

# Systematic Review of Hospital Resilience Instrument: Does it Fit to face the Disruption Era?

## Revisión Sistemática del Instrumento de Resiliencia Hospitalaria:

### ¿Se adapta a la Era de la Disrupción?

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#### SUMMARY

**Introduction:** As critical infrastructure, hospitals have an important role as a provider of health care in the health care system. In the era of disruption, hospitals are faced with many challenges known as Volatility, Uncertainty, Complexity, and Ambiguity (VUCA) World. Resilience capacities are needed to cope with all disruptions to maintain business and service functions. This study aims to review hospital resilience instruments to measure resilience in the context of facing a disruption era. **Methods:** A systematic review in 2020 was conducted. The search of articles was done from electronic databases according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement. Electronic databases such as PubMed, Ovid, Science Direct, and Google Scholar were used. Inclusion criteria were articles that provide indicators to measure resilience in a hospital or health care. Articles were analyzed based on the World Health Organization Resilience

framework such as context, stage of shocks, capacity to deal with disturbance, and outcomes of resilience. It was also assessed the indicators from the perspective of organizational resilience, whether indicators were mainly developed either based on static or dynamic perspective. **Results:** Were identified 1 464 potential studies. After eliminating duplicates and exclusion of literature, 18 selected articles were used to analyze the instrument to measure hospital resilience. Most hospital resilience instruments are developed to measure resilience in disasters. However, three articles focus on the required process or use a dynamic perspective, yet the concepts are not very detailed in the resilience measurement items. Capacities needed to deal with disturbance were mainly focused on input aspects that were not suitable for assessing the resilience of hospitals in dealing with dynamic situations in the disruption era. **Conclusion.** Hospitals as complex organizations must tackle all challenges in the disruption era. The resilience concept that focuses on disasters or pandemics could not accommodate the measurement of resilience in the VUCA world. The review underlines the need to develop an instrument of hospital resilience to tackle challenges in the disruption era.

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## RESUMEN

**Introducción:** Como infraestructura crítica, los hospitales tienen un papel importante como proveedor de atención médica en el sistema de atención médica. En la era de la disrupción, los hospitales se enfrentan a muchos desafíos conocidos como mundo de volatilidad, incertidumbre, complejidad y ambigüedad (VUCA). Se necesitan capacidades de resiliencia para hacer frente a todas las interrupciones para mantener las funciones comerciales y de servicio. Este estudio tiene como objetivo revisar los instrumentos de resiliencia hospitalaria para medir la resiliencia en el contexto de enfrentar una era de disrupción.

**Métodos:** Se realizó una revisión sistemática en 2020. La búsqueda de artículos se realizó a partir de bases de datos electrónicas de acuerdo con la declaración Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). Se utilizaron bases de datos electrónicas como PubMed, Ovid, Science Direct y Google Scholar. Los criterios de inclusión fueron artículos que proporcionaran indicadores para medir la resiliencia en un hospital o centro de salud. Los artículos se analizaron según el marco de resiliencia de la Organización Mundial de la Salud, como el contexto, la etapa de los choques, la capacidad para hacer frente a las perturbaciones y los resultados de la resiliencia. También se evaluaron los indicadores desde la perspectiva de la resiliencia organizacional, si los indicadores se desarrollaron principalmente en base a una perspectiva estática o dinámica.

**Resultados:** Se identificaron 1 464 estudios potenciales. Después de eliminar duplicados y exclusión de literatura, 18 artículos seleccionados fueron utilizados para analizar el instrumento para medir la resiliencia hospitalaria. La mayoría de los instrumentos de resiliencia hospitalaria se desarrollan para medir la resiliencia en los desastres. Sin embargo, tres artículos se centran en el proceso requerido o utilizan una perspectiva dinámica, pero los conceptos no están muy detallados en los elementos de medición de la resiliencia. Las capacidades necesarias para hacer frente a las perturbaciones se centraron en aspectos de entrada que no eran adecuados para evaluar la resiliencia de los hospitales para hacer frente a situaciones dinámicas en la era de las perturbaciones.

**Conclusión:** Los hospitales, como organizaciones complejas, deben abordar todos los desafíos en la era de la disrupción. El concepto de resiliencia que se enfoca en desastres o pandemias no podía acomodar la medición de la resiliencia en el mundo VUCA. La revisión subraya la necesidad de desarrollar un instrumento de resiliencia hospitalaria para abordar los desafíos en la era de la disrupción.

**Palabras clave:** Resiliencia, disrupción, hospital.

## INTRODUCTION

The hospital is one of the organizations that have a strategic role in the health care system. Hospitals are unique with very high levels of complexity, uncertainty, externalities, and risks (1). Along with increasing external challenges such as technological changes, financial crises, policy changes, and natural and non-natural disasters, hospitals are increasingly required to be able to adapt to conditions of uncertainty, ambiguity, and complexity (2). This condition is called VUCA world (Volatility, Uncertainty, Complexity, Ambiguity) (2).

The acronym VUCA world is becoming popular which describes the disruption faced by organizations, like hospitals. Volatility illustrates that there is no longer something that can be run stably due to the many innovations and technological developments that are fast and constantly changing in today's conditions. Uncertainty illustrates that nothing can be ensured in running an organizational cycle. This uncertainty makes conditions difficult to understand, predict, and manage. Complexity describes the various overlapping problems that may cause chaos in the health sector. Ambiguity illustrates the blurring of the boundaries of the health sector area. Many new hospitals have sprung up whose presence is not unexpected (3). The VUCA environment is an illustration of the disruption faced by the healthcare system.

In facing the VUCA world, several management concepts were developed in the hospital industry such as risk management approaches (5-7), change management (8,9), Crisis management (9), meta leadership Framework (10), Enterprise Risk Management (EPM) (11), and the concept of Resilience Health Care (RHC) (12). In recent years, one of the concepts that have attracted the attention of health experts is the concept of hospital resilience. This concept became popular due to the high health crisis caused by natural and non-natural disasters recently. The concept of hospital resilience was first developed at the World Conference on Disaster Reduction in Hyogo, Japan in 2005. At this conference, an important role of infrastructure, such as hospitals, is to reduce disaster risk and increase their capacity in disaster management. This is stated

in the Hyogo Framework for Action 2005-2015 document entitled “Building the Resilience of Nations and Communities to Disasters” (13). In addition, the concept of hospital resilience is then discussed more specifically in the Sendai Framework for Disaster Risk Reduction 2015-2030 document, in which hospital resilience to disasters is one of the priority targets (14).

The hospital resilience concept in health care studies is a combination of the traditional safety management paradigm concept that focuses on calculating, reducing incident risk, and understanding the causes of incidents and the adaptation of the Resilience Engineering (RE) concept which focuses on the ability of the system to withstand, absorb, and respond to disasters to maintain its function (15). Hospitals as very complex organizations require good resilience in the face of change. Organizational resilience was initially developed in the fields of business and management. Based on the theory of organizational resilience that was developed in the field of business and management, resilience can be seen from a static perspective and a dynamic perspective. The static perspective sees resilience as functional and resilience as a result. The static perspective focuses on the availability of inputs and compares the condition of the organization before and after the crisis, while the dynamic perspective sees resilience as a capacity and resilience as a process where resilience is seen as the spirit of an organization that should always be present in the daily routine of the organization so that it is ready to face any challenges, both expected and unexpected events (18,19). In the context of disruption to the VUCA environment, a more dynamic concept of resilience is needed. This study aims to review whether the hospital resilience instrument that has been developed can be used to face challenges in the dynamic era of disruption, which is considered the era in which technology and society are evolving faster than businesses can naturally adapt.

## METHODS

**Study Design.** The systematic review was conducted based on the Preferred Reporting Items for Systematic Reviews and Meta-

Analysis (PRISMA) tools. The literature search was conducted using international databases that were commonly used for health research studies, namely PubMed, Ovid, Science Direct, and Google Scholar. Some articles were identified by hand searching in WHO databases. The search strategy for database searching was as follows (“Health care resilience” OR “Hospital Resilience” OR “Hospital Safety Index” OR “Hospital Disaster Resilience”) AND (“Measurement” OR “Evaluation” OR “Assessment” OR “Framework” OR “Model”) published in 2010-2020. Articles and guidelines published in English, full text accessed, having frameworks, models, or indicators for measuring hospital resilience were included while studies discussing Individual Resilience, Community Resilience, and Resilience Engineering were excluded.

Two researchers conducted screening and assessed for eligibility. The first researcher screened the articles’ duplication, title, and abstract that did not meet the inclusion criteria. The second researcher then rechecked the chosen articles to assess articles that were eligible for full-text review. Then, both researchers reviewed the included articles for quality assessment for the studies included in the review. The eligible articles were then extracted using a form to describe the name of the authors, the aims of articles or guidelines, shock type, instrument, stage of shock, indicators used to measure hospital resilience, a term used to describe resilience (outcome of resilience) and perspective of resilience concept (static or dynamic). The categorization of the matrix follows the concept of resilience developed by WHO (18). The concept of health system resilience includes what challenges or shocks they face (context), the adaptive capacity that arises as a result of shocks (capacities to deal with disturbance), and the level of resilience outputs. In addition, to assess the instrument which could be used to measure hospital resilience in the context of the disruption era, the indicators of the instrument whether static or dynamic perspective was assessed. The articles were named static perspective if more than 50 % of indicators explain the input readiness and the articles were called dynamic perspective if more than 50 % of indicators explained capacity and processes.

**RESULTS**

There were 1 464 potential studies found using the four worldwide databases (Ovid, Science Direct, PubMed, and Google Scholar). After reviewing the title and abstract, 153 pieces of literature were duplicated, and 1 311 pieces were eliminated. 159 pieces of literature were then included for additional examination. There were still 70 works of literature to be evaluated for full articles. In the final literature for quality assessment, 18 articles and guidelines were included in this study (Figure 1).

After reviewing 18 articles and guidelines published before December 2020, it can be seen in Table 1 that there were 12 articles related to hospital resilience and 6 articles related to health system resilience. Adopting the WHO resilience framework, we categorized the variable of resilience by identifying shock, capacities, perspective organizational resilience, and level resilience used. Based on the shocks, 2 articles

discuss all hazards, and 16 articles discuss disaster-related, while the identified disasters included COVID-19, climate change, and Ebola.

Based on the capacity to deal with disturbance, the concept of Anderson et al. (19), Thomas et al. (20), Olu (21), Blanchet, et al. (22), Kruk et al. (23), and Samsuddin et al. (24) describe the general capacity of the domain. On the other hand, WHO (25,26) presents Hospital Readiness Checklist for COVID-19. A module from the suite of health service capacity assessments in the context of the COVID-19 pandemic, and Arab et al. (27) describe capacities that focus on the cycle of disaster management such as prevention and mitigation, preparedness, response, and recovery. While the concept of resilience developed by, CDC (28), Cimellaro et al. (29), Zhong, and Zong et al. (30,31), Ardalan et al. (32), and WHO (33) have a quite specific resilience domain capacity.

In describing the level of resilience (outcome of resilience), 3 articles labeled the level of resilience in the framework, namely the resilience concept of Anderson et al. (19), Blanchet, et

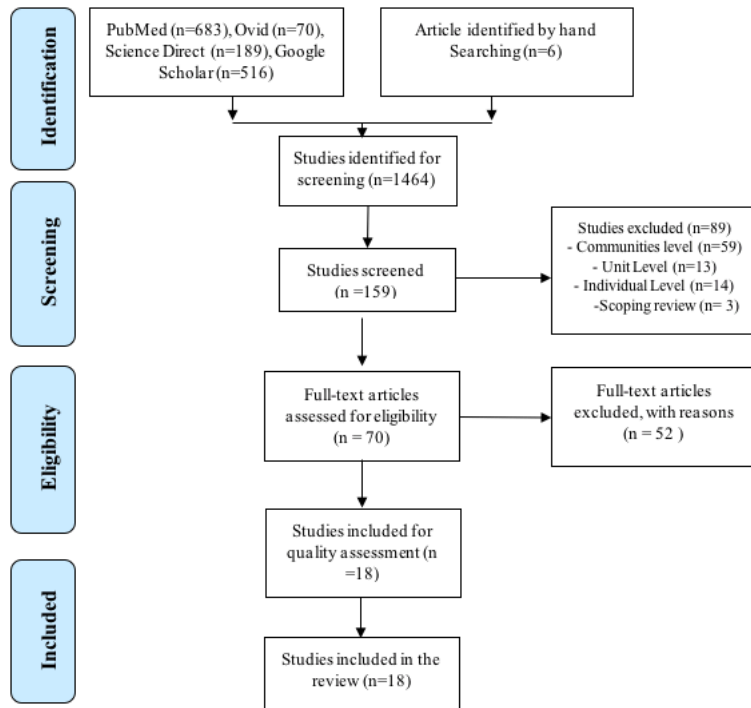


Figure 1. Literature Search Process related to Hospital Organizational Instruments/Framework using PRISMA Method.

Table 1. Literature Review Results

No.	Author, Year/ Title	Context	Capacity to Deal with Disturbance	Outcome of Resilience	Perspective	Conclusion
1.	Anderson et al., 2020 (19)	All Hazard	<ol style="list-style-type: none"> <li>1. Organizations can handle future disruption and opportunities.</li> <li>2. The organization can monitor all processes within the system and environment.</li> <li>3. Ability to respond to demands</li> <li>4. Able to organize knowledge and learn from experiences.</li> </ol>	<ul style="list-style-type: none"> <li>- Situated Resilience</li> <li>- Structural Resilience</li> <li>- Systemic Resilience</li> </ul>	Dynamic	100 % of capacities developed in these articles processes, however, there are no specific items in the instrument to measure those capacities'
2.	Thomas et al., 2020 (20)	All Hazard	<ol style="list-style-type: none"> <li>1. Organization leader has vision and the ability to communicate the organization's vision.</li> <li>2. Coordinating efforts among the government and major stakeholders</li> <li>3. A culture of organizational learning that responds to emergencies</li> <li>4. Reliable information flows and systems</li> <li>5. Monitoring that allows for quick detection of shocks and their effects</li> <li>6. Ensuring the system has enough financial resources and the flexibility to reallocate and add more money.</li> <li>7. Ensuring the stability of health system funding through countercyclical health financing mechanisms and reserves</li> <li>8. Purchasing adaptability and finance reallocation to address changing needs</li> <li>9. Complete health insurance</li> </ol>		Dynamic	69.2 % are processed needing to be resilient organization. However, these instruments are general, not only for hospitals but some indicators could be used at the system level (region).

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No.	Author, Year/ Title	Context	Capacity to Deal with Disturbance	Outcome of Resilience	Perspective	Conclusion
			<p>10. Having the right amount and distributing the available material and human resources</p> <p>11. The capability to expand to accommodate an unexpected spike in demand</p> <p>12. A workforce that is inspired and well-supported</p> <p>13. Alternative and adaptable methods of providing care</p>			
3.	WHO (2020) Disaster Hospital Readiness Checklist for COVID-19 (25)	Disaster	Capabilities needed are input-oriented such as human resources, Logistics, and management of supplies, including pharmacies, essential support services, IPC, and laboratory services. The process identified is too specific and related to preparing for disasters such as the Continuity of essential health services and patient care, surge capacity, communication, case management, and surveillance.		Static	100 % of indicators assess input preparation to face a disaster situation.
4.	Assistant Secretary for Preparedness and Response (ASPR) (2020) (26)	Disaster	<p>1. Safety / Infection Control Activities</p> <p>2. Emergency Medical Services Activities</p> <p>Hospital and Health Care Activities</p>		Static	All indicators specific to dealing with the COVID-19 situation
5.	WHO, 2020 Rapid hospital readiness	Disaster	Some inputs capacities identified are Human resources, Infection prevention and control, Occupational		- Static	- 66,7 % of indicators are input aspects in the stage of preparedness for disaster

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No.	Author, Year/ Title	Context	Capacity to Deal with Disturbance	Outcome of Resilience	Perspective	Conclusion
	<p>checklist A module from the suite of health service capacity assessments in the context of the COVID-19 pandemic</p>		<p>health, mental health, and psychosocial support. Some process capacities identified are rapid identification and diagnosis, surge capacity, leadership and incident management system, communication, surveillance and information management, risk communication and community engagement, administration, finance, business continuity, and patient management. The process is specific to facing the pandemic.</p>			
6.	<p>Arab et al., 2019 Developing a Hospital Disaster Risk Management Evaluation Model (27)</p>	<p>Disaster Disaster</p>	<p>Capacities focus on the cycle of disaster management such as prevention and Mitigation, preparedness, response, and recovery.  Some inputs capacities identified such structure, a written COVID-19 plan, Occupational Health, Education and Training, facility Communications, Medical Equipment and Supplies, visitor Access &amp; Movement within the Facility, and Healthcare Services/ Surge Capacity  Some process capacities identified are management and Leadership, Risk Assessment, planning, Key Performance Result, Identification and Management of Ill Patients</p>		<p>Static</p>	<p>All indicators are specific for disaster preparedness</p>

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No.	Author, Year/ Title	Context	Capacity to Deal with Disturbance	Outcome of Resilience	Perspective	Conclusion
7.	CDC (2020) Disaster Comprehensive Hospital Preparedness Checklist for Coronavirus Disease 2019 (COVID-19) (28)	Disaster	-	-	- Static	-All indicators specific to COVID-19 pandemic preparedness
8.	Samsudin et al., 2018 Disaster Preparedness Attributes and Hospital's Resilience in Malaysia (24)	Disaster	Capacity identified related to input factors such as building, Structural, and updated building plans , Critical lifeline system, basic and Medical Laboratory equipment and supplies, internal circulation, emergency management, operational plan standard operating procedures (SOP) and guidelines, hospital safety, and security system Hospital transportation and communication, and human resources.	- Absorptive capacity - Adaptive Capacity - Transformative Capacity - Transform - Recover Better than before - Recover to pre-event state - Recover but more than before - Collapse	- Static	-Input identification to prepare the organization to face disaster
9.	Cimellaro et al., 2018 Factor Analysis to Evaluate Hospital Resilience (29)	Disaster	All capacities regarding disaster preparedness such as hospital safety, cooperation and disaster plan, emergency stockpiles, training and staff, management of logistics, critical care, and recovery.	-	- Static	All indicators regarding disaster preparedness
10.	Olushayo Olu, 2017/ Resilient Health System as Conceptual	Disaster	Capacities identified are mostly about the process such as Leadership and governance, financing, Health Information management, management of medical products,	-	Dynamic	All indicators are processed but not specifically explained how to operationalize in a hospital context as an element of the health system.

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No.	Author, Year/ Title	Context	Capacity to Deal with Disturbance	Outcome of Resilience	Perspective	Conclusion
	Framework for Strengthening Public Health Disaster Risk Management: An African Viewpoint		vaccines, and technologies, management of human Resources, and Service Delivery			
11.	Blanchet et al., 2017/ Governance and Capacity to Manage Resilience of Health of Conflicts Systems: Towards a New Conceptual Framework (22)	pandemic, natural disaster, and armed conflict	1. Knowledge 2. Interdependences 3. Uncertainties 4. Legitimacy	- Absorptive capacity - Adaptive Capacity - Transformative Capacity	- Dynamic	-All indicators focus on governance in the organization to face any disruption. However, items to measure the indicators are not specifically explained.
12.	Samsudin et al., 2017/ Disaster Preparedness Attributes and Hospital Resilience in Malaysia (24)	Disaster	1. Robustness 2. Redundancy 3. Resourcefulness 4. Rapidity	-	- Static	-Focus on disaster preparedness
13.	WHO, 2014/ Strengthening Health Resilience to Climate Change (18)	Climate Change	Some capacities related to input readiness such as health workforce, Technologies and Infrastructures, leadership, and Governance.	- Transform - Recover - Better than before - Recover to	- Static	

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No.	Author, Year/ Title	Context	Capacity to Deal with Disturbance	Outcome of Resilience	Perspective	Conclusion
14.	Kruk et al. (2015) (23)	Ebola	Besides that, process capacities were also identified such as vulnerability Capacity & Adaptation Assessment, Integrated Risk, Monitoring, Early Warning, Research, Management of Environmental determinants of health, Informed Health Programs, Emergency Preparedness and Management, and Health Financing. Those process capacities are specific to Climate Change	pre-event state - Recover but more than before - Collapse	Dynamic	Very broad indicators but focus on process. However, the articles do not mention items to measure those indicators
15.	Zhong et al. 2014 (30)	Disaster	1. Aware 2. Diverse 3. Integrated 4. Self-regulating 5. Adaptive  All capacities are related to how medical care, resources, and safety in a disaster context, particularly disaster management mechanisms.	-	Static	All indicators focus on disaster preparedness
16.	Zhong, 2014 Developing Disaster an Evaluation Framework for Hospital Disaster Resilience: Tertiary Hospitals of Shandong Province, China (31)	Disaster Disaster Disaster	Capabilities developed covered preparedness for the recovery phase. All capacities also specific to disaster context such as disaster Leadership and Cooperation, plan, stockpiles and logistics, emergency staff, training, critical care capability, and adaptation and recovery procedure.	- - -	Static	All indicators focus on disaster preparedness  All indicators focus on disaster preparedness All indicators focus on disaster preparedness

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No.	Author, Year/ Title	Context	Capacity to Deal with Disturbance	Outcome of Resilience	Perspective	Conclusion
17.	Ardalan et al. (2014) Hospitals Safety from Disasters in I.R.Iran: The Results from Assessment of 224 Hospitals (32)	Disaster	All capabilities identified for disaster context, for input capabilities such as hospital building, electrical system, water supply, fuel storage, ventilation, medical equipment, the committee of hospital disaster, operational plan, contingency plan, and medicine. All this input is categorized by structural, nonstructural, and functional aspects.	-	Static	All indicators focus on disaster preparedness
18.	WHO, 2010 Safe Hospitals in Emergencies and Disasters (33)	Disaster	Capabilities are categorized into structural, non-structural, and function. All capabilities focus on input of the hospital such as site and accessibility, location, structure, architecture elements medical equipment, emergency standard operating, transportation, and human resources. The only process capability is monitoring and evaluation. All capabilities are specific to the disaster context.	-	Static	All indicators focus on disaster preparedness

al. (22), and WHO (18). The level of resilience in Anderson's concept is known as Situated Resilience, Structural Resilience, and Systemic Resilience (19). Situated Resilience includes the ability of resilience to manage unexpected events that occur within a relatively small time scale and scope and are revealed by utilizing resources and practices pre-existing sociotechnical techniques (such as skills, knowledge, tools, and data) to respond to and cope with some disturbance or source of stress—such as a surgical team responding to an unexpected perioperative emergency (19). Structural resilience is the ability of resilience where the redesign of its resources and processes are carried and on a larger time scale and scope such as redesign of SOP (Standard Operational Procedure). Systemic Resilience involves activities focused on completely reformulating the way business resources and practices are managed. This can happen across industries and on a large time scale and scope. Zhong et al. (30) used 4 criteria in assessing the level of resilience known as the 4R Framework, namely Robustness, Redundancy, Resources (Resourcefulness), and Speed (Rapidness). Robustness is the ability of a health facility or health system to withstand certain external shocks and the extent to which healthcare functions can be maintained. Redundancy is defined as the extent to which health facility resources can be substituted to keep the service function running. Resourcefulness is the ability to identify problems, set priorities, and mobilize resources when disasters occur. Meanwhile, Rapidness is the speed (at the right time) of a health facility where the level of its full operational function can be achieved through responsiveness, recovery, and adaptation activities (31). While Blanchet et al. (22) use the terms Absorptive capacity, Adaptive Capacity, and Transformative Capacity. Absorptive capacity is related to the capacity of the health system to continue to provide services at the same level (both quantity, quality, and equity). Even in the face of shock, it can function using the same level of resources and capacity. Adaptive Capacity is the capacity of the health system to provide the same level of health care with fewer and/or different resources, which requires organizational adaptation. Meanwhile, Transformative Capacity describes the ability of the health system to change the function and structure of the health system to respond to a

changing environment (22). Finally, the concept of resilience developed by WHO uses the term outcome resilience, namely transform, recover better than before, recover to pre-event state, recover but worse than before and collapse. These five levels of resilience compare the condition of the system before and after being hit by a shock. Based on perspective analysis, there were 5 articles that were developed to accommodate resilience either as process or dynamic perspective and 13 articles were instruments with a static perspective. However, most instruments with a dynamic perspective were very general for measuring hospitals and systems. Some instruments did not mention specifically the items to measure the indicators.

## DISCUSSION

This systematic review aimed to analyze whether existing hospital resilience instruments could be used to measure hospital resilience in a disruption era in the context of the VUCA world. Based on the shocks identified, most of the articles discussed disaster-related shocks. One characteristic of the disruption era is uncertainty which happens all the time. However, most articles discuss the shock based on disaster management cycles. Based on the term stage of shock, there were 4 that do not discuss the stage of shock and 14 that discuss the stage of shock. Judging from the shock stage, only 3 articles discuss the shock cycle, namely the concept of the resilience of Thomas et al. (20), Olu (21), and WHO (2010). There were 2 shock cycles identified, the first was Preparedness of the Health System for Shocks, Shock onset and alert, Shock impact and management, and Recover and Learning. This cycle was adopted from the WHO health resilience framework (2014). The second was the shock cycle with the stages of Disaster Preparedness, Disaster Responses, and Post-Disaster recovery. Finally, 10 articles only discuss the Preparedness stage.

Disruptions are not dealing only with disaster topics. Shaw and Chisholm (34) categorized disruption into three categories such as technology, social context, economy, and political context. In terms of technology, we are faced with Artificial Intelligent and digitalization in

health care. In a social context, we were facing society with high expectations of quality health care and the consumer behavior of patients who have recently shifted in access to health care. They preferred to access the online application to register and maximize some digital health platforms to do a consultation with doctors. They were also more aware of quality. In the economic aspect, disruption in health could be described in the case of inflation that influences health costs such as drugs, medical equipment, etc. From the political point of view, many policies were created by the policymakers that forced hospitals to change their hospital policies. Those disruptions were very dynamic and needed a dynamic perspective of resilience capacity. Based on the findings, the application of the hospital resilience concept is more about the ability to recover during a disaster.

In the context of disaster management, four important phases affect disaster response strategies known as the shock stages, namely the preparedness of the health system to shock, shock onset and alert stages, shock impact, and management stage, and recovery and learning stage (12). Each of these stages requires a different resilience strategy. Based on Table 1 related to the measurement of hospital resilience levels that have been developed by the World Health Organization (WHO), Pan American Health Organization (PAHO), and several researchers in developed countries, the concept of resilience currently focuses more on identifying the resources needed due to direct damage due to disasters such as infrastructure, coordination of emergency services and all aspects of disaster management preparedness (35-37). Even though the preparedness aspect, which mostly prepares input aspects such as the provision of isolation rooms, ventilators, and Intensive Care Units (ICU), for example, does not guarantee that it can solve future problems because the type of shock that a hospital could potentially experience is not only related to disasters but also crisis issues outside of disaster issues requiring good resilience.

The concept of organizational resilience in hospitals that have developed at this time by analyzing input readiness has not been able to accommodate disruptive types outside of disaster issues (16). The organizational resilience

literature in the fields of business and management then begins to fill this gap and focuses on the characteristics of organizations that survive and thrive (37). In recent years, crisis and disaster management have become a major topics for both practitioners and academics. Natural disasters, pandemics, terrorist attacks, economic recessions, and human errors have the potential to become unpredictable threats and threaten the sustainability of the organization (38). The concept of hospital resilience was developed related to Hospital Disaster Resilience (HRD) so that hospitals can provide optimal services in disaster conditions. From a disaster perspective, the concept of resilience is the ability of health services to survive a disaster event, while expanding their medical capacity to respond to a sudden and significant increase in patient demand (1) and then restoring hospital functions to their original state or adapting to new circumstances.

For instance, a lesson learned from the COVID-19 pandemic, hospitals are faced with an unprecedented number of patients who must be hospitalized and require intensive care units (ICUs). According to US Federal Data, nearly half of US hospitals (2 199 out of 4 587) were operating at a capacity of more than 85 % at some point during the peak of the pandemic, between August 2020 and April 2021 (39). In Indonesia, hospital Bed Occupancy Rate (BOR) data also shows that in nine provinces, it has reached a critical level which is above 80 % (40). The hospital struggled to maintain the standard of care with critically ill patients being treated outside the ICU so doctors cannot keep up with providing the care needed due to an increase in the patient-staff ratio. However, this problem was not universal. Some hospitals were reported to be able to accommodate sudden increases in demand, maintain standards of care, and provide high-quality patient care even at a time when COVID-19 cases were soaring (41).

As the pandemic begins to recede in terms of the number of patients hospitalized and requiring critical care, hospitals need to be aware of the possibility of additional spikes. Hospitals must evaluate why some hospitals can maintain effective operations while others struggle. In the management domain, organizational resilience characterizes companies that quickly adapt

in response to existential challenges allowing minimizing the effects of challenges and faster recovery (42). For example, after the terrorist attacks of September 11, 2001, empirical research revealed that airlines with more efficient business models and more stable finances imposed fewer layoffs and regained revenue more quickly than other airlines. The 9/11 recovery and the COVID-19 pandemic are different, but the concept of resilience is important because studying variations in past resilience can inform policies that promote resilience in the future.

Barbash and Jeremy (2021) state that the current concept of hospital resilience does not have to focus on disasters. The concept of hospital resilience from an organizational perspective that focuses on preparedness needs to shift to a more comprehensive concept that can accommodate any disruption other than disasters (42). Some of the changes in health services in the era of disruption according to Shaw and Chisholm (34) are technological changes, for example, cell and gene therapies that offer potential cures but also pose challenges for policymakers and payers (43-47). The growth of Artificial Intelligence (AI) and big data in healthcare have the potential to disrupt the science and economics of drug development and healthcare in several ways (48-50).

In addition to economic changes, various payment models, the subscription-based 'Netflix' type model, and others have also been proposed that have the potential to change the healthcare system (50), and social change, in the conditions of the COVID-19 pandemic, has accelerated the rollout of services that reduce face-to-face interactions in healthcare. For example, video consultations between doctors and patients have been rapidly implemented in Australia for several weeks (51).

Based on the disruptions that exist in this era, hospitals that have resilience capabilities can make it easier for them to consider various solutions to every problem and quickly maneuver when previously planned strategies do not work. The hospital can then quickly and effectively implement new solutions without relying solely on pre-planned solutions that may not be compatible with current problems (42). Resilience is more than just a contingency plan and something that should be practiced at the executive leadership

level. Resilience is a particular way of becoming more aware, and skilled, and is a process that enables organizations to embrace uncertainty and survive and recover from setbacks (52).

In dealing with the disruption of the VUCA environment, different hospitals have different ways of responding in dealing with disruptive conditions. Some organizations can successfully manage resources and continue to grow, and some organizations do not respond well and even collapse. Organizations that have resilience capabilities can adapt to unexpected challenges and have the flexibility to return to carrying out organizational functions as if conditions are normal or even transform for the better. Organizational resilience that can face various obstacles related to policies, economic crises, and changes in market mechanisms (19,53) is more discussed in the concept of organizational resilience in the business and management fields, namely in companies other than the health industry.

Barbash and Jeremy (42) argue that hospitals that have resilience capabilities allow them to consider multiple solutions to any problem and quickly maneuver when previously planned strategies don't work. Hospitals can then quickly and effectively implement new solutions without relying solely on pre-planned solutions that may not fit the current problem. Hospitals can be resilient even if they are not prepared and can also be well prepared but not resilient. This distinguishes the preparedness aspect of a disaster which is only useful during disasters and pandemics, factors that lead to hospital resilience tend to favor high-quality care during routine operations.

## CONCLUSION

Hospital resilience allows hospitals to adapt to expected and unexpected situations. Hospital organizations are characterized by high-complexity activities and are very dynamic. Dynamic situations are reflected as disruptions in an organization that require resilience capacity that allows the hospital to measure its resilience level. The established hospital instrument developed are not fit to tackle challenges in

the disruption era which is characterized by volatility, uncertainty, complexity, and ambiguity situation. However, this review shows that most of the articles that discuss hospital resilience instruments are used to measure hospital resilience in the context of disaster. For further studies, there is a need to develop a hospital resilience indicator that can measure a hospital's capacity in dealing with a dynamic situation in the disruption era. Therefore, research to identify which organizational elements are most important for driving hospital resilience and a more nuanced understanding of what it means to be a resilient hospital will provide new strategies for creating resilience ahead of the next disruption.

### Competing interests

The authors declare no conflict of interest

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