

Learning From Chaos. Suggestions for Hospitals under Extraordinary Stress

Paolo Gaetano Bisogni¹, Franca Cantoni², Elisa Mori³, Elena Zuffada⁴

Summary: 1. Introduction – 2 Extraordinary shocks require out of the ordinary approaches – 3. Identifying the resilience factors for the rebooting phase – 3.1 Research questions and propositions - 3.2 Method – 3.3. Participants – 4. Results – 5. The rebooting phase and the booster effect of technology – 6. Learning from chaos: some conclusions – 7. Limitations and further research - References

Abstract

Considered as an exogenous and continuous shock characterized by great difficulty in descriptive terms, COVID-19 management required out of the ordinary organizational approaches for hospitals. This paper aims to highlight the resilience factors than can curb or accelerate the rebooting phase of the resilient process for hospitals under COVID-19 stress. Resilience is here considered as a multilevel, multidimensional, and dynamic construct mainly composed of three characteristics: robustness, redundancy, resourcefulness. Technology resulted as an activator of change working as a booster in the rebooting phase. By leveraging on the concept of learning ambidexterity, hospitals made choices between exploitation and exploration-oriented activities. In this direction, it was found that it is necessary to acquire and develop crisis management skills as the existing pre-pandemic ones proved unable to cover a wide range of not linear issues such as those brought about by COVID-19.

Key words: Hospitals resilience, learning ambidexterity, technology

¹ **Paolo Gaetano Bisogni**, Adjunct Professor of Management at Università Cattolica del Sacro Cuore; e-mail: paologatano.bisogni@unicatt.it

² **Franca Cantoni**, Associate Professor of Organization Studies at Dipartimento di Scienze Economiche e Sociali, Università Cattolica del Sacro Cuore; e-mail: franca.cantoni@unicatt.it

³ **Elisa Mori**, Adjunct Professor of Business Administration at Università Cattolica del Sacro Cuore; e-mail: elisa.mori@unicatt.it

⁴ **Elena Zuffada**, Full Professor of Business Administration at Dipartimento di Scienze Economiche e Sociali, Università Cattolica del Sacro Cuore; e-mail: elena.zuffada@unicatt.it

1. Introduction

Even if the careful analysis of the data disclosed by the World Health Organization and processed with mathematical algorithms given clear signals, COVID-19 manifested itself with such *grandeur* as to leave people and structures almost completely unprepared (Achour et al., 2022). While noting the importance of the forecasting dimension such a wide and rapid spread of COVID-19 has proven to be above and beyond the hospitals' capability to manage it as little knowledge was available on how to deal with an event of such proportions and characteristics. The constantly changing characteristics of the virus, the presence of asymptomatic cases, the procrastinated time span between contraction of the contagion and its manifestation and other variables were all factors of uncertainty that contributed to the chaotic situation and complicated the identification of an appropriate organizational response (Jensen et al., 2022; Sindhu, S. 2022).

As shown in Par. 2, the external and extraordinary shock for the hospitals required out of the ordinary answers – in other words, a resilient approach (Van Der Vegt et al., 2015; Shaw et al., 2022). The organizational tools and approaches routinely employed to cope with crises have proven to be not entirely effective, leaving and requiring ample room for the definition and implementation of new organizational, procedural, and behavioral patterns.

Aim of this paper is to investigate the resilience areas and factors that curbed or accelerated the rebooting phase of the resilient process for hospitals under COVID-19 stress. In Par. 3 we expose our research question and highlight some propositions. These refer to the academic literature (Giustiniano & Cantoni, 2018) and are suggested by the main emergency hospital practice (Donelli et al., 2022). The propositions that we investigate underly assumption of strategies intended to promote an appropriate response over emergency department. Within this section we have also outlined methodology and participants.

Preliminary results are shown in Par. 4 while in Par. 5 we analyze the rebooting phase and the booster effect of technology.

Par. 6 highlights important lessons drawn from the Italian hospitals' experience. The intention that emerged from the interviews was not to disperse the organizational lesson learnt. Hospitals have demonstrated the ability to go far beyond survival and recovery leveraging on the concept of ambidexterity (Teece et al., 1997). The combination of exploitation of established practices, procedures, and structures with the exploration of new ones has enabled hospitals to activate organizational responses that are likely to become conventional over time. In this ambidextrous process, the explorative and exploitative activities were highly integrated. Structures, human resources and information technologies have represented the three pivotal resilience factors to invest in. In particular, the authors are prompted to reflect on the crucial role played by technology acting as a booster in the rebooting phase of the resilient process and then as powertrain on the exploration and exploitation mechanisms.

This research enriches the field of organization studies by offering hospitals an important reflection on the need to equip themselves in a resilience perspective.

2. Extraordinary shocks require out of the ordinary approaches

Resilience is a central concept in understanding how different entities (in our case hospitals) across different levels (individual, dyad, team, company) deal with different types of adversity (Hällgren et al., 2018). In connection with this assertion, talking about a resilient approach in a broad sense without considering the nature of the specific adversity would be very reductive and highly simplistic.

As the organizational response depends - among other factors - on the features of the exogenous shock (Cox, 1987), it is beyond crucial to make some specifications on the antecedents that can occur:

- when a one-shot exogenous shock occurs (i.e., earthquake, flood, air or rail disaster...), all available resources are mobilized to identify the resilient response in the full awareness that the wave of operational uncertainty is destined to decrease over time. The scenario - albeit complex - can be described as it is known, a posteriori;
- on the other hand, if the shock is continuous - and this is our case - the overall picture is difficult to describe as it is constantly evolving. In the case of the pandemic the effects of the generating events do not immediately manifest themselves in their full power but in a progression (waves) difficult to predict and consequently complicated to be managed. The system was continuously disoriented and unsettled (Burton et al., 2002).

For the purposes of this research, resilience is considered as a multilevel, multidimensional and dynamic construct (Giustiniano & Cantoni, 2018), mainly composed of three characteristics (robustness, redundancy, resourcefulness):

- *robustness*: the ability to absorb and withstand disturbances and crises;
- *redundancy*: the excess capacity and backup systems enable the maintenance of core functionality in the event of disturbances;
- *resourcefulness*: the ability to respond flexibility, and - when possible - transform a negative impact into a positive.

The multidimensional and dynamic construct relies on a continuous adjustment process over time in the sense that it arises from and - at the same time - nourishes the different phases (Hafeez et al., 2022).

This process is described through a dynamic framework (Cantoni, 2014) identified by two variables (time and operating level). To all effects, resilience is intended as the capacity to respond in a quick (time level) and effective way (operating level) to an exogenous shock; it can be summarized as follows:

$$\text{Resilience} = (\delta \text{ Performance}) / (\text{recovery time})$$

In our definition, resilience has to do with identifying a response that is both effective (minimizing δ performance) and timely (reducing recovery time). In fact, the rebooting involves the realization of a response which is effective from an organizational point of view but the same time quick in implementation so as not to create inconvenience, delay, dissatisfaction in the service user base (patients).

3. Identifying the resilience factors for the rebooting phase

Despite “hospital resilience” is gaining prominence in recent years, it remains poorly defined. Frequently, it is considered as a comprehensive concept derived from existing disaster resilience frameworks (Van Der Vegt et al., 2015; Shaw et al., 2022). In this work we acknowledge the complexity of resilience which we attempt to capture in its three basic characteristics: robustness (Sykes & Pandit, 2021), redundancy (Araujo et al., 2022) and resourcefulness (Azadeh et al., 2018; Zhong et al., 2014). Resilience – as described in procedural logic – finds its foundation on areas and consequently then factors that can act on rebooting (De La Garza & Lot, 2022; Zarrin, 2022).

This paper aims at highlighting the resilience areas and factors that curbed or accelerated the rebooting phase of the resilient process for hospitals under COVID-19 stress.

3.1 Research question and propositions

In line with the definition of resilience given by the Authors, the research question (RQ) that emerges is the following:

RQ: “What are the resilience factors than can curb or accelerate the rebooting phase for hospitals under COVID-19 stress?”.

From here, some research propositions (P) were investigated:

P1: Robustness and redundancy in procurement are essential to ensure both rapid response and rebooting.

Resilient hospitals aim to restore “efficacy” by enhancing their ability to quickly process feedback and flexibly rearrange, combine and deploy resources in new ways. Given the definition of resilience, it is nearly obvious that the classical concept of ‘efficiency’ applied to organizational structures and the use of resources does not convince us anymore (e.g., Håkonsson et al., 2013; Kihlström et al., 2022). Slack resources are fundamental to our definition of resilience (Schulman, 1993; Spieske et al., 2022). Woods (2015) similarly discusses the importance of maintaining an up-to-date understanding and sensitivity to where an organization is operating with respect to its limits (i.e., how much margin exists). The idea of margin is essential to resilience because maintaining an adequate margin is necessary for responding to unexpected events, and an organization that operates beyond its comfortable margin for too long is inviting disaster. The conventional meaning of ‘efficiency’ contrasts with the idea of preserving margins as it is generally used to express the capability of a specific application of effort to produce a specific outcome with a minimum amount or quantity of waste, expense and unnecessary effort.

On the other hand, robustness requires modularity in the organizational assets and adaptive decision-making models in human resource management (HRM) (Giustiniano & Cantoni, 2018; Chemali et al., 2022; Al-Ayed, 2019; Bagley et al., 2018), whereas:

- modularity means that the mechanisms designed to prevent unexpected shocks in one part of a system from spreading to other parts of a system can localize their impact;
- adaptive decision-making models mean that networked managerial structures can allow an organization to become centralized depending on circumstances.

Therefore, P2 and P3 are derived:

P2: The organizational structure (assets and infrastructures) can act on robustness.

With a critical shortage of intensive care and ward beds, the need for a new, more flexible solution is clear. The adaptive reuse of existing hospitals, the readaptation or reconversion of existing hospital or buildings, the conversion of a hospital into a specialized COVID hospital, the construction of whole hospitals or the addition of a medical emergency unit close to the hospital are examples of spatial strategies adopted by hospitals both to counter the pandemic and to mitigate the risk of further virus transmission (Asperges et al., 2020; Capolongo et al., 2020). Modularity of buildings and assets and flexible organization can cause *redundancy* that implies repetition of parts or a duplication of critical infrastructure and a variety of solutions and strategies (Donaldson & Joffe, 2014). In details, redundancy of critical infrastructure can generate the designing replication of modules that are not strictly necessary to maintain core function day-to-day but are necessary to maintain core function in the event of crises (Helfat & Samina, 2014; Carroll, 2012). According to our view, this concept is also strictly related to the next proposition (P3).

P3: The human resource (HR) mobilization can facilitate resourcefulness.

The complicated situation of managing a widespread infection risk determines a series of actions, protocols, procedures, and restrictions, limiting a complete humanized hospitalization experience (Hung et al., 2022). However, disposing of a good level of preparedness allows healthcare structures to manage interventions that can guarantee a quick response to the disease and a person-centred approach (De La Garza & Lot, 2022), improving the disease experience for all the individuals involved in the hospitalization process.

The ability to quickly mobilize HRs, to lead them by example (Håkonsson et al., 2013; Lengnick-Hall et al., 2011) and to organize them in multidisciplinary teams allows the rapid identification of the response and its effective implementation. In the face of crises, this combination can represent a good source of resourcefulness that can facilitate the resilient process.

This requires both effective and prompt communication that can be achieved through standardized protocols and procedures that differ in the various phases of appraisal and coping. Effective communication and reliable and timely information increase the likelihood that, in the event of a crisis, systems can disseminate and share information quickly, and ensure cooperation and fast response from the audience. In this regard, ICTs can be of help and support to communication and decision-making processes and facilitate monitoring through an orderly production, collection, analysis, and interpretation of information flows. Indeed, the pandemic has stimulated a greater breadth of data to be collected and increased the frequency of updates.

3.2 Method

The research was conducted with the use of the Delphi method which is appropriate for research and forecasting problems whose solutions are not yet determined, there is no true answer for a problem statement and requires opinionated decision-making (de Meyrick, 2003; Stone Fish and Busby, 2005; Niederberger and Spranger, 2020; Thude et al, 2019). Indeed, experts who were required to participate in the examination may lack communication experience and have different careers, expertise and skills and are too numerous to interact effectively in a face-to-face exchange. By applying the theoretical saturation approach for this qualitative research, the first phase ended when the added value of the interviews was marginal (Saunders et al. 2018). The individual interviews made it possible to gather information of good quality. The heterogeneity of the interlocutors also allowed the verification of some preliminary information collected. Results emerging from the individual interviews are presented in an anonymous and re-aggregated form at the organization level to not influence the second phase of the research. The re-aggregation of the individual interviews was carried out according to the organization they belong to.

3.3 Participants

To guarantee the validity of the results, the heterogeneity of the participants was preserved to avoid any domination imposed by a large group or by a strong personality. As stated by Niederberger and Spranger, 2020 "*cognitive diversity in the composition of the expert panel is important for the robustness and validity of the findings...Diversity can have a decisive influence on the quality of the data and on whether the judgments are accepted and considered feasible later on, especially if the number of experts is rather low*" (pg. 8).

The first phase was characterised by an exploration of the subject with separate interviews to interlocutors of the major hospitals in the Lombardy area (Tab. 1).

Table 1 – Main features of the hospitals investigated and representatives interviewed

Hospital	Abb.	City	Funding	Institutional settings	Representative interviewed	Beds accredited	Revenues (000) (year 2019)
Humanitas Research Hospital	HR	Rozzano (MI)	Private accredited	IRCSS	Supply Chain Director; Chief Medical Officer	747	n.a.
Humanitas Mater Domini	HMD	Varese	Private accredited	IRCSS	Chief Medical Officer; Supply Chain Director	182	81.540
Niguarda	N	Milano	Public	ASST	Chief Financial Officer; Managing Director; Head of Medicine Department	1.167	644.436
Ca' Granda Ospedale Maggiore Policlinico	PL	Milano	Private accredited	IRCSS	Chief Medical Officer	912	541.000
San Raffaele	SR	Milano	Private accredited	IRCSS	Chief Scientific Officer; Chief Medical Officer; Head of the Intensive Care Unit	1.350	672.610
San Gerardo	SG	Monza	Public	ASST	Managing Director; Chief Medical Officer	1.105	522.041

Source: own elaboration

To guarantee the complete neutrality of the study we decided to adopt a simple random sampling, a type of probability sampling in which we randomly selected a subset of participants. This is meant to provide a representation of a group that is free from researchers' bias. Like any sampling technique, there is room for error, but this method is intended to be an unbiased approach.

Each interlocutor contributed additional information pertinent to the issue through semi-structured interviews (for the text of the questions please refer to the ANNEX). In this sense, the value of interviewing is explained by Seidman (2006): *'Interviewing provides access to the content of people's behaviour and thereby provides a way for researchers to understand the meaning of the behaviour'* (p. 4). Due to the nature of the investigation, most of the questions were open questions. The text of the interview as well as the objective were anticipated so that the

interviewees could adequately prepare. Aim of the interviews – lasting on average one hour – was to understand the approach of the hospitals in the face of the adversity generated by the spread of COVID-19.

The emergence of the greatest possible diversity of opinions was promoted along with an awareness of the convergence and/or divergence of these opinions.

4. Results

Seven areas of resilience were identified: sources of supply and storage, layout redesign and reconfiguration of assets, organizational structure, strategic decision making, HRs, development of protocols, information flows. Subsequently, each area was split into different resilience factors. The main resilience factors that emerged were identified for each hospital. Results are summarized in Table 2 (P1), Table 3 (P2) and Table 4 (P3). It is necessary to specify that some boxes presented in the tables were not compiled due to the following reasons: the highlighted resilience factor depends on the interviewer’s specialty, the specific lever has not been activated by the hospital, or it is not perceived as relevant or primary by the interviewee. Regarding **P1**, results are shown in Tab. 2

Table 2 – Resilience areas, macro resilience factors, resilience factors for P1

P	Resilience Area	Resilience factors	HOS 1	HOS 2	HOS 3	HOS 4	HOS 5	HOS 6
P1	Sources of supply and storage	Double sourcing/multisourcing: Activation of alternative supply channels (A) Possibility to rely on group purchasing department (G)	A	A; G	A		A	G
		Storage Increase in the storage capacity of PPE, DM and drugs (I)	I		I			

Source: own elaboration

It was clear that consumables, medical devices, and equipment were among the main contributors involved in robustness. To restore ‘efficacy’, hospitals showed an improved ability in quickly and flexibly rearranging, combining, and deploying resources. As the ability to respond has been considered in its dynamism, varying over time (in the different phases of the crisis), robustness required effective technical solutions and ‘quick and dirty’ adjustments.

The existence of slack resources to be activated, combined and recombined, emerged as fundamental in new situations as challenges arise. The existence of margins, such as stocks of consumables, proved to be necessary for responding to the unexpected events from the beginning of the crisis; this required arranging a

compromise between the need to preserve financial sustainability and to guarantee a minimum slack for quick response to first moments of a crisis.

Procurement proved to be essential to ensure rapid reboot; it must be fast, flexible, and multi-sourced. The centralization of purchasing proved to be useful in guaranteeing the supply to all but the ability to activate alternative supply channels has been essential to ensure the availability of PPIs and medical devices that were in short supply. Collaboration with private entrepreneurs proved to be effective; public hospitals received an extra supply from donations from companies and trade associations, while private accredited hospitals were able to leverage the network of trade associations to locate near and far alternative suppliers.

As for **P2**, concerning the organizational structure and its ability to hinder or facilitate the resilient process and consequently act on robustness, results are summarized in Tab. 3.

Table 3 – Resilience areas, macro resilience factors, resilience factors for P2

P	Resilience Area	Resilience factors	HOS 1	HOS 2	HOS 3	HOS 4	HOS 5	HOS 6
P2	Layout redesign and reconfiguration of assets	Modularity of assets: Quick reconfiguration of the hospital layout (R) Compartmentalization of buildings (COVID and COVID-free) or departments (C)	R; C	R	R; C	R; C	R; C	R; C
		Pathways for patient: Clear separation COVID ER and COVID-free ER (S) Separation of pathways for patients (hospitalizations and intensive therapy for different levels of patient severity) (P)	S; P	P	S; P	S; P	S; P	P
	Organizational structure	Organizational reconfiguration: Institutionalization of bed managers (BM)	BM					BM
	Strategic Decision Making	Composition of the crisis unit: Enlarged (EN) Restricted (RES)	EN	EN	RES	RES	RES	RES
		Speed in making decisions: Ability to make decisions quickly, especially for members of the crisis management team (T)			T	T		
Frequency of the meetings: High frequency of meetings (H)		HF		HF	HF	HF		
	Decision making model: Hierarchical but collegial leadership (HCD)	HCD						

Source: own elaboration

It emerged that:

- the modular or network organizational structure is to be preferred over the monobloc one (i.e., a hospital was able to quickly set up a 40-bed COVID-19 ward by reconfiguring the day surgery area, which was not used during the pandemic crisis);
- the hierarchical organizational structure with unified and collegial command (regardless of the clinical specialties to which they belong) allows rapid and effective responses. This is the area where consensus among all experts came up first.

All hospitals have spawned crisis units, sometimes restricted in the first phase, and then enlarged in the second one by co-opting necessary functions, such as the ER, HR and pharmacy. As far as the criteria for the composition of the crisis unit, at the beginning, the specialization and organizational role prevailed, then professionals were co-opted based on personal characteristics and managerial skills and style.

The multisystemic nature of COVID cases led the organization from a structure based on specialized resources to one based on shared resources between different specialties. Such sharing of resources could also lead to economic improvement if it resulted in a better use of resources and a better saturation of production capacity.

The adaptive reuse of existing hospitals, the readaptation or reconversion of existing hospitals or buildings and the construction or addition of medical emergency are confirmed among the spatial strategies adopted by hospitals to counter the pandemic. However, great difficulties were found in compartmentalizing the hospital into two parts: COVID and COVID Free. This is due to structures and systems where a combination of services is difficult to separate except by significantly increasing costs in ordinary times (i.e., kitchens or the operating rooms).

As stated, sometimes being effective means being redundant: two hospitals operated three different intensive care units before the pandemic crisis, another one created an ER with a separate pre-admission room, and safety stocks of PPI were present in two other hospitals.

As for **P3**, flexibility, willingness to play and to learn new roles (i.e., surgeons have learned to ventilate, etc.) and ability to work as a team proved to be winning elements for HRs. Moreover, coordination resulted to be effective if collegial decisions were prioritized. The results are summarized in Tab. 4.

Table 4 - Resilience areas, macro resilience factors, resilience factors for P3

P	Resilience Area	Resilience factors	HOS 1	HOS 2	HOS 3	HOS 4	HOS 5	HOS 6
P3	HR	Re-allocation and increase of medical and nursing staff: Re-allocation of doctors and nurses to COVID and COVID-free wards (DN) Compensation system (CS) Hiring of extra doctors and nurses in the intensive areas (EDN)	DN; CS		DN	DN		EDN
		Operational decision-making empowerment: Shift-work self-management (SW) Lead by example (LBE)	SW		SW		LBE	
		Organizational culture: Ability to overcome the inertia associated with organizational changes (OC) Management by process (MP)	OC; MP	OC	MP			
		Team building: Multi-specialist team building (MS)	MS	MS	MS	MS	MS	
		Availability of systems and platforms for training (T)		T				
		Skills development: Hospital dimension and presence of different specializations (HD) Realization of research projects to consolidate and capitalise knowledge (RP) Scientific research as a catalyst for sharing and cohesion (SR)	HD	HD		RP; SR	SR	HD
	Development of protocols	Level of protocolisation	Low		High	Low		
		Development of new protocols: Ability to rapidly develop new protocols (NP) Ability to rapidly develop new protocols and frameworks/emergency plans (X) Ability to develop therapeutic protocols linked to research protocols (TP)	NP		X	TP	TP	
		Spread of protocols: Make available information from the international scientific community (IC) Multimedia use to spread protocols (MU) Exchange of information between multidisciplinary teams (EI)	IC				MU; EI	EI
	Information flows	Collection of information: Creation of a dedicated and manned e-mail box 24 hours a day (EM) Verification of the authoritativeness of the sources to avoid information overload/overflow (OL) Creation of a data collection form on the	EM; OL; DC			BA	DC	OL

		intranet (DC) Creation of a staff dedicated to the collection of information (Bio Angels) (BA)						
		Information sharing model: Top-down communication (TDC)		TDC	TDC	TDC		TDC

Source: own elaboration

Under normal circumstances, personnel rotations are staggered to ensure continuity of care and broad exposure for trainees to attending physicians and patients to enhance their educational experience. In a pandemic, these factors are considerably less important, and the re-allocation and increase of medical and nursing staff turned out to be one of the first problems to be faced. Campaigns to increase medical and nursing staff have been launched by many hospitals. In particular, the re-allocation of doctors and nurses to COVID and COVID-free wards has been essential to guarantee continuity of work.

Resilience proved to be a function of the learning process as well as the development of new organizational routines in some cases. It has essentially revolved around people's motivational drive and a value reaction (for example based on solidarity). However, it should be noted that tensions and conflicts arose during the second wave, and in this respect, to recover relationships and work on organizational well-being, some hospitals created tools such as a psychologist's intervention for conflict management or an extraordinary visit with psychiatry and occupational medicine (post-traumatic stress syndrome).

Another factor of vulnerability (or resilience) was represented by the hospital vocations or specializations, as scientific research aggregates the clinical staff; however, research objectives may be different from those of the company. The sharing of knowledge for research purposes in some cases has proved to be an effective glue and factor of organizational cohesion, but in other cases, the scientific research driver has become an element of conflict.

Moreover, operational empowerment has been fundamental. Decision-making speed, understood as the ability to anticipate the crisis point, as well as quick communication, proved to be another fundamental aspect for an effective response. Top-down communication, with a single communication route based on a hierarchical structure, has been more effective.

The collection of information was another important aspect. Communication technologies (i.e., groupware tools such as WhatsApp and videoconferencing systems and the Intranet) have helped the flow of information allowing the reduction of the number of coordination meetings required by the crisis unit. In one case, staff dedicated to the collection of information (Bio Angels) was created.

Regarding protocols, the interventions follow different schools of thought: one that aims to produce many, while others to rely on few and essential with multimedia aids.

A clinical database has been developed in one hospital, which is now the basis for investigative work with Big Data to perform predictive analysis, and at the same time, provides the opportunity to work by processes and objectives rather than by

specialty. At another hospital, it was reported – under pressure – that telemedicine and electronic medical records were adopted in departments where it had not yet been used.

5. The rebooting phase and the booster effect of technology

The intent of our research was to contribute to the on-going academic debate on how hospitals can face unexpected events in an effective way. Resilience resulted as an organizational competency and process that can be nurtured, improved, and consolidated through learning processes where the concept of technology expressed by Ciarli et al. (2021) can be fully found.

From the first phase of the investigation conducted and completed, most of the resilience factors were found to be in common to the hospitals analyzed regardless of the size, institutional nature and organizational model adopted (for example multi-specialistic team building, reconfiguration of spaces or reallocation of staff). On the other hand, peculiar manifestations of some factors have shown that each hospital adopted its own entrepreneurial formula, articulated through the strategy of providing services, the social strategy, and the relationship with the various stakeholders. The way in which hospitals have faced the pandemic also brings out a kind of specificity in being resilient that is linked to corporate identity. The factors to which we refer are mainly:

- the possibility to rely on group procurement to ensure continuity of supplies (stocks of consumables, medical devices and equipment);
- organizational routines that represented a strong point in countering the pandemic (i.e., the relationship with suppliers). Some new ones (see knowledge sharing) have developed under the pressure of the pandemic and need to be formalized (i.e., the ability to work as a team, willingness to discuss, multidisciplinary approach to the patient to be supervised with organizational tools in non-emergency periods);
- the differentiated use of protocols (widely used in public hospitals with a bureaucratic approach, less in others) and rules according to the specific organizational models based on formalization or on informal relationships. In the first case, the use of detailed organizational rules, stringent operational mechanisms and a precise assignment of goals was accentuated, and in the second, the centrality was focused on people, their motivation and entrepreneurship and social relations;
- the important role of values and mutual solidarity as an organizational glue (related to the small size of the hospital).

According to Ciarli et al. (2021), the implementation of these factors was made possible using technology as an element of information sharing and coordination, an enabling feature transforming the constraints of time and space in working leverages fostering resilience. Technology also revealed itself as a trigger for unexpected changes transforming expectations on and about work, by supporting

hospitals in learning, networking, breaking and creating organizational routines, orientating behaviors and spreading values (Ciarli et al., 2021).

COVID-19 presented more than one stimulus to rewrite the human-computer interaction (HCI) binomial as the human and the computer acted as a team in emergency management information systems. Building the computer as part of the emergency management team ensured that HRs continued to do the things they do well, supported by the technology, not driven by it (Carver & Turoff, 2007).

In our study we also noted that the HCI allowed a rapid pivot to telemedicine and virtual care that provided immediate and longer-term benefits. The intensive use of digital tools enabled:

- the hospitals to maintain clinical oversight of each remote patient through a daily contact (voice, text message, email, or other online service);
- the patient to use self-assessment tools to monitor symptoms (eg, temperature, heart rate, oxygen saturation, and respiratory rate).

Here “virtual care tools” - including remote monitoring - supported in tracking, monitoring, assessing, and managing decisions about care by health care workers and their patients when they are not collocated (Gray et al., 2022).

We also noted that according to organizational information processing theory (OIPT) hospitals with strong abilities to collect, analyze, and use information effectively were able to make proactive adjustments to mitigate uncertainty to build organizational resilience capacity (Srinivasan & Swink, 2015). Also according to OIPT, hospitals most effective in dealing with rebooting were those able to (a) acquire a greater amount of high-quality information, and (b) devote more efforts to improving information processing capabilities (Fan et al., 2017). In this sense technology also supported the process of “*cenesthesia*” improving the constant monitoring of environmental changes (Reuter et al., 2018).

A hospital - between the 6 analyzed - has proceeded with the creation of dedicated figures called “*bio angels*” with the specific task of collecting and sorting data to facilitate well-informed decisions. Through data collection and shared databases doctors have been put in the best conditions to detect other patients with the same unrelated symptoms in the area and epidemiologists to notice risk factors and trends across different locations and population groups. This significantly saved lots of lives, especially among patients at-risk. Doctors used different methods for entering data on patients and their treatment, some physicians locked documents, and others granted access to other specialists. It made quite difficult to cooperate, especially virtually. Bio-angels have made it possible to overcome some recurring criticalities such as low data quality, security (protection of information especially if it concerns sensitive data) and difficulties in collaboration.

In line with this, a developmental perspective implies the presence of latent resources that can be activated, combined and recombined in new situations as challenges arise. That is, resilient hospitals seem to turn traditional organization theory on its head by deploying resources rather than restricting the deployment of resources, as posited by the classical perspective of treating threats in a rigid and negative way (Staw et al., 1981). Here we discovered that - to reinforce our

developmental perspective - it is not merely the stock of information that determines resilience, but also its deployment (Välikangas & Romme, 2013).

6. Learning from chaos: some conclusions

From the first round of interviews conducted, the intention that clearly emerged was not to disperse the organizational-managerial practices and assets generated following the pandemic emergency. According to Tedeschi and Calhoun (2004), post-trauma growth *'is not simply a return to the "baseline" but an experience of improvement that for some people is extremely profound'*. As a result, this concept contains *'a quality of transformation or a qualitative change'* (ibid). Hospitals went far beyond survival and recovery (Lengnick-Hall & Beck, 2005) leveraging on the concept of ambidexterity (Teece et al., 1997) and demonstrating the ability to find a balance between exploration and exploitation by exploiting their existing competencies while simultaneously exploring new opportunities.

Following March's pioneering work (1991), a growing body of research has recognized the importance of ambidextrous learning in incorporating information that can be used to overcome challenges by improving resource utilization and enlarging resource pools (e.g., Junni et al., 2013; Orth and Schuldis, 2021; Pereira et al., 2021). Ambidextrous learning relies on either developmental or executional modes and occurs when unpredictable and unplanned situations in daily work arise and when other learning logics are not sufficient to solve the problem in the long run (Sollander & Engström, 2021; Engström et al., 2022). In an ambidextrous learning process, explorative and exploitative activities are highly integrated. According to OIPT, ambidextrous learning could thus act as a stabilizing processing mechanism, by enabling firms to utilize resources in operations and to manage unforeseen events that threaten normal processes.

The Authors of this research argue that the constituent factors of resilience must become part of the planning process; along these lines, it has become evident that it is necessary to acquire and develop crisis management skills as the existing pre-pandemic risk management skills proved unable to cover a range of issues such as those brought about by COVID-19 (Donelli et al., 2022). Here, hospitals' ambidexterity is considered as the capacity to simultaneously achieve necessary alignment (exploitation - excellence in daily operations) and adaptability (exploration -the ability to innovate and change in response to the changing demands in the environment). To ensure long-term success, a hospital needs to be able to master both adaptability and alignment; focusing too much on that alignment can often make the hospital lose its long-term vision, whereas emphasizing adaptability over alignment means building tomorrow's business at the cost of today's. Structures (both physical and organizational), human resources and information technologies have represented the three pivotal resilience factors to invest in.

In particular, hospitals are challenged to reflect on the interlink between these 3 factors and mainly on the relationship human-technology.

Here it is not simply a matter of recognizing a relational perspective but of fielding a radical change on the conceptual level amplifying the synergistic role of the pair rather than its individual components. In addressing uncertainty, not so much the role of the human resource or that of technology is recognized as the collaboration and intermingling of the two, essential for the exploration and exploitation mechanisms acting sometimes as "activator", others as "facilitator" of organizational change.

From the study specifically conducted, we can say that the hospitals surveyed are moving in the direction of mitigating disasters integrating the technical capacity of information technology with organizational design and communication processes. These appear to be among the major actors to create a community-wide system for risk reduction and response.

To conclude, referring to Wildavsky's (1988) insightful recognition of the need for both anticipation and resilience in managing risk effectively, we advocate the potential of information technology to provide a more consistent and reliable means of decision support to practicing managers operating in uncertain conditions. While the actual decision to mobilize emergency operations remains the function and responsibility of human managers, appropriate uses of information technology may significantly improve the validity, timeliness, and accuracy of information available to them to manage such events. The result is likely to increase effectiveness in organizational performance in complex, dynamic environments.

7. Limitations and further research

The main limitation concerns the numerosity of the survey sample, which is intended to be enlarged to approach the possibility of theory building based on the data and information collected through these case studies (Eisenhardt, 1989). The authors are working on the completion of the second round of interviews according to the Delphi method to be able to provide hospitals some organizational advice and develop guidelines that can incorporate the value of structural and behavioral policies

References

- Achour, N., Elhaj, H., & Ali, A. (2022). Hospital resilience to extreme events: A staff capability of attendance perspective. *International Journal of Disaster Risk Reduction*, 72. <https://doi.org/10.1016/j.ijdr.2022.102851>
- Al-Ayed, S. I. (2019). The impact of strategic human resource management on organizational resilience: An empirical study on hospitals. *Business: Theory and Practice*, 20, 179-186. <https://doi.org/10.3846/BTP.2019.17>
- Asperges, E. et al. (2020). Rapid response to COVID19 outbreak in Northern Italy: how to convert a classic disease ward into a COVID-19 response centre. *The*

- Journal of Hospital Infection*, 105(3), 477-479. <https://doi.org/10.1016/j.jhin.2020.03.020>
- Araujo, R., Fernandes, J. M., Reis, L. P., & Beaulieu, M. (2022). Purchasing challenges in times of COVID-19: Resilience practices to mitigate disruptions in the health-care supply chain. *Journal of Global Operations and Strategic Sourcing*. Vol. ahead-of-print No. ahead-of-print. <https://doi:10.1108/JGOSS-04-2022-0026>
- Azadeh, A., Yazdanparast, R., Abdolhossein Zadeh, S., & Keramati, A. (2018). An intelligent algorithm for optimizing emergency department job and patient satisfaction. *International Journal of Health Care Quality Assurance*, 31(5), 374-390. <https://doi:10.1108/IJHCQA-06-2016-0086>
- Bagley, C., Abubaker, M., & Sawyerr, A. (2018). Personality, work-life balance, hardiness, and vocation: A typology of nurses and nursing values in a special sample of english hospital nurses. *Administrative Sciences*, 8(4). <https://doi.org/10.3390/admsci8040079>
- Burton, R. M., Lauridsen, J., & Obel, B. (2002). Return on assets loss from situational and contingency misfits. *Management Science*, 48(11), 1461-1485. <https://doi.org/10.1287/mnsc.48.11.1461.262>
- Cantoni, F. (2014). *La resilienza come competenza dinamica e volitiva*. Torino: Giappichelli.
- Capolongo, S., Gola, M., Brambilla, A., et al. (2020). COVID-19 and Healthcare Facilities: a Decalogue of Design Strategies for Resilient Hospitals, *Acta Biomedica*, 91(9-S), 50-60. <https://doi.org/10.23750/abm.v91i9-S.10117>
- Carroll, T. (2012). Designing organizations for exploration and exploitation. *Journal of Organization Design*, 1(2), 64-68. <https://doi.org/10.7146/jod.6344>
- Carver, L., & Turoff, M., 2007. Human-computer interaction: the human and computer as a team in emergency management information systems. *Communication of ACM*, 50(3), 33-38. <https://doi.org/10.1145/1226736.1226761>
- Chemali, S., Mari-Sáez, A., El Bcheraoui, C., & Weishaar, H. (2022). Health care workers' experiences during the COVID-19 pandemic: A scoping review. *Human Resources for Health*, 20(1), 27. <https://doi.org/10.1186/s12960-022-00724-1>
- Ciarli, T., Kenney, M., Massini, S., & Piscitello, L. (2021). Digital technologies, innovation, and skills: Emerging trajectories and challenges. *Research Policy*, 50(7), 104289.
- Cox, T. (1987). Stress, coping and problem solving. *Work & Stress*, 1(1), 5-14. <https://doi.org/10.1080/02678378708258476>
- De La Garza, C., & Lot, N. (2022). The socio-organizational and human dynamics of resilience in a hospital: The case of the COVID-19 crisis. *Journal of Contingencies and Crisis Management*, 30(3), 244-256. <https://doi.org/10.1111/1468-5973.12419>
- Donaldson, L., & Joffe, G. (2014). Fit-the key to organizational design. *Journal of Organization Design*, 3(3), 38-44. <https://doi.org/10.7146/JOD.18424>
- Donelli, C. C., Fanelli, S., Zangrandi, A., & Elefanti, M. (2022). Disruptive crisis management: Lessons from managing a hospital during the COVID-19 pandemic.

- Management Decision*, 60(13), 66-91. <https://doi.org/10.1108/MD-02-2021-0279>
- Engström, A., Käkelä, N. & Wikner, J. (2022). Ambidextrous learning in a customer order-based context, *The Learning Organization*, 29(2), 116-128. <https://doi.org/10.1108/tlo-09-2021-0116>
- Fan, H., Li, G., Sun, H., & Chen T.C.E. (2017). An information processing perspective on supply chain risk management: antecedents, mechanism, and consequences. *International Journal of Production Economy*, 185, 63-75. <https://doi.org/10.1016/j.ijpe.2016.11.015>
- Giustiniano, L., & Cantoni, F. (2018). Between Sponge and Titanium: Designing micro and macro features for the resilient organization. In Boccardelli, P., Annosi, M.C., Brunetta, F. & Magnusson, M. (Eds.), *Learning and Innovation in Hybrid Organizations (Strategic and Organizational Insights)*, 167-190, Palgrave Macmillan, Basingstoke, UK.
- Gray, K., Chapman, W., Khan, U.,R., Borda, A., Budge. M., Dutch, M., Hart, G.K., Gilbert, C., & Wani, T.,A. (2002). The Rapid Development of Virtual Care Tools in Response to COVID-19: Case Studies in Three Australian Health Services. *JMIR Form Res.*, 6(4):e32619. <https://doi:10.2196/32619>.
- Hafeez, H., Abdullah, M.I., Zaheer, & M.A. and Ahsan, Q. (2022). Organizational resilience process: integrated model of safety culture. *Organization Management Journal*, 19(1), 2-21. <https://doi.org/10.1108/OMJ-03-2020-0893>
- Hällgren, M., Rouleau, L., & De Rond, M. (2018). A matter of life or death: How extreme context research matters for management and organization studies. *Academy of Management Annals*, 12(1), 111-153. <https://doi.org/10.5465/annals.2016.0017>
- Håkonsson, D. D., Klaas, P., & Carroll, T. N. (2013). The structural properties of sustainable, continuous change. *Journal of Applied Behavioral Science*, 49(2), 179-205. <https://doi.org/10.1177/0021886312464520>
- Hedberg, B. L. T. (1981). How organizations learn and unlearn. In Nystrom P. C. & Starbuck W. H. (Eds.), *Handbook of Organizational Design*, 1, 3-27, New York, NY: Oxford University Press.
- Helfat, C. E., & Samina, K. (2014). Fit between organization design and organizational routines. *Journal of Organization Design*, 3(2), 18-29. <http://dx.doi.org/10.7146/jod.16738>
- Hung, D. Y., Rundall, T. G., Lee, J., Khandel, N., & Shortell, S. M. (2022). Managing through a pandemic: A daily management system for COVID-19 response and recovery. *Journal of Healthcare Management*, 67(6), 446-457. <https://doi.org/10.1097/JHM-D-21-00319>
- Jensen, H. I., Thude, B. R., Boye, L. K., Gram, B., Primdahl, J., Elkjær, M., & Specht, K. (2022). A cross-sectional study of COVID-19 pandemic-related organizational aspects in health care. *Nursing Open*, 9(2), 1136-1146.
- Kihlström, L., Huhtakangas, M., Karreinen, S., Viita-aho, M., Keskimäki, I., & Tynkkynen, L. (2022). Local cooperation has been the cornerstone: Facilitators and barriers to resilience in a decentralized health system during COVID-19 in

- finland. *Journal of Health Organization and Management*. <https://doi.org/10.1108/JHOM-02-2022-0069>
- Lengnick-Hall, C. A., & Beck, T. E. (2005). Adaptive fit versus robust transformation: How organizations respond to environmental change. *Journal of Management*, 31(5), 738–757. <https://doi.org/10.1177/0149206305279367>
- Lengnick-Hall, C. A., Beck, T. E., & Lengnick-Hall, M. L. (2011). Developing a capacity for organizational resilience through strategic human resource management. *Human Resource Management Review*, 21(3), 243–255. <https://doi.org/10.1016/j.hrmr.2010.07.001>
- March, J., G. (1991). Exploration and Exploitation in Organizational Learning. *Organization Science*, 2(1), 71-87.
- Niederberger, M., & Spranger, J. (2020) Delphi Technique in Health Sciences: a Map. *Front Public Health*, 8, 457. <https://doi.org/10.3389/fpubh.2020.00457>
- O'Reilly, C. A., & Tushman, M. L. (2004). The ambidextrous organization. *Harvard Business Review*, 74-81.
- Reuter, C., Lee Hughes, A., & Kaufhold, M-A. (2018) Social Media in Crisis Management: An Evaluation and Analysis of Crisis Informatics Research, *International Journal of Human-Computer Interaction*, 34(4), 280-294. <https://doi.org/10.1080/10447318.2018.1427832>
- Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., Burroughs, H., & Jinks, C. (2018) Saturation in qualitative research: exploring its conceptualization and operationalization, *Quality & Quantity*, 52, 1893–1907. <https://doi.org/10.1007/s11135-017-0574-8>
- Schulman P. R. (1993). The negotiated order of organizational reliability. *Administration Society*, 25(3), 353-372. <https://doi.org/10.1177/009539979302500305>
- Seidman, I. (2006). *Interviewing as qualitative research: A guide for researchers in education and the social sciences*. New York: Teachers College Press.
- Shaw M, Anderson T, Sinclair T, Hutchings O, Dearing C, Raffan F, Jagers D, & Greenfield D. (2022). rpavirtual: Key lessons in healthcare organizational resilience in the time of COVID-19. *International Journal of Health Planning Management*, 37(3), 1229-1237. <https://doi.org/10.1002/hpm.3430>
- Sindhu, S. (2022). Digital health care services in post COVID-19 scenario: Modeling the enabling factors. *International Journal of Pharmaceutical and Healthcare Marketing*, 16(3), 412-428. <https://doi.org/10.1108/IJPHM-04-2021-0046>
- Sykes, A., & Pandit, M. (2021). Experiences, challenges and lessons learnt in medical staff redeployment during response to COVID-19. *BMJ Leader*, 5(2), 98-101. <https://doi:10.1136/leader-2020-000313>
- Sollander, K. & Engström, A. (2021). Unplanned managerial work: an ambidextrous learning potential, *Studies in Continuing Education*, 44(3), 441-459. <https://doi.org/10.1080/0158037X.2021.1874903>
- Spieske, A., Gebhardt, M., Kopyto, M., & Birkel, H. (2022). Improving resilience of the healthcare supply chain in a pandemic: Evidence from europe during the COVID-19 crisis. *Journal of Purchasing and Supply Management*, 28(5), 100748. <https://doi.org/10.1016/j.pursup.2022.100748>

- Srinivasan, R., & Swink, M. (2015). Leveraging supply chain integration through planning comprehensiveness: an organizational information processing theory perspective. *Decision Science*, 46 (5), 823-861. <https://doi.org/10.1111/deci.12166>
- Staw B. M., Sandelands L. E., & Dutton J. E. (1981). Threat Rigidity Effects in Organizational Behavior: A Multilevel Analysis. *Administrative Science Quarterly*, 26(4), 501-524. <https://doi.org/10.2307/2392337>
- Stone Fish L. & Busby D. M. (2005). The Delphi Method, In D. H. Sprenkle & F. P. Piercy (Eds), *Research Methods in Family Therapy*, Second Edition, NY: The Guilford Press.
- Tedeschi, R., & Calhoun, L. (2004). Posttraumatic growth: Conceptual foundations and empirical evidence. *Psychological Inquiry*, 15, 1-18. https://doi.org/10.1207/s15327965pli1501_01
- Thude, B. R., Juhl, A. G., Stenager, E., von Plessen, C., & Hollnagel, E. (2019). Staff acting resiliently at two hospital wards. *Leadership in Health Services*, 32(3), 445-457. <https://doi.org/10.1108/LHS-09-2018-0042>
- Väläkangas, L., & Romme, A. G. L. (2013). How to design for strategic resilience. *Journal of Organization Design*, 2(2), 44-53. <https://doi.org/10.7146/jod.7360>
- Van Der Vegt, G. S., Essens, P., Wahlström, M., & George, G. (2015). Managing risk and resilience. *Academy of Management Journal*, 58(4), 971-980. <https://doi.org/10.5465/amj.2015.4004>
- Wildavsky, A. (1988). *Search for safety*. New Brunswick: Transaction Publishers.
- Woods D. D. (2015). Four concepts for resilience and the implications for resilience engineering. *Reliability Engineering and System Safety*, 14(1), 5-9. <http://dx.doi.org/10.1016/j.ress.2015.03.018>
- Zarrin, M. (2022). Inferring causal networks of health care resilience and safety performance indicators: A two-stage fuzzy cognitive map approach. *Socio-Economic Planning Sciences*, 84. <https://doi.org/10.1016/j.seps.2022.101389>
- Zhong, S., Clark, M., Hou, X.Y., Zang, Y.L., & Fitzgerald, G. (2014). Development of hospital disaster resilience: conceptual framework and potential measurement. *Emergency Medicine Journal*, 31(11), 930-8. <https://doi.org/10.1136/emered-2012-202282>

ANNEX - Resilience interview guidelines - phase 1 of the project

Multidimensional Study on the Resilience of the National Health System.

One or more questions that can be used for interviews are proposed for each of the resilience revealing items. The proposed topics aim to identify priority issues to be addressed, although they are not exhaustive in nature. Other topics deemed relevant to emergency management may be pointed out during the interview.

Spaces, equipment, and facilities

- The ability to quickly reconfigure hospital areas and departments seems to have been one of the factors that enabled Lombard hospitals to respond quickly and effectively to the crisis. What equipment and facilities had to be moved, can you give a mobility index for these?
- What spaces have had to be redesigned or upgraded?
- What role did drug stocks and DM play in addressing the emergency? Are there signs of changing trends in stock management?
- Have the procedures for purchasing and supplying goods and equipment (e.g., through MEPA or other electronic platforms) revealed any advantages or problems from which to learn?

Human Resources

- An element that seems to have contributed to the ability to respond to the crisis is people. Which of the following characteristics of the people working in the hospital do you think played a decisive role?
- Flexible, multi-skilled, willing to job rotate to roles other than their usual or headcount roles, willing to return on leave, oriented to internal and external collaboration, able to handle psychological pressure, with good individual preparation, with good teamwork skills.
- How much has the COVID emergency prompted you to redefine organizational models in using the skills of different professional profiles (e.g., case managers)?
- What is happening today? Are you trying to go back to the way it was before or are there lessons/modes of working learned that you intend to pass on or consolidate?
- Speaking of emergency recruitment procedures, to what extent has it been true or useful that retired or inexperienced physicians and/or other practitioners have been enlisted in this emergency phase?
- What professional profiles are most likely to be relocated to the emergency supply chain?
- Is it possible to say anything about the preparedness of personnel to deal with unexpected emergencies?
- Speed of response, both in the emergency phase and in the subsequent phase, about decision-making, deployment of additional resources, and operational coping with the emergency. What is the situation in terms of outpatient agendas and elective surgical activity today?

Governance

- Is it possible to draw some considerations with respect to the governance of the system and the issue of centralization? How is national and civil defense coordination evaluated?
- Had the System adopted and updated (formally and substantively) emergency prevention/management strategies and plans?
- Can considerations be made on the issue of integration between the health system and the volunteer system?

Information

- Information sharing: to what extent does information flow freely through the different levels of the organization? And among the different actors involved? What tools in particular have worked?
- Did people always have the information they needed to respond to the sudden emergency?
- What role did information management and outward communication play?

Financial autonomy

- When and in what ways, having passed the peak of the crisis, does the hospital return to dealing with elective diseases?
- Is the availability of adequate financial resources one of the elements that can contribute to recovery, as well as to dealing with prolonged crisis situations?

Integration Hospitals - Territory (stakeholders)

- What has been the effective role of primary care physicians?
- What have been the most relevant and critical relationships