**Supplementary-Table 1.** **Qualitative Methods.**

For each Criteria [Yes-Y(2); Somewhat/partially- S(1); No-N(0); Can’t tell/not addressed-C(0)]

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Authors/methods** | **Screen** | **Screen** | **Type specific items** | | | | | **Comments**  **More than 10/14 (70%) were included** | |
| **T1.S1** | **T1.S2** | **T1.1** | **T1.2** | **T1.3** | **T1.4** | **T1.5** |  |
| 1. [1] | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **S** | **13/14** |
| 1. [2] | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **S** | **13/14** |
| 1. [3] | **Y** | **Y** | **Y** | **N** | **Y** | **Y** | **S** | **11/14** |
| 1. [4] | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **14/14** |
| 1. [5] | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **14/14** |
| 1. [6] | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **14/14** |
| 1. [7] | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **14/14** |
| 1. [8] | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **14/14** |
| 1. [9] | **Y** | **S** | **Y** | **S** | **S** | **Y** | **S** | **11/14** |
| 1. [10] | **Y** | **Y** | **Y** | **Y** | **Y** | **S** | **S** | **12/14** |
| 1. [11] | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **14/14** |
| 1. [12] | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **14/14** |
| 1. [13] | **Y** | **Y** | **Y** | **Y** | **S** | **S** | **S** | **11/14** |
| 1. [14] | **Y** | **Y** | **Y** | **Y** | **S** | **S** | **S** | **11/14** |
| 1. [15] | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **14/14** |
| 1. [16] | **Y** | **Y** | **Y** | **S** | **Y** | **S** | **S** | **11/14** |
| 1. [17] | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **14/14** |

***For Qualitative articles******[(Adapted from [18]]:***

T1.S1. Screening Question 1: Are there clear research questions/aim/objective?

T1.S2. Screening Question 2: Do the collected data allow to address the research questions?

T1.1. Is the qualitative approach appropriate to answer the research question?

T1.2. Are the qualitative data collection methods adequate to address the research question?

T1.3. Are the findings adequately derived from the data?

T1.4. Is the interpretation of results sufficiently substantiated by data?

T1.5. Is there coherence between qualitative data sources, collection, analysis and interpretation?

**Supplementary-Table 2. Quantitative Methods.**

For each Criteria [Yes-Y(2); Somewhat/partially- S(1); No-N(0); Can’t tell/not addressed-C(0)]

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Authors/methods** | **Screen** | **Screen** | **Screen** | **Type specific items** | | | | | **Comments**  **More than 11/16 (70%) were included** |
| **T2.S1** | **T2.S2** | **T2.S3** | **T2.1** | **T2.2** | **T2.3** | **T2.4** | **T2.5** |  |
| 1. Balay-odao 2021 | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **S** | **15/16** |
| 1. [19] | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | N | **Y** | **14/16** |
| 1. [20] | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **S** | **15/16** |
| 1. [21] | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** | Y | **16/16** |

***Quantitative methods articles[(Adapted from (Hong et al., 2018)]:***

For Quantitative descriptive articles:

T2.S1.Screening Question 1: Are there clear research questions/aim/objective?

T2.S2.Screening Question 2: Do the collected data allow to address the research questions?

T2.S3.Screening Question 3: Is it a statistical -mathematical

T2.1. Is the sampling strategy relevant to address the research question?

T2.2. Is the sample representative of the target population?

T2.3. Are the measurements appropriate?

T2.4. Is the risk of nonresponse bias low?

T2.5. Is the statistical analysis appropriate to answer the research question?

**Supplementary-Table 3. Mixed Methods.**

For each Criteria [Yes-Y(2); Somewhat/partially- S(1); No-N(0); Can’t tell/not addressed-C(0)]

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Authors/methods** | **Screen** | **Screen** | **Type specific items** | | | | | **Comment**  **Included studies should be More than 10=70%** |
| **T3.S1** | **T3.S2** | **T3.1** | **T3.2** | **T3.3** | **T3.4** | **T3.5** |  |
| 1. [22] | **Y** | **Y** | **Y** | Y | Y | N | Y | 12/14 |

***For Mixed Methods articles[(Adapted from (Hong et al., 2018)]:***

T3.S1.Screening Question 1: Are there clear research questions/aim/objective?

T3.S2.Screening Question 2: Do the collected data allow to address the research questions?

T3.1. Is there an adequate rationale for using a mixed methods design to address the research question?

T3.2. Are the different components of the study effectively integrated to answer the research question?

T3.3. Are the outputs of the integration of qualitative and quantitative components adequately interpreted?

T3.4. Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?

T3.5. Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?

**Supplementary-Table 4. Disaster Types and Countries of the 22 Included Articles.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Authors of the study** | | **Country** | **Type of disaster** |
|  | [1] | US | COVID-19 |
|  | [23] | Middle east  (Saudi Arabia) | COVID-19 |
|
|  | [22] | US | COVID-19 |
|
|  | [3] | Italy | COVID-19 |
|  | [16] | UK | COVID-19 |
|  | [20] | China | COVID-19 |
|  | [7] | Sierra Leone | Ebola |
|  | [12] | Sierra Leone | Ebola |
|  | [11] | Bangladesh | Infectious diseases |
|  | [14] | Singapore | Infectious diseases |
|  | [4] | Australia | EWE |
|  | [5] | Australia | EWE |
|  | [6] | Australia | EWE |
|  | [9] | UK | EWE -Flood |
|  | [10] | Canada | EWE- Earthquake |
|  | [15] | US | EWE -HURRICANE SANDY |
|  | [17] | US | EWE -Hurricane Harvey |
|  | [2] | Norway | Terroristic attack |
|  | [24] | Middle east(Beirut) | MCI/Bombing |
|  | [13] | Mumbai/India | MCI/ Terrorist Attacks |
|  | [19] | China | Non -specific disasters |
|  | [21] | China | Non-specific disasters |

**Supplementary-Table 5. Adopted Framework/Standards/Theory/System Components/Policies and Guidelines.**

|  |  |  |
| --- | --- | --- |
| **Adopted framework/standards/ theory/system components/ policies and guidelines** | **Study** | **Authors** |
| -Resilience Framework for Public Health Emergency Preparedness[25] | The powder keg: Lessons learned about clinical staff preparedness during the early phase of the COVID-19 pandemic | [1] |
| -The infection control and Middle East respiratory syndrome coronavirus (MERSCOV)policies and guidelines  -The WHO and CDC policies and guidelines | Hospital Preparedness, Resilience, and Psychological Burden Among Clinical Nurses in Addressing the COVID-19 Crisis in Riyadh, Saudi Arabia | [23] |
| -Hospital Preparedness Assessment Tool,  -The Depression, Anxiety, and Stress Scale−21 (DASS-21),  -The Resilience Scale for Nurses. |
| -Recommendations from the Better and Systematic  -Trauma Care foundation and in cooperation with the regional trauma centre  -PDSA | Local emergency medical response after a terrorist attack in Norway: a qualitative study | [2] |
| -The Plan, Do, Study, Act(PDSA) cycle proposed by the Institute of Health Quality Improvement(IHI)’ | Nurse Leaders' Knowledge and Confidence Managing Disasters in the Acute Care Setting | [22] |
| - The AONL Crisis Management Taskforce Guiding principles  - Federal Emergency Management Agency (FEMA) standards of Care |
| -The Italian Society of Anaesthesiology and Intensive Care  (SIAARTI) for patient’s clinical staging  -Brescia COVID Respiratory Severity Scale (BCRSS)  a staging system created at their hospital in cooperation  with the Italian Society for Infectious and Tropical Diseases  (SIMIT).  -The “four S’s” theory, the main components of surge capacity , are staff, stuff, structures, and systems | Nurse Leaders' Knowledge and Confidence Managing Disasters in the Acute Care Setting | [3] |
| -Gunderson and Holling’s Adaptive Cycle | A socio-ecological analysis of hospital resilience to extreme weather events | [4] |
| -Nonaka and Takeuchi's model of organizational knowledge creation | Hospital learning from extreme weather events: using causal loop diagrams | [6] |
| -The WHO’s six building blocks of health  systems and a resilience framework [26] | "For this one, let me take the risk": why surgical staff continued to perform caesarean sections during the 2014-2016 Ebola epidemic in Sierra Leone | [7] |
| -The Joint Commission International Accreditation standards.  PDSA | Developing a hospital disaster preparedness plan for mass casualty incidents: lessons learned from the downtown Beirut bombing | [24] |
| -The MCEER framework for measuring resilience | Fostering resilience to extreme events within infrastructure systems: Characterizing decision contexts for mitigation and adaptation | [10] |
| -Existing frameworks or checklists that measured these capacities and capabilities, and whether they overlapped with those identified in the WHO JEE tool.( WHO Joint External Evaluation (JEE))[27] | A checklist to improve health system resilience to infectious disease outbreaks and natural hazards | [11] |
| -Public Health England (PHE) recommendations | Emergency medicine response to the COVID-19 pandemic in England: a phenomenological study | [16] |
| -The conservation of resources (COR) theory  . | When there is a will there is a way: The role of proactive personality in combating COVID-19 | [20] |
| -The strategic technique of strengths, weaknesses, opportunities, and threats (SWOT) analysis. | Hurricane Harvey One Hospital's Journey Toward Organizational Resilience | [17] |
| -Framework of evaluating hospital disaster resilience. | Disaster resilience in tertiary hospitals: a cross-sectional survey in Shandong Province, China | [21] |

**Supplementary Table 6. The Most Significant Recommendations and Lessons Learnt from Hospitals’ Battle with Disasters**.

|  |  |
| --- | --- |
| Focus of hospitals’ learning | Recommendations and lessons Learnt from disasters |
| Governance and leadership  (LA-1) | * Policymakers and leaders can create solutions for crisis management grounded by data collection knowledge and confidence. In addition, they should motivate others by setting the example, ensure the adequacy of materials, personal equipment, vaccines, and financial resources to support the staff and protect them from physical and psychological hazards [2, 7, 14]. * “Evidence-based, robust approaches to public health emergency preparedness with a focus on supporting the frontline clinical staff, can promote effective responses to both the current COVID-19 pandemic and future public health emergencies”[1]. * Policymakers should ensure the interpretation of the assessment of local healthcare performance against the framework of the broader health system disasters and preceding standards [7]. |
| Planning and risk assessment **(LA-2)** | * Developing a comprehensive disaster preparedness plan should include consistent and appropriate operational plans and prioritise capacity-building[1, 19]. In addition, decision-makers should adopt a well-resourced, continuous, integrated and collaborative approach to disaster planning[4]. * Continuing annual education program as hospital preparedness is recommended to update the knowledge and steadily review plans (Balay-odao et al., 2021; Cariaso-Sugay, Hultgren, Browder, & Chen, 2021). A multi-professional, scenario-based educational approach is mandatory (Brandrud et al., 2017; Gao et al., 2018). Proactive orientation in frontline health professionals is advised to support dealing with uncertainty (Yi-Feng Chen et al., 2021). * Effective disaster preparedness plans should establish networks of communication and include continuous training and learning to enhance coping mechanisms building into routine systems and anticipate devastations instead of late response to the crises/disasters [2, 7, 12, 19]. Planners must include new and shared lessons learnt into potential and future hospital disaster planning processes [5, 6]. In addition, planning should embrace daily hospital activities and disaster preparedness monthly meetings [10]. * Moreover, transparent reserve supplies’ record on a centralized system is critical for organised planning[14] |
| Surveillance and monitoring  (LA-3) | * The establishment of obvious and honest feedback mechanisms, clinical, epidemiological data are recommended. Furthermore, hospital management should have lessons sharing approaches and a straightforward programme for trust restoration with the community [6, 12, 14] |
| Communication and network engagement **(LA-4)** | * Planning, conducting and monitoring effective communication, information management and networking are significant areas that should be the hospital decision-makers’ focus of interest [1, 4, 6, 12, 14, 19, 24]. * Establishment of communications networks and improved systems and technologies to manage information to improve their capacity during the crisis[4, 19] * The communication enhancement helps supervision, peer support, training, educating, informing, motivating the staff towards protective performance and workforce trust [1, 12]. * Timely and transparent news and satisfactory upward and downward communication channels with the essential staff, flatter and broader structure could be better adopted and applied and broadcast organisations should be ensured [14, 24]. It is crucial to enhance the integration between clinical staff readiness and hospital response actions [1]. |
| Staff practices and safety  (LA-5) | * Staff voices, fears and needs should be considered, including securing their vulnerable life [7, 13]. * Additional staff hiring and training and also distributing trained staff in the same hospital department has to be adopted rather than relying on volunteers [14] * Health professionals’ responsive Health Systems should define their roles and responsibilities [12, 24]. Staff become less loaded because they utilize the knowledge and work flexibly and responsibly [14]. * Staff training guarantees rapid hospitals’ recovery from extreme events [10]. Specific training is necessary including proper infection control practices, quarantine processes and how to treat, isolate, report and track patients using electronic systems [1, 11, 14]. * Leadership training for hospital management and the development of emergency management operations plans are crucial [7, 22] * Continuing annual education program as hospital preparedness is recommended to update the knowledge and steadily review plans [22, 23]. * A multi-professional, scenario-based educational approach is mandatory [2, 19]. * Proactive orientation in frontline health professionals is advised to support dealing with the uncertainty [20]. |
| Equipment and resources  (LA-6) | * An autonomous store for PPE’s and drugs for at least three days should be available in hospitals to have enough time to reorder in any sudden surge [14]. During the disaster, available supplies from other sources and effectively running transportation system were critical to proper hospital performance [10] |
| (Facilities and infrastructure) (LA-7) | * Concrete hospital resilience could be approached by considering the specific infrastructure facility/s and incorporating hospital infrastructure resilience into the disaster planning and preparedness of the health service[5, 10]. |
| Novelty andinnovation  (LA-8) | * Innovation should be part of the orientation, training and education in novel visualisation, simulation, and monitoring technologies as effective means and promising learning approaches for disaster management and planning [5]. These innovative tools could help develop emerging pattern outbreaks detection and systems response [14]. * Exploring new visualisation and simulation technologies and investing in automated devices are potent tools for disaster management planning and improved patients monitoring, respectively [5, 14] |

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