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Developing a conceptual framework for flexible surge capacity based on complexity and collaborative theoretical frameworks

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ABSTRACT

Objectives: This study aims to develop a theoretical framework for the flexible surge capacity, inspired by existing surge capacity, complexity theory, and collaborative theoretical frameworks, and discuss its implementation and use in emergencies.
Study design: This was a descriptive study.
Methods: Theoretical frameworks for surge capacity, the complexity and resilience theory, and collaboration were reviewed and combined to develop a theoretical framework for the flexible surge capacity, incorporated with standard practical tools used in disaster and emergency management as interconnecting collaborative factors.
Results: The expanded number of disasters, public health emergencies, and the emergence of new risks and vulnerabilities indicate a complex situation and an apparent need to revisit the core of preparedness for unexpected incidents. Four crucial elements as parts of surge capacity, that is, staff, stuff, space, and systems, need to be considered in the planning and managing disasters and emergencies. Within the ordinary contingency plans, primary and secondary surges are planned and prepared. However, there are situations where those surges may not exist or are impossible to deliver. In such situations, available community resources should be used, described as flexible surge capacity. The flexible surge capacity framework incorporates a balanced and innovative process of integrating various resilience factors in complex incidents and collaboration among multiagency organizations.
Conclusions: The flexible surge capacity theoretical framework was developed. Nonetheless, further studies on the willingness of the medical and non-medical organizations to partake in the flexible surge capacity system are required.

Introduction

With an increasing number of disasters, public health emergencies, and armed conflicts, there has been a plethora of publications, which could have been categorized into several research topics, such as the 5Cs (command, control, communication, coordination, and collaboration), citizen participation, self-organization, risk perception, vulnerability, and the use of advanced technologies. These studies address the gaps and shortcomings of the management in all four phases of disaster management, that is, mitigation, preparation, response, and recovery.[1]

Such a broad change in disaster and emergency management demonstrates an obvious need to revisit the core of preparedness for unexpected incidents. In addition, global geopolitical changes, hybrid conflicts, climate change, and pandemics are new risks that create new vulnerabilities that influence the principles of disaster preparedness in a broad range of nations, from high-income to middle- and low-income countries. Moreover, one of the experiences gained in the current pandemic caused by COVID-19 was the need for a more comprehensive multiagency collaboration and the creation of diverse technical and practical innovations and measures.[2,3]

Two crucial factors need to be considered in the planning and managing disasters and emergencies that all constitute the four vital elements of surge capacity (SC). The first factor consists of the

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first three elements of SC, that is, elements that need to be scaled up or down during disaster management. These are staff, stuff, and space, often planned through contingency plans, using available resources within the organizations or facilities. The system is the second crucial factor and the fourth vital element of SC, that is, the guidelines and instructions that govern the quality and quantity of staff, stuff, and spaces. In most cases, the system is the contingency plan itself.[4] It describes how medical and non-medical management is organized to give staff a structural framework for working and prioritizing their activities. For years, emergency services in several countries, including Sweden and the United Kingdom, have implemented and used a joint framework, so-called the Joint Emergency Services Interoperability Principles, which were initially used by prehospital units but later used found to be useful even in hospital and clinical environments. These principles originate from MIMMS (Major Incident Medical Management and Supports) and are shortened as CSCATTT, which stands for command and control, safety, communication, assessment, triage, treatment, and transport. CSCATTT paradigm provides a systematic and structured approach for individuals and organizations involved in major incidents, both as a planning and evaluating tool.[5–7]

In practical terms, there is a primary capacity surge when disasters strike. According to the contingency plan (system), this surge targets the available staff, stuff, and spaces and is, in most cases, sufficient to overcome disaster challenges. However, with an extension of the process of the disaster or with simultaneous incidents elsewhere requiring central resources, a secondary surge is necessary. Both the primary and secondary surges should be seen as integrated parts of resilience. Still, the transition may create a complex situation when the process may happen simultaneously or in a random order.[8] This overwhelming situation can be understood with the help of complexity theory, which emphasizes interactions and the accompanying feedback loops that constantly change systems. Although it proposes that systems are unpredictable, they are also constrained by order-generating rules.[8] Such rules can enhance the interaction between diverse parts of the management system and the collaboration between organizations. Most healthcare systems are capable of a second surge based on their available but out-of-duty resources. Staff can be called into work and functional, but not used resources and spaces can be used.[4] Additional extension of an incident or a multidomain incident such as a terror attack, an armed conflict, or when the infrastructure necessary for delivering support is affected necessitates extra resources, which may not exist or be possible to deliver. Such a scenario should use the community resources and has been described as flexible SC (FSC).[7–9]

The idea of resource flexibility in disaster management is nothing novel and has been mentioned by several studies that have also targeted communities as a relevant resource.[10,11] However, the description of such a flexible system was first published in 2020, suggesting a partnership with diverse medical and non-medical institutions and facilities, led by public health authority.[9] There is a theoretical framework for SC, but a similar framework for FSC is missing. Such a theoretical framework should consider the multiagency involvement of several non-governmental and governmental organizations at the local level, which implicates a need for interaction and collaboration. Collaboration is a complex process that aims at building a relationship between two partners and typically encompasses factors such as trust, open communication, mutual respect, shared goals, and values among actively participating members to yield shared responsibility and decision-making.[12] A critical point in collaboration is to create interactivities using practical tools such as CSCATTT, which is widely used in emergency management.

This article aims to develop a conceptual, theoretical framework for FSC, inspired by the existing SC, complexity, and collaboration theoretical frameworks, and discuss its implementation and use in emergencies. A conceptual framework illustrates what can be expected through the research. It defines the relevant variables for the study and maps out how they might relate to each other. It also represents expected causes and the expected effects. These steps must be conducted before the details can be planned.[13]

Conceptual framework of SC

Inspired by the works of Hick et al.,[10,11] Bonnett et al. described the SC framework in 2006.[4] According to the authors and based on their review of published papers, there are several so-called surge-generating events. These events are either contained (geographically defined and the incident site is integral to the event, such as in bombings, tornadoes, flooding, etc.) or are population based (not defined geographically and can propagate throughout a population, such as pandemics, bioterrorism, etc.).[4] All these events cause a healthcare system to respond, expand, or scale up[9] in three broad areas: (1) public health SC aiming to increase the overall ability of the public health system to manage a significant incident, (2) facility-based, and (3) community-based surge capacities.

The latter highlights the significance of communities' off-site treatments facilities or as a unified area for command and control units to overview the multiagency operation and the work in healthcare facilities.[10,11] It also highlights the importance of a multilevel response to a disaster and that a response should be tiered, scalable, and flexible in treating many patients.[4,9]

It is not a secret that proper preparedness is built upon ordinary and daily activities and standards of care. With appropriate standards of care and daily operation, a facility can increase its volume with its available resources, and there is no need for modification in the system.[4] Disasters and emergencies influence the daily activities of health systems. A contained event requires immediate resources around the affected area and rapid transport of casualties to the hospitals, which may lead to overwhelming hospitals.[6] Such a situation requires extra resources, either being recruited from other hospitals or provided by evacuating non-disaster patients. Concern should be given to the event in which the hospital is a target itself. On this occasion, a total hospital evacuation is inevitable.[6] On the other hand, a population-based event requires proper isolation of infected or affected victims and selective transport to the hospitals. On such occasions, appropriate community care must be available to comfort patients and allow them to be tested and treated at home without seeking already affected hospitals.[14]

According to Bonnett et al.,[4] the surge starts as an intrinsic surge, including facilities and communities. A primary surge is a facility-based surge by activating disaster plans and implementing all steps and instructions. Operations will expand, but the situation will be contained within the hospital. In the second step, the community-based surge is activated when the situation expands. Off-site care centers and surge hospitals will start to work, overviewed, and supervised by municipal or regional coordination centers. The final step is when the community-based surge is not enough or available. This inadequacy indicates a need for extrinsic surge, which includes receiving assets from unaffected areas or evacuating victims to unaffected areas based on the type of event.[4]

Complexity and resilience framework

Using the vital elements of SC, Therrien et al.[8] expands the discussion on the needs of healthcare facilities to respond to an event by integrating the Hick et al. concept, which generates a model for health systems' readiness for and response to a wide

range of scenarios[15] to the strategies based on the four crucial elements of SC, that is, trained personnel (staff), supplies and equipment (stuff), rooms in which to treat patients (structure) and policies and procedures (systems),[16–18] and the concept of resilience, which from a crisis management perspective is the ability to "bounce back."[8,19] This response may indicate flexibility in the system (intrinsic) scale up and down and adjust its functioning before, during, or following changes and emergencies to sustain critical operations under expected and unexpected conditions.[20] It also means building capacity in crisis by reducing vulnerability and improving response planning. However, Therrien et al. noted that other organizational concerns in disaster and emergency management should also be addressed.

There is simply an interorganizational perspective that governs the connection between and dependency among organizations and influences the system's ability to respond to crises. Organizational resilience is thus partly dependent on the collaboration between various agencies' capacity to obtain accurate and recent information necessary equipment to jointly manage an influx of patients in each hospital and region based on previously negotiated coordination mechanisms and the power dynamics between organizations.[21,22] Complexity theory focuses on interaction dynamics, the unpredictable properties of interaction, and the relation between a system and its environment.[8]

Detailed and dynamic complexity is essential to manage such complexity as SC. The former is updated knowledge on the risk or etiology and management of scientific uncertainty, resources management, and internal decision-making and communication. The latter is the systematic management of stakeholders on municipal, regional, and national levels, the disparity, and inequity of the care between populations, and the risks presented by the public, policymakers, and professionals. To overcome these complexities and establish a robust network, common denominators found in 4S of SC can obtain interorganizational consistency. To develop and communicate various treatment or protective procedures to prevent early deaths or the spread of infection (system), to establish a unified triage system for assessment of patients (system), shared knowledge (staff), shared bed and equipment (stuff), are all examples of factors that can decrease the uncertainty, link diverse groups, facilitate resource coordination, and enhance the ability to respond.[23] Another essential tool that can be used in the event of disasters and emergencies to increase the compatibility of the multiagency management is the use of CSCATTT, which is part of MIMMS education in several countries.

Taking this conceptual theory into the World Health Organization's change of activity in disaster and emergency management from reactivity to proactivity,[9] the complexity of a crisis depends on the type of event, the presence of scientific uncertainty, and the speed at which it develops. Therefore, the response can be different if there is a pandemic or a terror attack.[8] In conclusion, Therrien et al. suggest a balanced and innovative process of integrating various resilience factors, building on a pragmatic approach based on complexity theory and the four "S" of SC.

Collaboration framework, incorporating CSCATTT

The collaborative framework aims at identifying and building those critical relationships that ease up and accommodate the process of achieving a goal. Fig. 1 shows the collaboration components. The words joint and shared are crucial to collaboration, which does initiate with cooperation, and coordination to end up with collaboration. From a theoretical perspective, two units start as separate entities, but they approach their final collaboration path, as they find mutual interests and contact points. Total collaboration is an

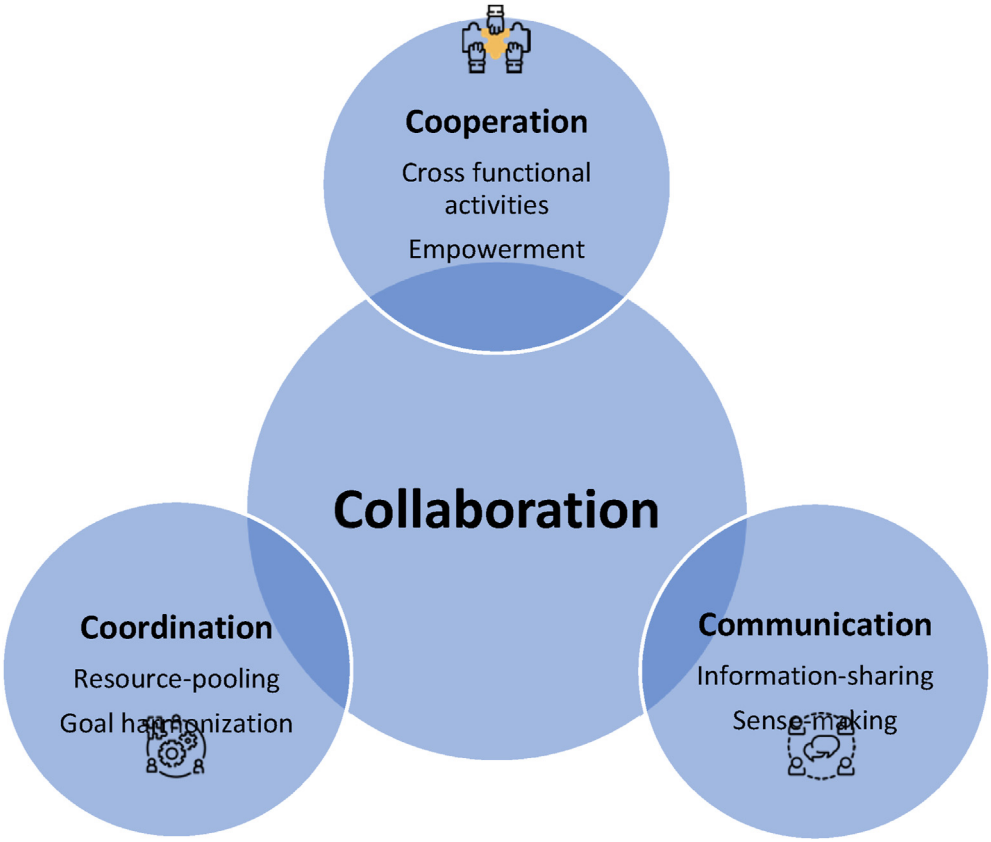

Fig. 1. Collaboration characteristics.[12,24,25]

integration process that lets units achieve a fusion. Fusion, however, is not a goal in disaster and emergency management because diversities are significant factors enabling the management of entire affected areas with diverse populations.[24,25]

Collaboration research emerges from several disciplines and professional fields. In their review, Patel et al.[24] found that the following are some essential factors for successful collaboration:

1. Context: This is the most critical factor determining the tasks and the types of individuals and teams working together. It also determines the kinds of support the collaboration needs.
2. Support: Appropriate support and resources can be decisive for the outcome of a collaboration. Well-designed teams with inadequate support are deemed to fail in their missions.
3. Tasks: Defining tasks is an essential factor in achieving the ultimate goals at all levels of response and engagement.
4. Interaction process: A collaborative approach requires an environment where collaborators engage in the interaction process, such as learning, coordination, communication, and decision-making.
5. Teams: These are individuals with shared tasks and common goals, a specified organizational function contributing to corporate objectives.
6. Individuals: These are people that interact to achieve collaboration. Individual performance (social and technical) is crucial to teams' performance.
7. Overarching factors: These are factors that are relevant to and interact with factors 1–6, such as trust, conflict, experience, goals, incentives, constraints, management, time, and performance. Trust is simply necessary for any collaboration, which may face disputes. A trustful relationship facilitates better communication, leadership, and the implementation of diverse security or medical measures. However, experienced people can overcome a conflict by having a clear goal and appropriate incentives. Constraints should enhance collaboration at its best, supported by decisive and trustful management, knowing that almost all factors inherent to collaboration and interactions will change over time and may influence the performance and outcome.

From disaster and emergency management perspectives, the context is the etiology of the incident, which needs support and teams that can work on the scene. Each team needs to have defined tasks performed by educated individuals. As disaster management is a multiagency performance, there must be an interactive process, that is, learning from each other, coordinating, communicating, and enhancing the mutual decision-making, which requires a mutual assessment of the situation. The communication and interaction between teams and organizations or the overarching factors can be expressed as CSCATTT, used as a planning and evaluation tool. Consequently, it can also be used as interaction points during interagency collaboration. It facilitates all necessary parts of collaboration, that is, cooperation, coordination, communication, information sharing, cross-functional activities, resource pooling, sense-making, empowerment, and goal-congruence. It also clarifies the benefits and challenges in collaboration.[25]

Conceptual framework of FSC

Having adopted SC theoretical framework adding the complexity and collaboration frameworks, Fig. 2 shows the FSC framework development. The concept is useful when the extrinsic surge has been initiated. In the Bonnett framework, after a hospital surge, the community resources are called in before going to extrinsic resource surge. Community resources in this model are medical facilities in the affected community. In contrast to Bonnett's model, the extrinsic surge in FSC starts directly after a failure in the facility-based surge. Then the first approach is to ask from other similar facility resources locally, regionally, and nationally. Suppose these resources are insufficient or cannot be delivered due to infrastructure disruption around the incident site. In that case, an FSC may initiate and use medical and non-medical facilities within the community.

Such surge results in two different approaches on the incident sites, depending on whether it is a contained event or a population-based event.[4] The resources could be recruited to the incident site or the affected area could be evacuated. In most scenarios, staff, stuff, and to some degree even space (field hospital) can be brought to the affected areas. However, this may not be possible with affected infrastructures, requiring community resources. In a population-based scenario, medical facilities cannot risk having infected individuals admitted to the hospital. Thus, community resources could be used to serve those remaining at home without overwhelming and threatening hospitals' capacity.[4,6,8,9]

Both scenarios require an FSC, including medical and non-medical resources. The FSC framework suggests medical resources be divided into certified and authorized primary and allied healthcare centers, including dental and veterinary clinics, physiotherapists, and pharmacists. The non-medical resources, according to an FSC framework, refer to all public and private facilities in the local area, such as schools, hotels, sports complexes, and similar facilities. Implementing such a system requires legal and individual willingness and a set of interactions points that enhance and facilitate collaboration between different units and agencies. Viewed from a theoretical perspective of complexity, FSC suggests a stepwise action of different levels of society to activate available local resources, but it may not follow a stepwise presumption.[9] Future investigations should investigate legal requirements for the implementation of FSC, but the willingness of individuals, both professional and lay people, should also be evaluated. Previous reports[26–29] have already shown that healthcare workers may not be willing to work under some circumstances, whereas laypersons seem eager to do more on the scene. These issues need to be discussed and clarified in future research.

Another critical point of discussion is the leadership of this community-based organization. Khorram-Manesh (FSC) proposed public health professionals as the ones who could carry this responsibility because of their broad experience in community work and knowledge of community health issues. However, using other specialists in different positions may also be needed. Irrespective of who will take part and how this system will be created, multiagency collaboration requires training in all interaction points, for example, as part of the collaboration, learn about Incident Command System, how command and control works, and how it can bind various organizations, horizontally, and own organization, vertically. A mutual understanding of leadership facilitates better communication in safety and management areas. In addition, it results in achieving a common situation assessment that further accommodates better management within the healthcare facility, the triage, treatment, and transport areas. The latter three needs are also considered multiagency tasks, particularly in mass casualty situations and in a case that requires other resources than the involved professional assets. These collaborations allow primary triage of victims and treatment of light injuries by allied healthcare workers and a new logistics line that may involve both allied healthcare workers and laypeople.

As disasters and emergencies needing an FSC are rare, table-top exercises and simulations should be used to understand FSC's usefulness better. Current pandemics and the Ukraine conflict present opportunities to test home isolation care and hospital evacuation as two scenarios that can engage the community's

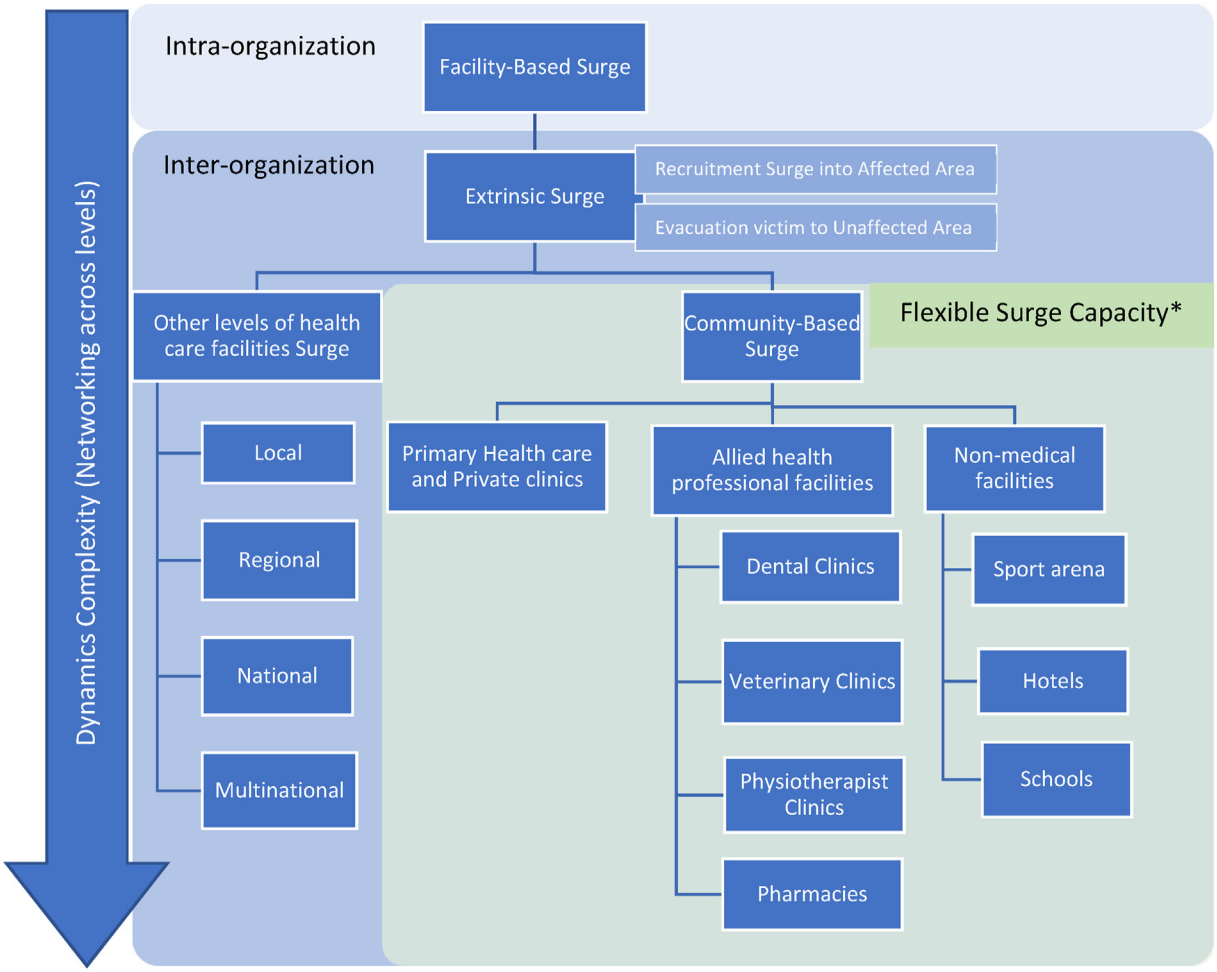

Fig. 2. Surge capacity framework incorporating the Flexible Surge Capacity. *This surge capacity will be recruited in case of failure in all other surge capacities.

resources. From an organizational perspective, the sustainability of collaboration depends on the factors, the benefits, and the challenges obtained from collaborating. These items can be trained and tested to help organizations understand and better collaborate to maximize benefits and the challenges curtailed.[30–32]

Conclusions

In conclusion, this paper has described the theoretical framework for the FSC, its use, and implementation. A conceptual, theoretical framework is necessary to understand the relevant variables for the need and use of FSC before the details at the local level can be planned. For years the topic of "surge capacity" has primarily been operating on a larger scale; the benefit of FSC is to bring the concept down to the individual, the family, and community level, where it truly belongs. FSC does not campaign for independent action of each facility. Still, a collaboration, allowing each facility to do what it is best to do, for example, hotels and restaurants can provide food services, and schools can take care of children and victims in need of shelter, etc., working throughout disasters and emergencies, and led by authorities such as public health with the knowledge in prevention and community-based healthcare management (e.g. infectious diseases). Future studies are needed to investigate the willingness of diverse medical and non-medical organizations in taking part in such a system to test and evaluate the system in an event when the population should not overwhelm a hospital, such as in the current coronavirus pandemic, and in a situation when the hospital needs community resources, such as in an incident, leading to hospital evacuation, for example, armed conflict.

Author statements

Ethical approval

Ethical approval for this study was waived because there was no human or animal in the methods and results of the study.

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Competing interests

None declared.

References

1. Changing landscape of emergency management research: A systematic review with bibliometric analysis - Science [Internet]. [cited 2022 Mar 29]. Available from: https://www-sciencedirect-com.ezproxy.ub.gu.se/science/article/pii/S2212420920304891?via%3Dihub.
2. Khorram-Manesh A, Carlström E, Hertelendy AJ, Goniewicz K, Casady CB, Burkle FM. Does the Prosperity of a Country Play a Role in COVID-19

Outcomes? Disaster Med Public Health Prep [Internet]. undefined/ed [cited 2021 Sep 8];1–10. Available from: https://www.cambridge.org/core/journals/disaster-medicine-and-public-health-preparedness/article/does-the-prosperity-of-a-country-play-a-role-in-covid19-outcomes/0124EC2CD7EFA004668C39DDD1E99384.
3. Civilian Population Victimization: A Systematic Review Comparing Humanitarian and Health Outcomes in Conventional and Hybrid Warfare | Disaster Medicine and Public Health Preparedness | Cambridge Core [Internet]. [cited 2022 Apr 21]. Available from: https://www-cambridge-org.ezproxy.ub.gu.se/core/journals/disaster-medicine-and-public-health-preparedness/article/civilian-population-victimization-a-systematic-review-comparing-humanitarian-and-health-outcomes-in-conventional-and-hybrid-warfare/17FCC046518C0C9AB617102F5AFDC69D.
4. Bonnett CJ, Peery BN, Cantrill SV, Pons PT, Haukoos JS, McVaney KE, et al. Surge capacity: a proposed conceptual framework [Internet] *Am J Emerg Med* 2007 Mar 1;**25**(3):297–306 [cited 2021 Jan 24] Available from: http://www.sciencedirect.com/science/article/pii/S0735675706003652.
5. Mass Casualty Incidents | SpringerLink [Internet]. [cited 2022 Mar 29]. Available from: https://link-springer-com.ezproxy.ub.gu.se/chapter/10.1007/978-3-030-83628-3_22.
6. Khorram-Manesh A, Phattharapornjaroen P, Mortelmans LJ, Goniewicz Krzysztof, Verheul M, Sörensen JL, et al. Current perspectives and concerns facing hospital evacuation: the results of a pilot study and literature review [Internet] *Disaster Med Public Health Prep* 2021 Feb 3:1–9 [cited 2021 Feb 27] Available from: https://www.cambridge.org/core/product/identifier/S1935789320003912/type/journal_article.
7. Phattharapornjaroen P, Glantz V, Carlström E, Dahlén Holmqvist L, Sittichanbuncha Y, Khorram-Manesh A. The feasibility of implementing the flexible surge capacity concept in Bangkok: willing participants and educational gaps [Internet] *Int J Environ Res Publ Health* 2021 Jan;**18**(15):7793 [cited 2021 Sep 5] Available from: https://www.mdpi.com/1660-4601/18/15/7793.
8. Therrien MC, Normandin JM, Denis JL. Bridging complexity theory and resilience to develop surge capacity in health systems. *J Health Organisat Manag* 2017 Mar 20;**31**(1):96–109.
9. Khorram-Manesh A. Flexible surge capacity – public health, public education, and disaster management [Internet] *Health Promot Perspect* 2020 Jul 12;**10**(3):175–9 [cited 2021 Jan 24] Available from: https://hpp.tbzmed.ac.ir/Article/hpp-32033.
10. Hick JL, Koenig KL, Barbisch D, Bey TA. Surge capacity concepts for health care facilities: the CO-S-TR model for initial incident assessment. *Disaster Med Public Health Prep* 2008 Sep;**2**(Suppl 1):S51–7.
11. Hick JL, Einav S, Hanfling D, Kissoon N, Dichter JR, Devereaux AV, et al. Surge capacity principles: care of the critically ill and injured during pandemics and disasters: CHEST consensus statement [Internet] *Chest* 2014 Oct 1;**146**(4, Supplement):e1S–16S [cited 2021 Jan 24] Available from: http://www.sciencedirect.com/science/article/pii/S0012369215519879.
12. Griffiths Amy-Jane, Alsip James, Hart Shelley R, Round Rachel L, Brady John. Together we can do so much: a systematic review and conceptual framework of collaboration in schools. *Canadian J School Psychol* 2021 [Internet]. [cited 2022 Mar 29]. Available from: https://journals-sagepub-com.ezproxy.ub.gu.se/doi/10.1177/0829573520915368.
13. Crawford Linda M. Conceptual and theoretical frameworks in research. In: *Foundations in research design*. SAGE Publications, Inc.; 2020. p. 35–48.
14. So B, Kwon KH. The impact of physical activity on well-being, lifestyle and health promotion in an era of COVID-19 and SARS-CoV-2 variant. *Postgrad Med* 2022 Mar 14.
15. Watson SK, Rudge JW, Coker R. Health systems' "surge capacity": state of the art and priorities for future research [Internet] *Milbank Q* 2013 Mar;**91**(1):78–122 [cited 2022 Mar 29] Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3607127/.
16. Barbisch DF, Koenig KL. Understanding surge capacity: essential elements. *Acad Emerg Med* 2006 Nov;**13**(11):1098–102.
17. Carne B, Kennedy M, Gray T. Review article: crisis resource management in emergency medicine. *Emerg Med Australasia (EMA)* 2012 Feb;**24**(1):7–13.
18. Bayram JD, Sauer LM, Catlett C, Levin S, Cole G, Kirsch TD, et al. Critical resources for hospital surge capacity: an expert consensus panel. *PLoS Curr* 2013 Oct 7:5. ecurrents.dis.67c1afe8d78ac2ab0ea52319eb119688.
19. Weick K, Sutcliffe K. *Managing the unexpected resilient performance in an age of uncertainty*. New York, NY: John Wiley & Sons, Inc; 2007 Jan 1. p. 208.
20. Hollnagel E. Prologue: the scope of resilience engineering. In: Hollnagel E, Paries J, Woods DD, Wreathall J, editors. *Resilience Engineering in Practice: A Guidebook*. Bulington: Ashgate Publishing Company; 2011 Jan 1. xxix–xxxix.
21. (17) (Pdf) Stratégies De Résilience Et Infrastructures Essentielles [Internet]. [cited 2022 Mar 29]. Available from: https://www.researchgate.net/publication/267394070_Strategies_De_Resilience_Et_Infrastructures_Essentielles.
22. Karlsson M, Garvare R, Zingmark K, Nordström B. Organizing for sustainable inter-organizational collaboration in health care processes. *J Interprof Care* 2020 Apr;**34**(2):241–50.
23. Lagadec P. A new cosmology of risks and crises: time for a radical shift in paradigm and practice [Internet] *Rev Pol Res* 2009;**26**(4):473–86 [cited 2022 Mar 29] Available from: http://onlinelibrary.wiley.com/doi/abs/10.1111/j.1541-1338.2009.00396.x.
24. Patel H, Pettitt M, Wilson JR. Factors of collaborative working: a framework for a collaboration model [Internet] *Appl Ergon* 2012 Jan 1;**43**(1):1–26 [cited 2022 Mar 29] Available from: https://www.sciencedirect.com/science/article/pii/S0003687011000573.
25. Lozano R, Barreiro-Gen M, Zafar A. Collaboration for organizational sustainability limits to growth: developing a factors, benefits, and challenges framework. *Sustain Dev* 2021;**29**(4):728–37. Wiley Online Library [Internet]. [cited 2022 Mar 29]. Available from: https://onlinelibrary-wiley-com.ezproxy.ub.gu.se/doi/10.1002/sd.2170.
26. Sultan MAS, Løwe Sørensen J, Carlström E, Mortelmans L, Khorram-Manesh A. Emergency healthcare providers' perceptions of preparedness and willingness to work during disasters and public health emergencies. *Healthcare (Basel)* 2020 Oct 29;**8**(4):E442.
27. Khorram-Manesh A, Plegas P, Högstedt Å, Peyravi M, Carlström E. Immediate response to major incidents: defining an immediate responder. *Eur J Trauma Emerg Surg* 2020 Dec;**46**(6):1309–20.
28. Al-Hunaishi W, Hoe VC, Chinna K. Factors associated with healthcare workers willingness to participate in disasters: a cross-sectional study in Sana'a, Yemen [Internet] *BMJ Open* 2019 Oct 1;**9**(10):e030547 [cited 2022 Apr 1] Available from: https://bmjopen.bmj.com/content/9/10/e030547.
29. Ives J, Greenfield S, Parry JM, Draper H, Gratus C, Petts JI, et al. Healthcare workers' attitudes to working during pandemic influenza: a qualitative study. *BMC Publ Health* 2009;**9**(1):1–13.
30. Khorram-Manesh A, Berlin J, Carlström E. Two validated ways of improving the ability of decision-making in emergencies; results from a literature review [Internet] *Bull Emerg Trauma* 2016 Oct;**4**(4):186–96 [cited 2021 Feb 4] Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5118570/.
31. Berlin JM, Carlström ED. *The three-level collaboration exercise – impact of learning and usefulness* [Internet]. Rochester, NY: Social Science Research Network; 2015 Dec [cited 2021 Oct 26]. Report No.: ID 2679133. Available from: https://papers.ssrn.com/abstract=2679133.
32. Yii J, Mahmud A, Abd Samat AH, Sabardin DM, Mohd Isa MH, Mohd Saiboon I, et al. A qualitative study on emergency healthcare worker (EHCW) perception towards COVID-ACLS simulation training in resuscitating suspected COVID-19 patients [Internet] *JSM* 2021 Sep 30;**50**(9):2847–58 [cited 2021 Nov 12] Available from: http://www.ukm.my/jsm/pdf_files/SM-PDF-50-9-2021/27.pdf.