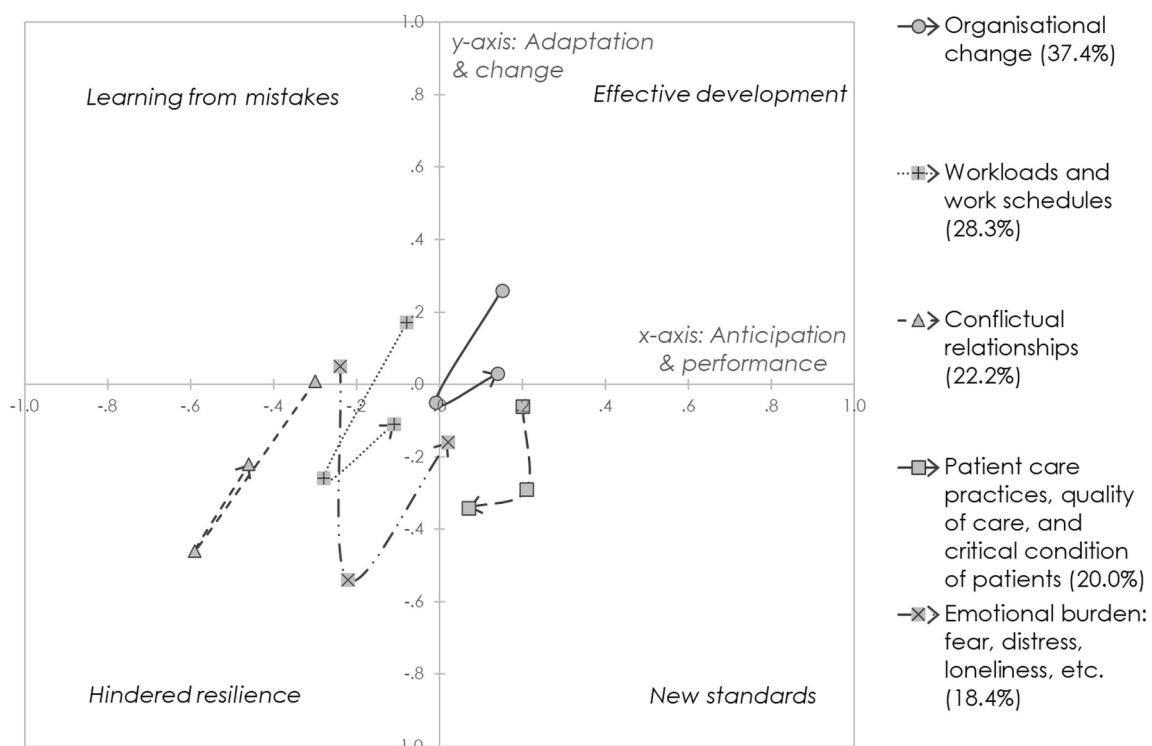


Fig. 3. Evolution of the five most frequent categories of problematic situations along the factorial axes of resilience.

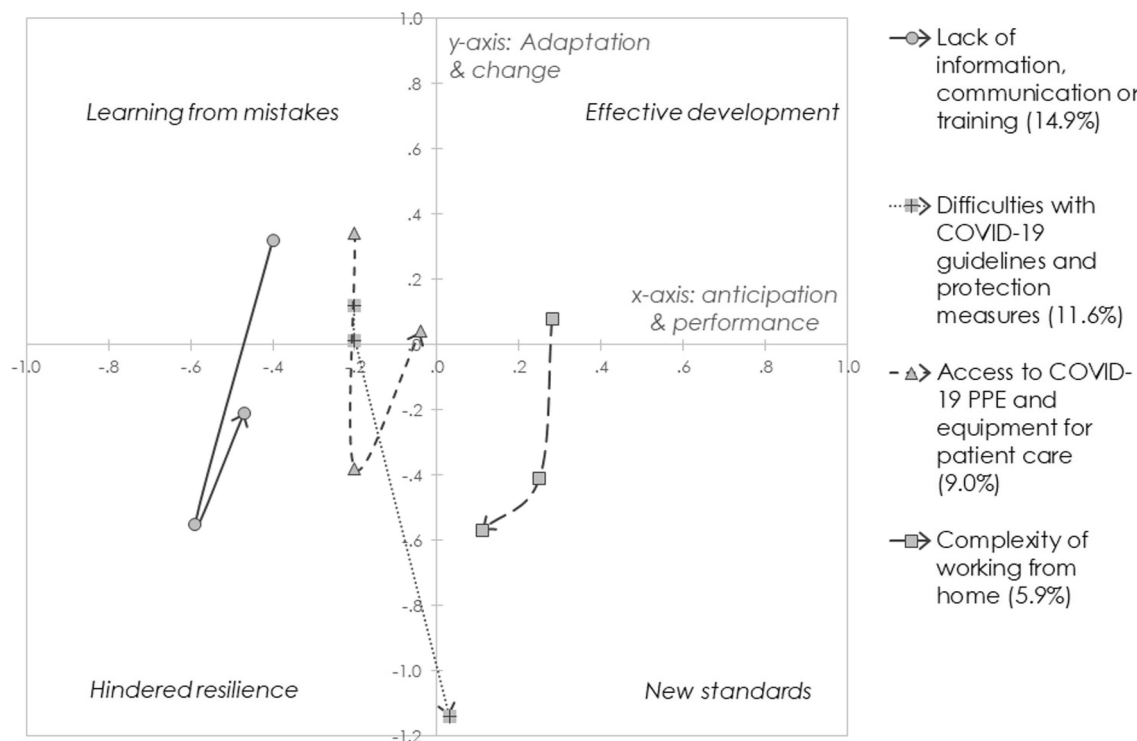


Fig. 4. Evolution of the four least frequently reported categories of problematic situations along the factorial axes of resilience.

communication, or training—ended in the “hindered resilience” configuration. The “access to equipment” and “emotional burden” problems followed a u-shaped path, with an improvement along the “anticipation and performance” axis. Finally, problems related to organisational change decreased along the adaptation and change axis but fluctuated along the anticipation and performance axis.

5. Discussion

The present study explored trajectories of organisational resilience as perceived by healthcare workers in Switzerland during the first two waves of the COVID-19 pandemic. To this end, we sought to identify the evolution of the problematic situations they experienced in their daily work (research question 1). We then investigated healthcare workers’ perceptions of their team’s reactions to these problems in terms of its anticipation, adaptation, and performance (research question 2). Finally, we monitored the evolution of these problematic situations and reactions to them over time (research question 3).

5.1. Problematic situations

At the pandemic’s onset, reactions to most types of problematic situation were characterised by a “learning from mistakes” strategy, with little anticipation and poor performance, but high adaptation and major changes. Six to nine months later, several of these problems were perceived to be well managed, with workers considering that their team had implemented new, effective, and stable ways of working (the “new standards” trajectory). However, some situations had worsened, hindering team resilience: problems did not allow staff to adapt, and they developed a sense of helplessness. We grouped problematic situations into four trajectories based on the resilience configurations they fell into, on average, throughout the study period.

5.1.1. “Learning from mistakes” trajectory

Healthcare workers and institutions learned a lot from the problems they encountered. Thus, by the end of the study period, there was no

category of problematic situation remaining in the “learning from mistakes” configuration except the “lack of COVID-19 PPE and patient care equipment” problem. Nevertheless, this problem’s average values along the two axes (anticipation and performance; adaptation and change) were very close to the mean. Moreover, its frequency decreased over time, suggesting that management of this problem improved. At an international level, the rational use of COVID-19 PPE and the distribution of sufficient medical supplies were also essential strategies (Clay-Williams et al., 2020; Haldane et al., 2021).

5.1.2. “Effective development” trajectory

Only problematic situations in the category of organisational changes remained in the “effective development” configuration throughout the entire study period. Dealing with constant changes required a lot of adaptation, especially in the pandemic’s first phase, but it was associated with high performance. Moreover, the relative frequency of reporting about this category decreased over time, either because changes became better managed, individuals got used to them, or the frequency of other problematic situations increased. Many organisations in other countries were confronted with the same problems. They implemented similar strategies, such as creating new treatment facilities, converting existing medical facilities into COVID units, cancelling elective surgery to maintain the system capacity, developing home care services, or mobilising volunteers and military forces. Many institutions worldwide also expanded the capacity of their healthcare workforce by hiring students, civil servants, retired and nonpracticing health workers, and repurposing healthcare professionals from other specialities (Haldane et al., 2021).

5.1.3. “New standards” trajectory

Four categories of problematic situations were associated with the development of new standards: (1) difficulties implementing COVID guidelines and protection measures, (2) the complexity of teleworking, (3) emotional burden, and (4) concerns about patient care practices, quality of care, and patients’ critical conditions. Taken together, these problems required progressively less adaptation over time, and

performance remained above average. Healthcare workers got used to new ways of working and developed new skills to perform effectively. Routinisation is a known coping strategy among nurses (McKnight et al., 2020), and the incorporation of these new standards probably also helped to decrease stress.

This trend was particularly salient for problems involving teleworking and COVID-19 guidelines, as their proportions decreased. Teleworking appeared to become a normal part of office workers' daily lives and even for some healthcare professionals. Indeed, digital technologies and telehealth saw unprecedented development in patient triage and care (Clay-Williams et al., 2020; Haldane et al., 2021). The problematic situations related to COVID-19 guidelines and protection measures stabilised after a while, reducing adaptive stress. These measures also protect against PTSD (Carmassi et al., 2020).

In contrast, the relative proportions of the two other trajectory categories increased and they were less positive in terms of adaptation and performance. The management of problems involving emotional burden slightly improved but remained problematic. According to the literature, several factors have contributed to emotional exhaustion during the pandemic, including heavy workloads, the obligation to wear PPE, fear of contamination, and feelings of helplessness in managing patients' conditions (Liu et al., 2020; López Steinmetz et al., 2021). To mitigate these effects, institutions have provided mental health support through psychological debriefings, meal facilities, days off, or even financial assistance (Haldane et al., 2021). Finally, concerns about the quality of care and patient's critical conditions were associated with above-average performance. However, performance worsened over time, possibly due to increases in the number of critically ill patients. As in previous studies, many nurses reported moral injury and distress due to violations of their moral code concerning the quality of care (Lamb et al., 2021). Their primary concern was their perceived duty of being fully responsible for their patients' well-being (Liu et al., 2020). These feelings were strongly associated with increased levels of anxiety, depression, PTSD symptoms and alcohol misuse (Lamb et al., 2021).

5.1.4. "Hindered resilience" trajectory

The last trajectory refers to three categories of problematic situations: workload and work schedules, conflictual relationships, and problems with information, communication and training. These were characterised by a decreasing ability to adapt and maintain performance levels, presumably because of resource exhaustion, resignation, learned helplessness or high levels of stress factors. Common to these situations were difficulties adapting and developing new, effective skills. Previous studies have reported health workers experiencing more verbal violence during the COVID-19 pandemic (Jung et al., 2020b), with unclear communication, disrupted work schedules and more conflicts at work in a context of deteriorating professional relations (El-Hage et al., 2020).

We do not know of any studies addressing the trajectories of organisational resilience processes in healthcare institutions during the pandemic. However, we can draw a parallel with a study on mental health trajectories conducted by Dufour et al. (2021). They described four separate trajectories, which they named the "recovered" (significant mental health symptoms during the first wave but then recovery), "resilient" (stress-resistant during the whole crisis with no mental health problems), "sub-chronic" (resistant at the start of the crisis, with mental health issues occurring later but then fading away), and "delayed" (worsening of mental health symptoms throughout the pandemic period) trajectories. These authors revealed an optimistic picture because they showed that most healthcare workers followed the resilient trajectory. In contrast, however, our study suggested that there were enduring hindrances to organisational resilience in the face of the widespread problematic situations caused by the pandemic.

5.2. The severity of problematic situations and perceptions of their handling

The cluster analysis of our impact scales revealed a connection between the configurations of organisational resilience, on the one hand, and perceptions of the severity of problematic situations and how well they were managed, on the other. Two clusters remained, on average, in the "hindered resilience" configuration throughout the study period: the "severe and poorly managed" and the "more benign but poorly managed" situations. The former cluster was characterised by an over-representation of several problems: lack of information, insufficient access to equipment, difficulties with guidelines and protection measures, emotional burden and conflictual relationships. The latter was also over-represented by problems of conflictual relationships.

Previous publications have suggested that resilience mechanisms may differ according to the severity of the context (Davydov et al., 2010; Fletcher & Sarkar, 2013). However, they focused on psychological rather than organisational resilience, showing how resilience might develop differently for daily hassles rather than major traumatic events. More specifically, traumatic experiences can reduce feelings of self-efficacy (Resick & Schnicke, 1992)—an essential component of individual resilience (Hobfoll et al., 2007)—but also of collective organisational efficacy (Albott et al., 2020). Time is another potential factor explaining these different trajectories. It has been suggested that resilience processes develop over time, with some strategies taking longer to become effective (Davydov et al., 2010).

5.3. Occupational categories and hierarchical status

Different professional categories did not perceive the development of organisational resilience equally. According to Regenold and Vindrola-Padros (2021), crises exacerbate the dangers of gender inequalities developing within healthcare systems as they contribute to a disproportionate burden of care being shouldered by women. Our findings showed that nurses, healthcare assistants and auxiliary nurses—occupations in which women are over-represented—tended to follow a "hindered resilience" trajectory; they also reported lower self-perceived performance than the other occupational categories. Doctors, medical technicians, medical therapists, sociomedical staff and administrative staff, however, seemed to maintain their performance and adapt more easily. Other authors have identified differences in nurses' and doctors' capacities for adaptation and resilience (Sánchez-Zaballos and Mosteiro-Díaz, 2020; Santabàrbara et al., 2021). Self-perceived job performance worsened over time among healthcare workers whose mental health was observed to deteriorate significantly (López Steinmetz et al., 2021). Previous research has suggested several explanations. The burden induced by more prolonged contact and greater exposure to patients' suffering has been reported to be higher among nursing staff than among doctors (Carmassi et al., 2020; Lai et al., 2020). Nurses have been more exposed to COVID-19 patients and the risk of infection (Stringhini et al., 2021). Doctors have higher educational levels than nurses, and education has a protective effect by increasing the personal skills needed to cope with critical situations (Afshari et al., 2021). Moreover, previous studies have found a link between psychological resilience and work autonomy, for example, the ability to organise one's work and remain flexible about deadlines (Eley et al., 2013; McKnight et al., 2020). Medical technicians, medical therapists, sociomedical staff and, most of all, doctors probably have more autonomy and independence than nurses. Administrative employees who mainly teleworked during the pandemic presumably benefited from greater flexibility. On the contrary, nurses, healthcare assistants and auxiliary nurses might have experienced even less leeway than usual due to the numerous constraints imposed on their tasks, schedules or work organisation.

The same hypothesis might explain the differences in organisational resilience found according to hierarchical status. Throughout the study

period, employees were more critical than managers regarding adaptations to problematic situations, perhaps because of their lower level of autonomy. There is a similarity between this observation and the job-demand-control model (Karasek, 1979), according to which job strain depends on the relationship between work demands and decision latitude. High levels of decision latitude and job demands foster learning and personal development. Indeed, in our data, managers had higher adaptation scores than employees, but they also more frequently reported being overloaded. Moreover, participants' feelings of being 'underloaded' were associated with hindered resilience, corresponding to low levels of performance and adaptation. A parallel can be drawn with the "passive work" category found in the job-demand-control model, defined by low levels of workload and autonomy. This kind of work situation can lead to boredom, skill atrophy and negative health consequences (Karasek, 1979; van Wassenhove, 2014).

5.4. Strengths, limitations and future avenues of research

The present study had several strengths. The large sample size facilitated an extensive exploratory quantitative analysis. Few research projects have used a mixed-methods approach to study RHC (Ellis et al., 2019). Transforming themes into quantitative categories enabled us to study relationships between resilience processes and demographic and work-related variables. Longitudinal analysis was another strength since it allowed us to observe changes in organisational resilience processes in relation to the evolution of problematic situations.

There were nevertheless some limitations. First, 90 % of the sample was made up of staff from a single large university hospital, which limits generalisability. However, no major differences were observed with the rest of the sample. Second, compared to interviews or activity observations, addressing organisational resilience processes through closed-ended questions did not provide much information on the precise nature of the strategies that teams implemented. Future field analyses could expand on these findings and constitute a new avenue of research; follow-on studies will have to perform a psychometric validation of the scales created to measure organisational resilience processes. Finally, further investigations are needed to better understand the relationships between organisational resilience processes, coping strategies and health consequences. This work is in progress.

6. Conclusion

This study revealed that some of the problematic situations encountered by healthcare workers during the COVID-19 pandemic caused more difficulties than others, whether for managers, teams or individuals. Certain structural problems were already present before the crisis, such as shortages of specialised staff, understaffing in some specific sectors or heavy workloads. These were aggravated by the global health crisis. Immediate effective responses to these situations were difficult to find within individual institutions, let alone individual care teams. Preventing and correcting problematic situations requires a multi-level approach. The macro-level measures implemented by governments and health authorities are essential to ensuring overall healthcare system resilience. These relate to budgets, recognising the value of the different healthcare professions, training systems, and so on, and they comprise four elements (Clay-Williams et al., 2020; Haldane et al., 2021). Firstly, a comprehensive approach is necessary, considering health and well-being together with social and economic aspects. Secondly, the overall healthcare system's capacity must be adapted to meet communities' needs. Thirdly, the system's functions and resources must be maintained so that care for chronic and acute non-COVID patients can continue as COVID patients receive treatment too. Fourthly, macro-level measures should strive to reduce mortality and maintain financial sustainability at the same time, while continuously learning, monitoring and adjusting.

However, macro-level measures are insufficient. The present study

highlighted the importance of meso- and micro-level adaptations by institutions, teams and individual healthcare workers. Indeed, team resilience is insufficiently considered and should be promoted (Koh et al., 2020). Interventions aimed at supporting frontline workers must consider the organisational, social, personal and psychological factors influencing resilience (Pollock et al., 2020). Previous publications have recommended organisational actions, such as stress management training, mentoring programmes for younger colleagues and developing a culture of open communication (Koh et al., 2020). The clear and prompt communication of management directives and information is needed, as is a supportive attitude from the hierarchy (e.g. empathy and compassion, open dialogue and active listening) (Carmassi et al., 2020; Jung et al., 2020a). Nurse managers play an essential role in inspiring and empowering nurses, as well as building morale and a collective commitment to safe, quality care (Markey et al., 2021). At the team level, many authors have stressed the importance of strong relationships, peer support and senior staff who lead by example and display their optimism (Albott et al., 2020; Koh et al., 2020; Liu et al., 2020). At the psychological level, it seems important to promote a sense of calm and safety, self-efficacy and group efficacy, self-compassion, connectedness and hope (Albott et al., 2020; Hobfoll et al., 2007). Finally, at the personal level, support from family and friends has been shown to be an important factor in resilience (Carmassi et al., 2020).

We conclude from our study that resilient healthcare requires a combination of top-down and bottom-up approaches. Management of the pandemic has necessitated that many political, administrative and financial actions be taken to support the health system. At the same time, the commitment and creativity of healthcare workers individually, their teams and their frontline managers have proven indispensable when adapting processes and activities to the realities on the ground. These proactive 'job crafting' attitudes and behaviours need to be recognised as critical dimensions of resilient healthcare.

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CRedit authorship contribution statement

Sandrine Corbaz-Kurth: Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Software, Writing – original draft. **Typhaine M. Juvet:** Formal analysis, Writing – original draft. **Lamyae Benzakour:** Methodology, Writing – review & editing. **Sara Cereghetti:** Methodology, Writing – review & editing. **Claude-Alexandre Fournier:** Funding acquisition, Writing – review & editing. **Gregory Moulec:** Formal analysis, Writing – review & editing. **Alice Nguyen:** Data curation, Formal analysis. **Jean-Claude Suard:** Methodology, Software. **Laure Vieux:** Resources, Software. **Hannah Wozniak:** Methodology, Writing – review & editing. **Jacques A. Pralong:** Supervision, Project administration. **Rafaël Weissbrodt:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Software, Supervision, Writing – original draft. **Pauline Roos:** Conceptualization, Funding acquisition, Methodology, Supervision, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ssci.2022.105879>.

References

- Afshari, D., Nourollahi-darabad, M., Chinisaz, N., 2021. Demographic predictors of resilience among nurses during the COVID-19 pandemic. *Work* 68 (2), 297–303.
- Albott, C.S., Wozniak, J.R., McGlinch, B.P., Wall, M.H., Gold, B.S., Vinogradov, S., 2020. Battle Buddies: Rapid Deployment of a Psychological Resilience Intervention for Health Care Workers during the COVID-19 Pandemic. *Anesth. Analg.* 131 (1), 43–54.
- Amalberti, R., 2010. Résilience et Sécurité : Proximités et différences. *Actes Du 45e Congrès De La Société D'ergonomie De Langue Française*. Retrieved From <https://Ergonomie-Self.Org/Publications/Actes-Des-Congres/>.
- Anderson, J.E., Ross, A.J., Macrae, C., Wiig, S., 2020. Defining adaptive capacity in healthcare: A new framework for researching resilient performance. *Appl. Ergon.* 87, 1–9. <https://doi.org/10.1016/j.apergo.2020.103111>.
- Barasa, E.W., Cloete, K., Gilson, L., 2017. From bouncing back, to nurturing emergence: Reframing the concept of resilience in health systems strengthening. *Health Policy and Planning* 32 (suppl_3), iii91–iii94.
- Barasa, E., Mbui, R., Gilson, L., 2018. What is resilience and how can it be nurtured? A systematic review of empirical literature on organizational resilience. *Int. J. Health Policy Manage.* 7 (6), 491–503. <https://doi.org/10.15171/ijhpm.2018.06>.
- Batra, K., Singh, T.P., Sharma, M., Batra, R., Schvaneveldt, N., 2020. Investigating the Psychological Impact of COVID-19 among Healthcare Workers: A Meta-Analysis. *Int. J. Environ. Res. Public Health* 17 (23), 9096. <https://doi.org/10.3390/ijerph17239096>.
- Berg, S.H., Akerjordet, K., Ekstedt, M., Aase, K., 2018. Methodological strategies in resilient health care studies: An integrative review. *Saf. Sci.* 110, 300–312.
- Carmassi, C., Foghi, C., Dell'Oste, V., Cordone, A., Bertelloni, C.A., Bui, E., Dell'Osso, L., 2020. PTSD symptoms in healthcare workers facing the three coronavirus outbreaks: What can we expect after the COVID-19 pandemic. *Psychiatry Res.* 292, 113312.
- Clay-Williams, R., Rapport, F., & Braithwaite, J. (2020). The Australian health system response to COVID-19 from a resilient health care perspective: what have we learned? In *Public Health Research and Practice* (Vol. 30, Issue 4). Sax Institute. <https://doi.org/10.17061/PHRP30402025>.
- Cooper, S., Cant, R., Connell, C., Sims, L., Porter, J.E., Symmons, M., Nestel, D., Liaw, S. Y., 2016. Measuring teamwork performance: Validity testing of the Team Emergency Assessment Measure (TEAM) with clinical resuscitation teams. *Resuscitation* 101, 97–101. <https://doi.org/10.1016/j.resuscitation.2016.01.026>.
- Cuvellier, L., Falzon, P., 2010. Adaptation des systèmes, adaptation des opérateurs : de la résilience à l'ergonomie et retour. In: 45e Congrès De La Société D'Ergonomie De Langue Française, pp. 114–118.
- Davydov, D.M., Stewart, R., Ritchie, K., Chaudieu, I., 2010. Resilience and mental health. *Clin. Psychol. Rev.* 30 (5), 479–495. <https://doi.org/10.1016/j.cpr.2010.03.003>.
- Dufour, M.-M., Bergeron, N., Rabasa, A., Guay, S., Geoffrion, S., 2021. Assessment of Psychological Distress in Health-care Workers during and after the First Wave of COVID-19: A Canadian Longitudinal Study: Évaluation de la Détresse Psychologique Chez Les Travailleurs de la Santé Durant et Après la Première Vague de la COVID-19: une étude longitudinale canadienne. *Canad. J. Psychiatry* 66 (9), 807–814.
- Eley, D.S., Cloninger, C.R., Walters, L., Laurence, C., Synnott, R., Wilkinson, D., 2013. The relationship between resilience and personality traits in doctors: implications for enhancing well being. *PeerJ* 1. <https://doi.org/10.7717/peerj.216>.
- El-Hage, W., Hingray, C., Lemogne, C., Yrondi, A., Brunault, P., Bienvenu, T., Etain, B., Paquet, C., Gohier, B., Bennabi, D., Birmes, P., Sauvaget, A., Fakra, E., Prieto, N., Bulteau, S., Vidalhet, P., Camus, V., Leboyer, M., Krebs, M.O., Auouizerate, B., 2020. Health professionals facing the coronavirus disease 2019 (COVID-19) pandemic: What are the mental health risks? *Encephale* 46 (3), S73–S80. <https://doi.org/10.1016/j.encep.2020.04.008>.
- Ellis, L.A., Churrua, 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. *Saf. Sci.* 118 (May), 241–257. <https://doi.org/10.1016/j.ssci.2019.04.044>.
- Fang, J., Liu, Y.T., Lee, E.Y., Yadav, K., 2020. Telehealth solutions for in-hospital communication with patients under isolation during COVID-19. *West. J. Emerg. Med.* <https://doi.org/10.5811/westjem.2020.5.48165>.
- Fletcher, D., Sarkar, M., 2013. Psychological resilience: A review and critique of definitions, concepts, and theory. *Eur. Psychol.* 18 (1), 12–23. <https://doi.org/10.1027/1016-9040/a000124>.
- Ghahramani, S., Lankarani, K.B., Yousefi, M., Heydari, K., Shahabi, S., Azmand, S., 2021. A systematic review and meta-analysis of burnout among healthcare workers during COVID-19. *Front. Psychiatry* 12, 758849. <https://doi.org/10.3389/fpsy.2021.758849>.
- 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. *Nat. Med.* 27 (6), 964–980. <https://doi.org/10.1038/s41591-021-01381-y>.
- Hanse, J., 2008. The “Working conditions and control questionnaire” (WOCQ): Towards a structural model of subjective stress. *Eur. Rev. Appl. Psychol.* 58 (4), 253–262. <https://doi.org/10.1016/j.erap.2008.09.008>.
- Harris, P.A., Taylor, R., Minor, B.L., Elliott, V., Fernandez, M., O'Neal, L., McLeod, L., Delacqua, G., Delacqua, F., Kirby, J., Duda, S.N., 2019. The REDCap consortium: Building an international community of software platform partners. *J. Biomed. Inform.* 95, 103208.
- Hobfoll, S.E., Watson, P., Bell, C.C., Bryant, R.A., Brymer, M.J., Friedman, M.J., Friedman, M., Gersons, B.P.R., de Jong, J.T.V.M., Layne, C.M., Magueen, S., Neria, Y., Norwood, A.E., Pynoos, R.S., Reissman, D., Ruzek, J.I., Shalev, A.Y., Solomon, Z., Steinberg, A.M., Ursano, R.J., 2007. Five essential elements of immediate and mid-term mass trauma intervention: empirical evidence. *Psychiatry* 70 (4), 283–315.
- Hollnagel, E., 2011. Prologue: the scope of resilience engineering. In: Hollnagel, E., Paries, J., Woods, D.D., Wreathall, J. (Eds.), *Resilience Engineering in Practice: A Guidebook*. Ashgate.
- Hollnagel, E., 2013. Epilogue: how to make health care resilient. In: Hollnagel, E., Braithwaite, J., Wears, R. (Eds.), *Resilient Health Care*. CRC Press.
- Hollnagel, E., 2017. Safety-II in practice: Developing the resilience potentials. In: *Safety-II in Practice: Developing the Resilience Potentials*. Routledge. <https://doi.org/10.4324/9781315201023>.
- Iflaifal, M., Lim, R.H., Ryan, K., Crowley, C., 2020. Resilient Health Care: A systematic review of conceptualisations, study methods and factors that develop resilience. *BMC Health Services Research* 20 (1). <https://doi.org/10.1186/s12913-020-05208-3>.
- Ishak, A.W., Williams, E.A., 2018. A dynamic model of organizational resilience: adaptive and anchored approaches. *Corporate Communications* 23 (2), 180–196. <https://doi.org/10.1108/CCJ-04-2017-0037>.
- Jung, H., Jung, S.Y., Lee, M.H., Kim, M.S., 2020a. Assessing the Presence of Post-Traumatic Stress and Turnover Intention Among Nurses Post-Middle East Respiratory Syndrome Outbreak: The Importance of Supervisor Support. *Workplace Health & Safety* 68 (7), 337–345.
- Jung, S., Kneer, J., Krüger, T., 2020b. Mental Health, Sense of Coherence, and Interpersonal Violence during the COVID-19 Pandemic Lockdown in Germany. *Journal of Clinical Medicine* 9 (11), 3708.
- Juvet, T., Corbaz-Kurth, S., Roos, P., Benzakour, L., Cereghetti, S., Moulec, 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. *Saf. Sci.* 139, 1–9.
- Kang, L., Li, Y., Hu, S., Chen, M., Yang, C., Yang, B.X., Wang, Y., Hu, J., Lai, J., Ma, X., Chen, J., Guan, L., Wang, G., Ma, H., Liu, Z., 2020. The mental health of medical workers in Wuhan, China dealing with the 2019 novel coronavirus. *The Lancet Psychiatry* 7 (3), e14. [https://doi.org/10.1016/S2215-0366\(20\)30047-X](https://doi.org/10.1016/S2215-0366(20)30047-X).
- Kantur, D., 2015. Measuring Organizational Resilience: A Scale Development. *Pressacademia* 4 (3). <https://doi.org/10.17261/Pressacademia.2015313066>.
- Karasek, R.A., 1979. Job Demands, Job Decision Latitude, and Mental Strain: Implications for Job Redesign. *Adm. Sci. Q.* 24 (2), 285.
- Koh, M.Y.H., Hum, A.Y.M., Khoo, H.S., Ho, A.H.Y., Chong, P.H., Ong, W.Y., Ong, J., Neo, P.S.H., Yong, W.C., 2020. Burnout and Resilience After a Decade in Palliative Care: What Survivors Have to Teach Us. A Qualitative Study of Palliative Care Clinicians With More Than 10 Years of Experience. *J. Pain Symptom Manage.* 59 (1), 105–115.
- Kruk, M.E., Myers, M., Varpilah, S.T., Dahn, B.T., 2015. What is a resilient health system? *The Lancet* 385 (9980), 1910–1912.
- Lai, J., Ma, S., Wang, Y., Cai, Z., Hu, J., Wei, N., Wu, J., Du, H., Chen, T., Li, R., Tan, H., Kang, L., Yao, L., Huang, M., Wang, H., Wang, G., Liu, Z., Hu, S., 2020. Factors Associated With Mental Health Outcomes Among Health Care Workers Exposed to Coronavirus Disease 2019. *JAMA Network Open*. <https://doi.org/10.1001/jamanetworkopen.2020.3976>.
- Lamb, D., Gnanapragasam, S., Greenberg, N., Bhundia, R., Carr, E., Hotopf, M., Razavi, R., Raine, R., Cross, S., Dewar, A., Docherty, M., Dorrington, S., Hatch, S., Wilson-Jones, C., Leightley, D., Madan, I., Marlow, S., McMullen, I., Rafferty, A.-M., Parsons, M., Polling, C., Serfoti, D., Gaunt, H., Aitken, P., Morris-Bone, J., Simela, C., French, V., Harris, R., Stevelink, S.A.M., Wessely, S., 2021. Psychosocial impact of the COVID-19 pandemic on 4378 UK healthcare workers and ancillary staff: initial baseline data from a cohort study collected during the first wave of the pandemic. *Occup. Environ. Med.* 78 (11), 801–808.
- Lane, S.J., McGrady, E., 2018. Measures of emergency preparedness contributing to nursing home resilience. *Journal of Gerontological Social Work* 61 (7), 751–774. <https://doi.org/10.1080/01634372.2017.1416720>.
- Liu, Q., Luo, D., Haase, J.E., Guo, Q., Wang, X.Q., Liu, S., Xia, L., Liu, Z., Yang, J., Yang, B.X., 2020. The experiences of health-care providers during the COVID-19 crisis in China: a qualitative study. *The Lancet. Global Health* 8 (6), e790–e798.
- López Steinmetz, L.C., Herrera, C.R., Fong, S.B., Godoy, J.C., 2021. A Longitudinal Study on the Changes in Mental Health of Healthcare Workers during the COVID-19 Pandemic. *Psychiatry* 85 (1), 56–71.
- Lorente, L., Vera, M., Peiró, T., 2021. Nurses' stressors and psychological distress during the COVID-19 pandemic: The mediating role of coping and resilience. *J. Adv. Nurs.* 77 (3), 1335–1344.
- Markey, K., Ventura, C.A.A., Donnell, C.O., Doody, O., 2021. Cultivating ethical leadership in the recovery of COVID-19. *J. Nurs. Manag.* 29 (2), 351–355.
- McKnight, J., Nzinga, J., Jekosgei, J., English, M., 2020. Collective strategies to cope with work related stress among nurses in resource constrained settings: An ethnography of neonatal nursing in Kenya. *Soc. Sci. Med.* 245, 112698.
- Nuzzo, J. B., Meyer, D., Snyder, M., Ravi, S. J., Lapascu, A., Souleles, J., Andrada, C. I., & Bishai, D. (2019). What makes health systems resilient against infectious disease outbreaks and natural hazards? Results from a scoping review. *BMC Public Health*. <https://doi.org/10.1186/s12889-019-7707-z>.
- Pollock, A., Campbell, P., Cheyne, J., Cowie, J., Davis, B., McCallum, J., McGill, K., Elders, A., Hagen, S., McClurg, D., Torrens, C., Maxwell, M., 2020. Interventions to

- support the resilience and mental health of frontline health and social care professionals during and after a disease outbreak, epidemic or pandemic: a mixed methods systematic review. *The Cochrane Database of Systematic Reviews* 11 (11), CD013779.
- Rangachari, P., Woods, J., 2020. Preserving organizational resilience, patient safety, and staff retention during COVID-19 requires a holistic consideration of the psychological safety of healthcare workers. *Int. J. Environ. Res. Public Health* 17 (12). <https://doi.org/10.3390/ijerph17124267>.
- Regenold, N., Vindrola-Padros, C., 2021. Gender matters: A gender analysis of healthcare workers' experiences during the first COVID-19 pandemic peak in England. *Social Sciences* 10 (2), 43. <https://doi.org/10.3390/socsci10020043>.
- Resick, P.A., Schnicke, M.K., 1992. Cognitive processing therapy for sexual assault victims. *J. Consult. Clin. Psychol.* 60 (5), 748–756.
- Roberts, T., Hirst, R., Sammut-Powell, C., Reynard, C., Daniels, J., Horner, D., Lyttle, M. D., Samuel, K., Graham, B., Barrett, M. J., Foley, J., Cronin, J., Umana, E., Vinagre, J., Carlton, E., Kane, L., Mackenzie, L., Sharma Hajela, S., Phizacklea, J., ... Vinagre, J. (2021). Psychological distress and trauma during the COVID-19 pandemic: survey of doctors practising anaesthesia, intensive care medicine, and emergency medicine in the United Kingdom and Republic of Ireland. *British Journal of Anaesthesia*, 127(2). <https://doi.org/10.1016/j.bja.2021.05.017>.
- Roberts, N.J., McAloney-Kocaman, K., Lippiett, K., Ray, E., Welch, L., Kelly, C., 2021a. Levels of resilience, anxiety and depression in nurses working in respiratory clinical areas during the COVID pandemic. *Respir. Med.* 176, 106219.
- Robertson, H.D., Elliott, A.M., Burton, C., Iversen, L., Murchie, P., Porteous, T., Matheson, C., 2016. Resilience of primary healthcare professionals: A systematic review. *Br. J. Gen. Pract.* 66 (647), e423–e433.
- Sánchez-Zaballos, M., Mosteiro-Díaz, M.P., 2020. Resilience Among Professional Health Workers in Emergency Services. *Journal of Emergency Nursing* 47 (6), 925–932.e2.
- Santabárbara, J., Bueno-Notivol, J., Lipnicki, D.M., Olaya, B., Pérez-Moreno, M., Gracia-García, P., Idoiaga-Mondragon, N., Ozamiz-Etxebarria, N., 2021. Prevalence of anxiety in health care professionals during the COVID-19 pandemic: A rapid systematic review (on published articles in Medline) with meta-analysis. *Prog. Neuro-Psychopharmacol. Biol. Psychiatry* 107, 110244.
- Sarma, R., Vig, S., Rathore, P., Pushpam, D., Mishra, S., Gupta, N., Garg, R., Kumar, V., Bharati, S., Bhatnagar, S., 2020. Concerns of health care professionals managing non-COVID patients during the COVID-19 pandemic: A descriptive cross-sectional study. *Indian Journal of Palliative Care* 26, 21–26. https://doi.org/10.4103/IJPC.IJPC_155_20.
- Sasaki, N., Asaoka, H., Kuroda, R., Tsuno, K., Imamura, K., Kawakami, N., 2021. Sustained poor mental health among healthcare workers in COVID-19 pandemic: A longitudinal analysis of the four-wave panel survey over 8 months in Japan. *Journal of Occupational Health* 63 (1). <https://doi.org/10.1002/1348-9585.12227>.
- Sheikh, K., Gilson, L., Agyepong, I.A., Hanson, K., Ssenkooba, F., Bennett, S., 2011. Building the Field of Health Policy and Systems Research: Framing the Questions. *PLoS Med.* 8 (8) <https://doi.org/10.1371/journal.pmed.1001073>.
- Slotkin, J.R., Murphy, K., Ryu, J., 2020. How One Health System Is Transforming in Response to Covid-19. *Harvard Business Review* 2–7.
- Stephenson, A., 2010. Measuring and comparing organisational resilience in Auckland. *Australian Journal of Emergency Management*.
- Sterne, J., White, I., Carlin, J., Spratt, M., Royston, P., Kenward, M., Wood, A., Carpenter, J., 2009. Multiple imputation for missing data in epidemiological and clinical research: Potential and pitfalls. *BMJ (Online)* 339 (7713), 157–160. <https://doi.org/10.1136/bmj.b2393>.
- Stringhini, S., Zaballa, M.-E., Pullen, N., de Mestral, C., Perez-Saez, J., Dumont, R., Picazio, A., Pennacchio, F., Dibner, Y., Yerly, S., Baysson, H., Vuilleumier, N., Balavoine, J.-F., Bachmann, D., Trono, D., Pittet, D., Chappuis, F., Kherad, O., Kaiser, L., Azman, A.S., Alber, V., Arm-Vernez, I., Bachmann, D., Bachmann, D., Baggio, S., Monteiro, G.B., Baysson, H., Bleich, P., Boissel, I., Collombet, P., Courvoisier, D., Couson, P., Davidovic, A., Deiri, C., Del Rio, D., de Mestral, C., De Ridder, D., D'ippolito, P., Duc, J., Eckerle, I., El Merjani, N., Ferniot, G., Flahault, A., Francioli, N., Frangville, M., Garande, C., Gétaz, L., Giraldo, P., Golaz, F., Guérin, J., Haboury, L., Harnal, S., Javet, V., Kaiser, L., Laboulais, A., Lamour, G., Lefebvre, X., Lescuyer, P., Loizeau, A.J., Lombard, F.-B., Lortie, E., Martinez, C., Massiha, K., Metral-Boffod, L., Meyer, B., Mostaguier, K., Nehme, M., Noël, N., Oederlin, N., Petrovic, D., Piumatti, G., Portier, J., Poulain, G., Pugin, C., Rakotomiamanana, B., Randrianandrasana, Z.F., Richard, A., Richard, V., Rodriguez-Velazquez, S., Salzmänn-Bellard, L., Thorens, L., Torroni, S., Vidonne, D., Violot, G., Waldmann, Z., Will, M., Wisniak, A., Guessous, I., 2021. Large variation in anti-SARS-CoV-2 antibody prevalence among essential workers in Geneva. Switzerland. *Nature Communication* 12 (1).
- Thomas, S., Sagan, A., Larkin, J., Cylus, J., Figueras, J., Karanikolos, M., 2020. Strengthening health systems resilience: Key concepts and strategies. *Health Systems and Policy Analysis*.
- Van Steenkiste, E., Schoofs, J., Gilis, S., Messiaen, P., 2021. Mental health impact of COVID-19 in frontline healthcare workers in a Belgian Tertiary care hospital: a prospective longitudinal study. *Acta Clin. Belg.* 77 (3), 533–540.
- van Wassenhove, W., 2014. In: *Modèle De Karasek. Sous La Direction De Philippe Zawieja Et Franck Guarnieri. Dictionnaire Des Risques Psychosociaux*, pp. 170–174.
- Wears, R., Hollnagel, E., Braithwaite, J., 2015. Preface. In: *Resilient Health Care Volume 2: the Resilience of Every Clinical Work*. CRCPress, pp. 27–29.
- Weick, K., Sutcliffe, K., 2001. *Managing the unexpected. Assuring high performance in an age of complexity*. Jossey-Bass.
- Whitman, Z.R., Kachali, H., Roger, D., Vargo, J., Seville, E., 2013. Short-form version of the Benchmark Resilience Tool (BRT-53). *Measuring Business Excellence* 17 (3), 3–14. <https://doi.org/10.1108/MBE-05-2012-0030>.
- Woods, D.D., 2015. Four concepts for resilience and the implications for the future of resilience engineering. *Reliab. Eng. Syst. Saf.* 141, 5–9.
- Wu, A.W., Connors, C., Everly, G.S., 2020. COVID-19: Peer Support and Crisis Communication Strategies to Promote Institutional Resilience. *Ann. Intern. Med.* 172 (12), 822–823.