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Informing and harmonising preparedness and response to biological hazard: the case study of COVID-19 pandemic

Tutor:
Prof. Fausto Marincioni

PhD Candidate:
Noemi Marchetti

Co-Tutor:
Dott. Mario Caroli

Abstract

The 30 January 2020 the World Health Organization declared the international outbreak of COVID-19 establishing the beginning of a global pandemic emergency. The new Coronavirus spread is characterised by speed and high capacity of infection. In such a challenging background, every hit Country run for a rapid solution. Italy is one of the Western country most impacted by the COVID-19 pandemic, yet the diffusion patterns of the virus was different in different geographical area of the peninsula. In this Ph.D. project, the main study area was the Marche Region, and the analysis focuses on Hospitals' preparedness and response to the pandemic crisis. A subsequent comparison with the pandemic emergency management approach of New Zealand, one of the country most successful in managing the COVID-19 pandemic, was carried out to highlight similarities and differences in the two Countries.

The research methodology was structured on six steps: (i) selection of macro-areas and indicators for pandemic preparedness; (ii) evaluation the macro-areas and indicators using Multi-Criteria Decision Analysis; (iii) analysis the perception of Italian healthcare workers regarding pandemic emergencies; (iv) analysis the New Zealand pandemic management using PRISMA statement and interviews; (v) comparison the Italian and New Zealand pandemic management; and (vi) validation the selected indicators through the Field Exercise EU MODEX.

Starting from the scrutiny of the fragmented governance of the pandemic emergency, highlighting the misalignment between theoretical and practical emergency response model, this research aims at providing guidelines to enhance resilience of the local health system for future pandemic emergencies.

The research findings underscore the inadequacy of resources within the Italia Health System and the readiness of the population for pandemic events. Moreover, outputs demonstrate the fundamental importance of factors such as culture and ethics in pandemic planning, just as training and prior experiences are crucial. In essence, these factors are inextricably linked to the success of preparedness efforts.

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TABLE OF CONTENTS

1. INTRODUCTION

The 31 December 2019 marks the beginning of the COVID-19 pandemic when the Health Commission of Wuhan in China communicated to the World Health Organization (WHO) the appearance of a new Coronavirus. On 30 January 2020, due to the global spread of the new virus (Chintalapudi et al., 2020), the WHO declared the international outbreak of COVID-19 as a Public Health Emergency of International Concern (PHEIC) (World Health Organization, 2020c). On 11 March 2020, the General Director of WHO declared the impact of the new Coronavirus, named Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), a pandemic (Hoffman & Hancock, 2017). The emergency has prompted a swift and international response to mitigate the impact and curb the transmission of contagion (Santeramo et al., 2021). The crisis has engaged political, scientific, healthcare, economic, and social systems, necessitating a multidisciplinary response capacity (Agnoletti et al., 2020; J. A. Long & Ren, 2022; Rovetta & Castaldo, 2020).

At the global health level, the World Health Organization is the designated Institution to coordinate Countries, provide information, and offer updates or recommendations to limit health risk and promote well-being (World Health Organization, 2020a). Since the initial COVID-19 outbreak in China, the World Health Organization has maintained continuous contacts with the People's Republic of China to receive updates[1]. In the short term, during the alert, pandemic, or response phase, it is crucial to investigate the spread and transmission speed of the virus in the different areas (World Health Organization, 2020d, 2023). Related to this reason, the WHO activated a database to share data and encouraged Member States to update the policy[2]. The understanding of pandemic phases is essential for the implementation of a pandemic plan (World Health Organization, 2018). The coordination among Countries led by the principal global health authority, the World Health Organization is grounded in the International Health Regulations (IHR) of 2005 with subsequent updates adopted in 1969 (Merianos & Peiris, 2005; World Health Organization, 2011). The IHR helps "to prevent, protect against, control and provide a public health response to the international spread of disease in ways that are commensurate with and restricted to public health risks, and which avoid unnecessary interference with international traffic and trade" (Merianos & Peiris, 2005). Another instrument where Countries can find indications for pandemic preparedness and management is the Pandemic Influenza Preparedness Framework (PIP) adopted in 2011 by WHO and constantly updated

[1] World Health Organization, Listings of WHO's response to COVID-19, https://www.who.int/news/item/29-06-2020-COVIDtimeline

[2] World Health Organization, WHO COVID-19 dashboard, Metadata, https://data.who.int/dashboards/COVID19/cases?n=c (last consultation 06.01.2024).

World Health Organization, 2011, 2023). The purpose is "to improve pandemic influenza preparedness and response and strengthen the protection against the pandemic influenza by improving and strengthening the WHO Global Influenza Surveillance and Response System ("WHO GISRS")" (World Health Organization, 2011). Each member Country of the WHO has to update and adapt its pandemic plan based on the guidelines provided by the WHO Pandemic Influenza Plan and International Health Regulations (Merianos & Peiris, 2005; World Health Organization, 2011, 2023). This regulation should aid Countries not only during the pandemic emergency but also during the interpandemic phase in implementing their preparedness to pandemic events (World Health Organization, 2018). The World Health Organization published numerous updates throughout the pandemic, including another crucial document being the Risk Communication and Community Engagement (RCCE). This strategy is fundamental for ensuring community acceptance and adherence to essential public health and biomedical interventions aimed at preventing and controlling the spread of the virus (World Health Organization, 2020d). The strategy suggests to all member Countries some principal guidelines in the management of pandemic (World Health Organization, 2020d):

1. "Establishing a strong and cohesive RCCE partner coordination at global, regional, and Country levels for a more effective response.
2. Communicating science-based information and recommendations in a timely manner that address critical risks and counter misinformation.
3. Accelerating priority research and innovation in social sciences to support the implementation of public health measures and to ensure participation of at-risk and affected communities to ensure effectiveness and efficiency of the response and accountability towards people.
4. Enhancing Country-level capacity to roll out effective and coordinated RCCE approaches through identification of capacity needs, provision of simplified tools and resources, distance-based training and guidance and rapid deployment of RCCE expertise."

A scientific team called Scientific Division was established in 2019, emphasising the best scientific evidence related to COVID-19 and its treatment[3,4]. The WHO managed the COVID-19 pandemic by coordinating with all Countries, publishing reports, and convening teleconferences with the global network of diagnostics and laboratories experts[5]. The aim was to inform all communities about new

[3] World Health Organization, Timeline: WHO's COVID-19 response, https://www.who.int/emergencies/diseases/novel-coronavirus-2019/interactive-timeline#! (last consultation 02.01.2024).
[4] World Health Organization, Science Division - Harnessing the power of science to achieve health for all, https://www.who.int/our-work/science-division (last consultation 02.01.2024).
[5] World Health Organization, Archived: WHO Timeline - COVID-19, https://www.who.int/news/item/27-04-2020-who-timeline---COVID-19 (last consultation 06.01.2024).

discoveries related to the novel Coronavirus, its spreads, and transmission characteristics[5]. The WHO convened an IHR Emergency Committee (EC) composed of 15 independent experts from around the world[5,6] which has the consulting role and support of the Director-General (World Health Organization, 2020c). The multidisciplinary experts adopted a multidisciplinary approach in the management of the pandemic (World Health Organization, 2020c). The table below describes the varied impact of differently by COVID-19 on different continents and Countries and the corresponding response by the WHO:

Table 1: *World Health Organization response to COVID-19 in different global areas.*

Region	*Coordination, planning, and monitoring*	*Risk communication and community engagement*
European	Activation of the Incident Management Support Team (IMST), which supported Country needs, and organised response pillars, with public health and health systems.	Understanding public's trust levels, their risk perceptions, and the barriers they may face in adhering to the recommendations is crucial for the effectiveness and success of pandemic response measures. European WHO implemented innovative solutions for risk communication and community engagement (RCCE) to support Countries.
Americas	Activation of regional and Country incident management system teams providing direct emergency planning and response support to Ministries of Health and national authorities for surveillance, laboratory capacity, support health care services, infection prevention control, clinical management, and risk communication. 32 of 35 Countries drew a COVID-19 preparedness and response plans.	The need for clear, consistent, and authoritative information were the base for detailed risk communication guidelines for leaders, journalists, and a planning template for risk communication and community engagement. At regional level, the information was shared through social media too.
Mediterranean	Multidisciplinary technical teams from WHO, Global Outbreak Alert and Response Network (GOARN) partners and other experts supported	At the regional level, establishment of an Interagency Risk Communication and Community Engagement: a working group providing strategic

[6] World Health Organization, COVID-19 IHR Emergency Committee, https://www.who.int/groups/COVID-19-ihr-emergency-committee

	and assessed ongoing COVID-19 readiness and response efforts.	guidance to Countries. A map of national risk communication plans was implemented.
African	Development of a joint regional partners' preparedness and response plan adaptable to all Countries in the WHO African region. A coordination mechanism has been set up. At regional level, WHO weekly coordinated with Emergency Medical Teams and the African Partner Outbreak Alliance (APORA) and the deans of African university medical faculties. National Action Plans using the operational planning have been finalised, disseminated, and tailored to the Member State.	Information about risk and measures of safety for the community broadcasted through the region craft radio messaging and TV spots. Setting up of call centres to ensure the public is informed. The Regional Office used social media, with simple, clear messages on how individuals can protect themselves and others from COVID-19.
Western pacific	Establishment of a joint Incident Management Team (IMT) to support COVID-19 preparedness and response efforts in the Pacific. The IMT has developed and implemented a Pacific Action Plan for COVID-19 preparedness and response. Pacific adopted containment and mitigation strategies and a multi-sectoral and all-of-society approach.	Development of the Regional Risk Communication Strategy. Implementation of an Interagency Asia-Pacific Risk Communication and Community Engagement Working Group appointed to develop guidelines specific to vulnerable populations.
South-east Asia	Setting up of the Regional Incident Management Support Team (IMST) to implement all critical action provided by the Emergency Response Framework and coordinate Countries. The Regional Office provided technical guidance and support to the WHO Country offices testing the response capacities and identifying the gaps.	Adaptation of risk communications messages and products on the current needs of the population. Development of a regional risk communications plan. The Facebook page of the Ministry of Health's Centre for Communication and Education for Health (CCEH) was updated to involve the population.

Source: elaboration from "WHO COVID-19 preparedness and response progress report" (World Health Organization, 2020a).

The "WHO COVID-19 preparedness and response progress report", summarised in table 1.1, illustrates the first action adopted at global level to face the COVID-19 pandemic. Considering the health risk, the principal indications about the response to the pandemic came from the World Health Organization (World Health Organization, 2020b). The impact of the COVID-19 pandemic extended beyond the health sector, affecting also economic, political, and social dimensions as well (J. A. Long & Ren, 2022; Sundararaman et al., 2021). As previously mentioned, these sectors are interconnected and depend on ethical and cultural characteristics and population density (Barrios & Hochberg, 2021; J. A. Long & Ren, 2022). Considering changes in mobility, border closure, or the shutdown of non-essential activities implemented at political level, the economic impact involves restriction in the global market and circulations of goods (Moosavi & Hosseini, 2021; Summers et al., 2020). Consequently, the social sphere could be impacted by social discrimination in the accessibility of goods or healthcare, as well as by physical distancing measures (World Economic Forum, 2024). The most effective Countries in managing the COVID-19 pandemic include New Zealand, South Korea, Japan, and Singapore (Beattie & Priestley, 2021; Blair et al., 2022; Wu, 2023). These nations promptly implemented measures as border closures, mandatory mask wearing, and restriction, successfully limiting the rise of COVID-19 cases in the community (Wu, 2023).

In April 2023, the WHO launched the new Preparedness and Resilience for Emerging Threats Initiative (PRET), a tool designed to assist Countries in better preparing for future pandemics[7]. It provides guidance on integrated planning for responding to any respiratory pathogen[8]. The aim of PRET is to share knowledge and particularly to update pandemic plans with a coordinated response among Countries limiting impact of future pandemic emergencies.

On 24 January 2020, the first case of coronavirus disease was registered in Europe, specifically in France (European Centre for Disease Prevention and Control, 2023; Spiteri et al., 2020). On 27 January 2020, the European Centre for Disease Prevention and Control (ECDC) and the WHO Regional Office for Europe requested that Countries complete a WHO standard COVID-19 case report form for all confirmed and probable cases in accordance with WHO criteria (Spiteri et al., 2020). On 28 January 2020, a cluster with indirect links to Wuhan, was reported from Germany[9]. Concurrently, the European Union activated the Integrated Political Crisis Response mechanism

[7] European Centre for Disease Prevention and Control, Risk assessment: Outbreak of acute respiratory syndrome associated with a novel coronavirus, China: first local transmission in the EU/EEA − third update, https://www.ecdc.europa.eu/en/publications-data/risk-assessment-outbreak-acute-respiratory-syndrome-associated-novel-1

[8] World Health Organization, Preparedness and Resilience for Emerging Threats Initiative (PRET), https://www.who.int/initiatives/preparedness-and-resilience-for-emerging-threats

[9] European Centre for Disease Prevention and Control, Risk assessment: Outbreak of acute respiratory syndrome associated with a novel coronavirus, China: first local transmission in the EU/EEA − third update https://www.ecdc.europa.eu/en/publications-data/risk-assessment-outbreak-acute-respiratory-syndrome-associated-novel-1.

(IPCR) to address the COVID-19 outbreak. This EU framework facilitates the coordination of cross-sectoral crises at the highest political level[10]. The main priorities for the emergency response to COVID-19 recommended by European Union leaders were[11]:

- "Limiting the spread of the virus;
- ensuring the provision of medical equipment;
- promoting research for treatments and vaccines;
- supporting jobs, businesses and the economy."

On 17 March 2020, the European Council suggested recommendations on the temporary restriction on non-essential travel into the European Union and the possible lifting of such restriction[12]. Supporting EU citizens, businesses, and Countries in recovering from the economic downturn caused by the COVID-19 pandemic, EU leaders implemented a recovery plan for Europe, aiming to mitigate the effects of the crisis[13]. The package of € 2.018 billion should boost EU's member states to rebuild after the COVID-19 pandemic and support investment in the green and digital transitions[14]. The European Council Member implemented the "Joint European Roadmap towards lifting COVID-19 containment measures" to promote a coordinated EU approach for gradually easing containment measures, including scientific advice, coordination, and solidarity (European Union, 2020). On 21 December 2020, the Europe Commission approved and partially financed the vaccines starting from BioNTech and Pfizer i) to ensure quality, safety, and efficacy of vaccines, ii) to secure timely access to vaccines for Member States and their population while leading the global solidarity effort, iii) to ensure equitable and affordable access[15]. By November 2021, approximately 70% of the total European population will get anti-COVID-19 vaccine[16]. The European Commission prioritised the healthcare sector and the economies of small and medium business, swiftly allocating funds to secure essential personal protective equipment, ventilators, and ambulances. Additionally, they promote new

[10] European Centre for Disease Prevention and Control, Risk assessment: Outbreak of acute respiratory syndrome associated with a novel coronavirus, China: first local transmission in the EU/EEA − third update, European Council Council of the European Union, The EU's response to the COVID-19 pandemic, https://www.consilium.europa.eu/en/policies/coronavirus/#emergency

[11] European Council, COUNCIL RECOMMENDATION (EU) 2020/912 of 30 June 2020 on the temporary restriction on non-essential travel into the EU and the possible lifting of such restriction, https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX%3A32020H0912

[12] European Council, COUNCIL RECOMMENDATION (EU) 2020/912 of 30 June 2020 on the temporary restriction on non-essential travel into the EU and the possible lifting of such restriction, https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX%3A32020H0912

[13] European Council Council of the European Union, A recovery plan for Europe, https://www.consilium.europa.eu/en/policies/eu-recovery-plan/

[14] European Council Council of the European Union, A recovery plan for Europe, https://www.consilium.europa.eu/en/policies/eu-recovery-plan/

[15] European Commission, Securing access to vaccines, https://commission.europa.eu/strategy-and-policy/coronavirus-response/public-health/eu-vaccines-strategy_en

[16] European Commission, The regional impact of COVID-19, 2. The first wave affected the southern EU most, while the next waves affected the eastern EU more, https://cohesiondata.ec.europa.eu/stories/s/The-regional-impact-of-COVID-19/24gj-n8r2/#:~:text=Between%20March%202020%20and%20July,the%20pandemic%20was%2013%25%20higher.

projects to assist medical institutions, business owners, employees, and vulnerable people. The European Regulation on the EU Digital COVID Certificate, which includes information about vaccine doses, came into effect in every European Country, commonly referred to as the "Green Pass"[17]. It is a digital and printable (paper) certification, which contains a two-dimensional barcode (QR Code) and a qualified electronic seal. The Certification attests one of the following conditions[18]:

- having received the anti-COVID-19 vaccination;
- being negative in the rapid antigen test in the last 48 hours or in the molecular test in the last 72 hours;
- having recovered from COVID-19 for no more than six months.

The Green Pass was fundamental for travel both within European Countries and abroad. It served as a means to resume regular mobility and travels, but more importantly, as a global control measure of containment.

In Italy, the overall management of hazards falls under the purview of the National Department of Civil Protection, working in collaboration with regional governments and local authorities. Their responsibilities include promoting and coordinating activities related to risk prevention and management, rescuing affected populations, and addressing overcoming emergencies while mitigating risks18F19.

The geographical and demographic characteristics of Italy could be among the contributing factors to the spread of COVID-19 (Consolandi, 2021; Murgante et al., 2020). It was one of the first Countries severely affected by the COVID-19 pandemic Chen et al., 2021; Chintalapudi et al., 2020). The first COVID-19 positive cases were identified in two Chinese tourists in Rome on 30 January 2020. The first local case of COVID-19, not linked to travel from China, was a young boy residing in Codogno, a small city in the Lombardy Region (Gatto et al., 2020; Rezza et al., 2020; Sanfelici, 2020). Lombardy quickly emerged as the epicentre of a pandemic cluster, leading to the declaration of the first lockdown in Europe for the Codogno area on 7th March 2020 (Kamps & Hoffmann, 2021; Rezza et al., 2020). The virus spread with inconsistent impact over the national territory during the different waves of contagion (Casti & Riggio, 2022; Rivieccio et al., 2020). Three different waves of COVID-

[17] Green certification of COVID-19, What is it, https://www.dgc.gov.it/web/checose.html#:~:text=Il%20Regolamento%20europeo%20sulla%20Certificazione,fino%20al%2030%20giugno%202023.
[18] COVID Reference, https://COVIDreference.com/timeline_it
[19] National Department of Civil Protection, Activities, https://www.protezionecivile.gov.it/it/dipartimento/attivita/

19 pandemic have been identified (Bartolucci & Farcomeni, 2022; Bonetti & Melani, 2022; Casti & Consolandi, 2021; Jurgensen et al., 2021; Marmo et al., 2022):

- the first: from February to May 2020;
- the second and the third: from the second half of September 2020 to June 2021 are not well defined;
- the fourth: from August 2021 to March 2022 (which corresponds to the end of the state of emergency) (Gazzetta Ufficiale della Repubblica Italiana, 2022).

The northern regions experienced a more significant impact compared to the southern regions (Gioia et al., 2022; Santeramo et al., 2021).

The National Health System is public, and it was established in 1978 with the Law n. 833 (Gazzetta Ufficiale della Repubblica Italiana, 1978). The three fundamental principles are i) universality, ii) equality, iii) globality and the level of competency are three as described in the figure below:

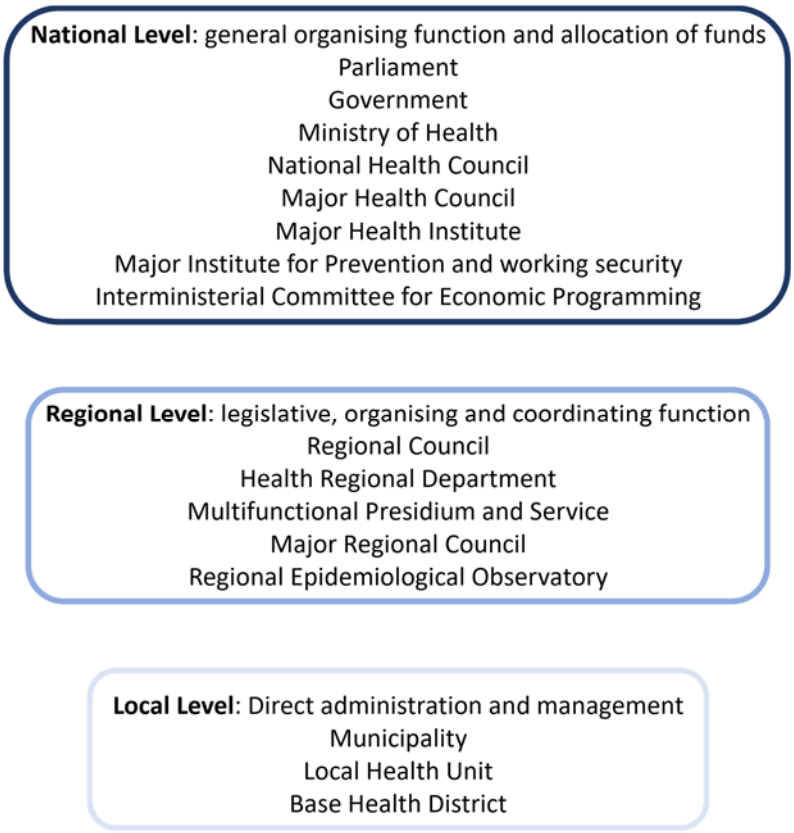


Figure 1.1: *Italian Health System level of competency*

Source: elaboration of the author from the Law of 23 December 1978 n. 883 (Gazzetta Ufficiale della Repubblica Italiana, 1978)

The national and the regional principal role are administrative; at local level, the structure is divided into Local Health Companies (including the Prevention Department, the Social-Health Districts, and the Aid Hospitals) and Health Hospital Companies (providing specialist services, hospitalisations, and rehabilitation treatments) as described in the Law of 1978 and subsequent updates.

The Health System Resilience is the capacity to prevent, prepare for, detect, adapt to, respond to, and recover from public health threats while ensuring the maintenance of quality essential and routine health services in all contexts, including in fragile, conflict and violence settings19F20. Italian Health System Resilient is not very high within the structure composition, number of healthcare workers, and population health literacy (Cicchetti et al., 2021; EU Expert Group on Health System Performance Assessment, 2020; Jovanović et al., 2020; Merianos & Peiris, 2005).

At the time of the COVID-19 outbreak in Italy, the national pandemic emergency plan dated back to 2006 (Ministero della Salute, 2006). Measures and restrictions adopted to contain the spread of COVID-19 were unprecedented, deeply affecting the social, economic, and political spheres (Lazzerini & Putoto, 2020). Immediately after the announcement of the COVID-19 outbreak in China, the Italian Government took steps to implement an Ordinance by the Ministry of Health

[20] World Health Organization, Health Systems Resilience, https://www.who.int/teams/primary-health-care/health-systems-resilience.

providing operational guidelines for monitoring the health status of passengers on flights originating from China through the ministerial order (Circolare del Ministero della Salute Oggetto: Epidemia Cinese da Coronavirus NCoV: Misure Urgenti a Tutela della Salute Pubblica. Divieto di Atterraggio di tutti i voli provenienti dalla Cina negli aeroporti di Ciampino, Roma Urbe, Perugia Ancona, 2020). These directives were further reinforced with the ministerial order of urgent measures to protect public health, imposing a ban on the landing of all flights arriving from China at the airports of Ciampino, Rome Urbe, Perugia and Ancona and the declaration of the state of emergency (Circolare del Ministero della Salute Oggetto: Epidemia Cinese da Coronavirus NCoV: Misure Urgenti a Tutela della Salute Pubblica. Divieto di Atterraggio di tutti i voli provenienti dalla Cina negli aeroporti di Ciampino, Roma Urbe, Perugia Ancona, 2020). The Government organised a weekly online meeting (called National Operational Committee) handled by the National Civil Protection with the aim to be constantly updated about the transmission situation, needs and requests of participating responsible for regional health and civil protection[21]. The principal lack highlighted shared by the majority of Italian Regions were about i) healthcare personnel; ii) health specialised instruments; iii) adequacy of health structures[22]. After 152 positive cases and 3 deaths near the end of February 2020, especially in the Lombardy and Veneto Regions, the first days of March 2020 the Government i) issued guidelines for the care of critically ill patient affected by COVID-19; ii) promoted the establishment of additional hospital beds; iii) added limitations to sport and events activities; and iv) described the principal hygienic and sanitary measures (CIRCOLARE Del Ministero della Salute incremento disponibilità posti letto del Servizio Sanitario Nazionale e ulteriori indicazioni relative alla gestione dell'emergenza COVID-19, 2020; DECRETO DEL PRESIDENTE DEL CONSIGLIO DEI MINISTRI Disposizioni attuative del Decreto-Legge 23 Febbraio 2020, n. 6, Recante Misure Urgenti in materia di contenimento e gestione dell'emergenza epidemiologica da COVID-19. (20A01381), 2020). On the 4th of March 2020, the Government extended the provisions of the previous decree, which included restrictions on events and the suspension of educational services of all levels (Decreto del Presidente del Consiglio dei Ministri 04 Marzo 2020 Ulteriori disposizioni attuative del Decreto-Legge 23 Febbraio 2020, n. 6, Recante misure urgenti in materia di contenimento e gestione dell'emergenza epidemiologica da COVID-19, applicabili aull'intero territorio nazionale. (20A01475), 2020). On 9th March 2020, Italy is totally under lockdown until 3rd of May 2020: with the closure of non-essential activities, suspension of educational services, ban of movements among

[21] Department of Civil Protecion, - Dipartimento della Protezione Civile Presidenza del Consiglio dei Ministri, National Operational Committee - Comitato Operativo, https://servizio-nazionale.protezionecivile.gov.it/it/comitato-operativo/

[22] Parlamento Italiano, Camera dei Deputati, Misure per il rafforzamento del personale sanitario nell'emergenza coronavirus, https://temi.camera.it/leg18/temi/misure-per-il-rafforzamento-del-personale-sanitario-nell-emergenza-coronavirus.html

borders (Decreto del Presidente del Consiglio dei Ministri 09 Marzo 2020 Ulteriori disposizioni attuative del Decreto-Legge 23 Febbraio 2020, n. 6, Recante misure urgenti in materia di contenimento e gestione dell'emergenza epidemiologica da COVID-19, applicabili sull'intero territorio nazionale. (20A01558), 2020). From May to mid-June 2020, the Italian Government has relaxed containment measures, starting the "phase two" of the pandemic management. Physical distancing, the use of facial masks, the adoption of smart-working and movements inside the regional territories are allowed (DECRETO DEL PRESIDENTE DEL CONSIGLIO DEI MINISTRI 26 Aprile 2020. Ulteriori disposizioni attuative del Decreto-Legge 23 Febbraio 2020, n. 6, Recante misure urgenti in materia di contenimento e gestione dell'emergenza epidemiologica da COVID-19, applicabili sull'intero territorio nazionale. (20A02352), 2020). From the second half of June to October 2020, education institutes partially reopened as some non-essential activities, but the limitation defined the various waves of COVID-19, as outlined in the Ministerial Decree of August 2020 which was subsequently extended or partially modified several times (Decreto del Presidente del Consiglio dei Ministri 07 Agosto 2020 Ulteriori disposizioni attuative del Decreto-Legge 25 Marzo 2020, n. 19, Recante misure urgenti per fronteggiare l'emergenza epidemiologica da COVID-19, e del Decreto-Legge 16 Maggio 2020, n. 33, Recante ulteriori misure urgenti per fronteggiare l'emergenza epidemiologica da COVID-19. (20A04399), 2020). The year 2021 was marked by a colour-code system that delineated the level of restrictions for each region. This classification was contingent on the decree of COVID-19 contagion and transmission within regions, with categories ranging from white (indicating no contagion), to yellow (denoting a low level of contagion and restrictions), orange (reflecting medium level of contagion and restrictions), red (signifying high level of contagion and restrictions)[23] (DECRETO-LEGGE 12 Febbraio 2021, n. 12. Ulteriori disposizioni urgenti in materia di contenimento dell'emergenza epidemiologica da COVID-19. (21G00016), 2020). One of the pivotal milestones in the phases of COVID-19 was the start of vaccination on 27th December 2020: the "Vaccine Day"[24]. The initial recipients were healthcare workers, followed by individuals employed in educational institutions at all levels, the elderly and immunocompromised individuals, and subsequently the wider population (Vaccinazione Anti-SARS-CoV-2/COVID-19 Piano Strategico elementi di preparazione e di implementazione della Strategia Vaccinale - Aggiornamento del 12 Dicembre 2020, 2021). The 31st of March 2022, after almost three years of pandemic, the Government declared the end of the state of emergency (Decreto Legge n. 24 Del 24 Marzo 2022 - Disposizioni urgenti per il superamento delle misure di contrasto alla diffusione

[23] GIMBE Evidence for Health, Region colour criteria, https://coronavirus.gimbe.org/normativa-vigente-COVID19/criteri-colori-regioni.it-IT.html
[24] Health Ministry, COVID-19, Vaccine Day il 27 dicembre in tutta Italia e in Europa, https://www.salute.gov.it/portale/nuovocoronavirus/dettaglioNotizieNuovoCoronavirus.jsp?id=5242

dell'epidemia da COVID-19, in conseguenza della cessazione dello Stato di Emergenza, 2022). Furthermore, between 2020 and 2021, a new pandemic emergency plan was implemented (Piano Strategico-Operativo Nazionale di Preparazione e Risposta a una Pandemia Influenzale (PanFlu) 2021-2023, 2021) as a national plan for prevention (Piano Nazionale della Prevenzione 2020-2025, 2020).

Focussing on the central Italy, specifically on the Marche Region and its healthcare sector, it is possible to observe that the Region exercises a unitary management across the regional territory and, in particular, the functions of planning, programming, direction, coordination, monitoring and control, verification and evaluation, as well as the other functions delegated to it by state legislation[25]. The Municipalities contribute to regional socio-health planning. The five Local Health Companies (Azienda Sanitaria Territoriale - AST) before Regional Unit Health Companies (Azienda Sanitaria Unica Regionale - ASUR) or Vast Area (Area Vasta - AV) have the role of protagonists of governance in their respective areas which approximately correspond to provincial areas[26] (figure 1.2). These companies are guarantors of the services provided and managers of the structures and organisations designated for health purpose, according to an organisational and operational combination, integrated at a socio-health level, composed of departmental areas both at territorial and hospital, made up of Complex and Simple Structures. The provision of services takes place in compliance with some fundamental principles in accordance with the Directive of the President of the Council of Ministers of 27 January 1994:

- Equality and impartiality;
- Continuity;
- Right to choice;
- Essential and uniform levels of assistance;
- Clarity and courtesy[59].

[25] Marche Region, Marche Regional Council, Regional Law 8 August 2022, n. 19, https://www.consiglio.marche.it/banche_dati_e_documentazione/leggi/dettaglio.php?idl=2261
[26] AST, guide to services Local Health Company, Health company, https://serviziweb.asur.marche.it/GASASUR/gas.php

Figure 1.2: *Vast Area or Area Vasta and correlated territorial administrations in the Marche Region*
Source: Local Health Companies – Marche Region, https://www.asur.marche.it/

In reference to the organisation of the social sector, there are the 13 Marche Health Districts related to the 23 Social Territorial Areas (ATS) (Marche et al., 2018). The District is a structure of the Local Health Authority aimed at achieving a high level of integration in the territory between the various services that provide health services and between these and the social-welfare services, in order to allow a coordinated and continuous response to the health needs of the population (figure 1.3).

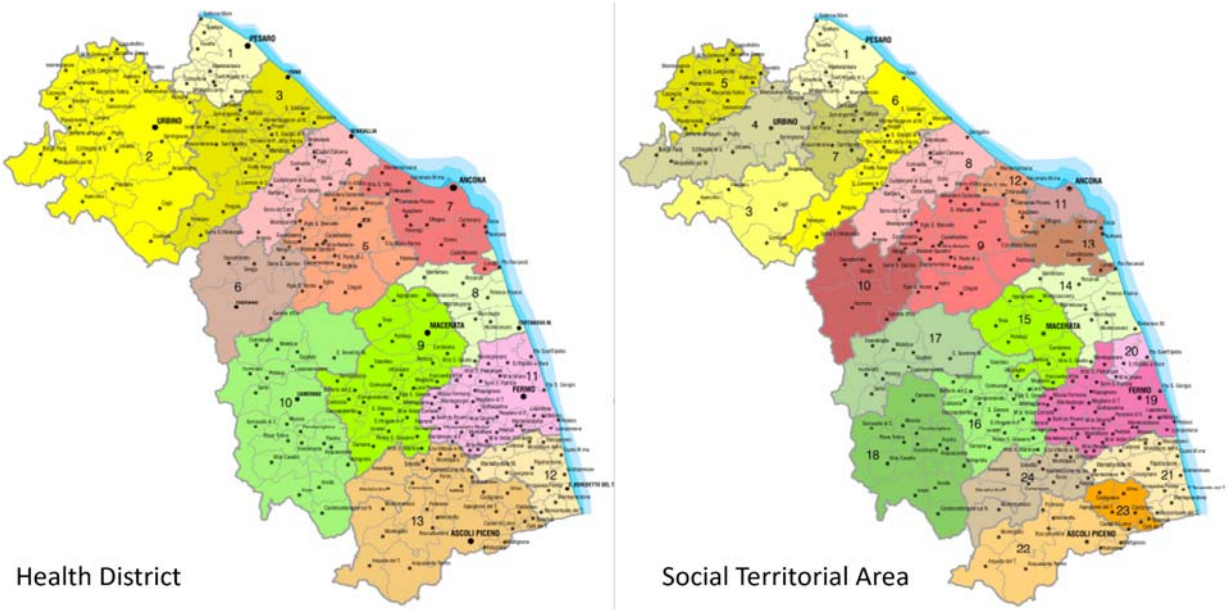


Figure 1.3: *Health Districts and Social Territorial Areas with correlated territorial administrations in the Marche Region*
Source: elaboration from Marche Region, https://www.regione.marche.it

The Marche Region was one of the first Italian regions impacted by the COVID-19 pandemic beginning from the province of Pesaro and Urbino in February 2020 (Gioia et al., 2022; Rivieccio et al., 2020). This province was among the initial 26 Italian northern provinces designated as "red zone", with restriction on internal and external movements (DPCM 8 MARZO 2020 Presidenza del Consiglio dei Ministri, Ulteriori disposizioni attuative del Decreto-Legge 23 Febbraio 2020, n. 6, in: Recante misure urgenti in materia di contenimento e gestione dell'emergenza epidemiologica da COVID-19, 2020). The transmission of SARS-CoV-2 virus subsequently extended to the province of Ancona and later to the other three southern provinces of Macerata, Fermo and Ascoli Piceno26F27. The entry of the virus into the Marche Region could be attributed to its geographical location, population composition, and economic and travel connections with northern Italian regions as well as with European Countries and China (Casti & Riggio, 2022; Gioia et al., 2022). When the virus entered the region, there was no comprehensive regional pandemic plan; only a Scheme for Local Pandemic Plan was in place (Grilli Gualtiero & Fiacchini Daniel, 2009). This document aimed to facilitate the implementation of a local pandemic plan by the Local Health Companies (Grilli Gualtiero & Fiacchini Daniel, 2009). The Marche Region adhered to national guidelines for managing the COVID-19 pandemic, commencing with the initial Regional Ordinance in February 2020 (Regione Marche Ordinanza n 1 del 25 Febbraio 2020 COVID-19, 2020). This ordinance provided instructions for the suspension, throughout the regional territory, of public events, educational services at all levels, museums, cultural venues, and libraries. Additionally, it outlined the suspension of public competitions (excluding health professions) and the activation of GORES (Regional Operational Group for Health Protection) functions (Regione Marche Ordinanza n 1 del 25 Febbraio 2020 COVID-19, 2020). This is a structure established in October 2011 to address issues related to organising responses to major emergencies, dealing with various types of risk. It is made up of 17 people, with different specialisations and precisely: measures to deal with the biological, nuclear, and radiological threat and the PEIMAF project (Intra-hospital emergency plans for maximum influx of injured), capable of dealing with exceptional emergencies. In essence, GORES is the structure that guarantees the connection between the Civil Protection-Local Security Service and the Personal and Community Services Department (Deliberazione della Giunta Regionale 1388 - GORES, 2011).

The COVID-19 contagion had been quite high during the first and the second wave in Italy and the Marche Region implemented ordinance in accordance with the national laws and decrees as shown in table 1.2.

[27] Marche Region, regional daily bulletin, https://www.regione.marche.it/

Table 1.2: *Legislation issued by the Marche region during the first wave of COVID-19*

Normative	**Description**
Ordinance n. 2 of 27.02.2020	Suspension of public events; educational services and schools of all levels and attendance of school activities; educational trips; opening of museums and libraries to the public; public competitions.
Ordinance n. 19 of 03.04.2020	Suspension of the activity of semi-residential centres for elderly and for people with mental health problems. Incentive for home care programs and/or local services.
Ordinance n. 36 of 03.10.2020	Obligation to use respiratory protection devices (masks) during the entire day outdoors, in places open to the public and in public spaces in the event of gatherings.
Ordinance n.40 of 31.10.2020	Provisions for distance learning in secondary schools. Secondary, state, and private educational institutions adopt 100% integrated digital teaching with the possibility of carrying out laboratory activities and tests in person.

Source: Elaboration of the author of Marche Region database https://www.regione.marche.it/ars/Aree-di-Attivit%C3%A0/Coronavirus/Normativa-regionale

During the COVID-19 emergency, the Marche Region update its official webpage with guidelines, information, and the results of the contact-tracing differentiating the contagion setting i) domestic environment and close contacts, encompassing infections within the family or between relatives; ii) scholastic context, referring to infections occurring at any school or university level; iii) workplace, covering infections that occurred in the workplace; iv) recreational area, including infections that occurred in places of aggregation such as squares, bars, restaurants, gyms; v) care setting, indicating infections occurring in care facilities; vi) healthcare sector, detailing infections within hospitals and health facilities; vii) returns from abroad or from another region, i.e. infections that occurred during a stay in a place outside the Marche (Amato et al., 2021)(Amato et al., 2021)(Amato et al., 2021). Furthermore, the Marche Region allocated contributions to health and economic activities, trying to contrast the crisis.

In the management of COVID-19, Aotearoa/New Zealand (hereinafter New Zealand) is considered among the most successful Countries to face COVID-19 pandemic and to control its spread (Jovanović et al., 2020). Probably thanking to its geographical isolation from the rest of the world, in

the South Pacific Ocean, and not representing an international travel hub, New Zealand gained a little time comparing to many other Countries in the world before COVID-19 entered in the Country (Gilray, 2021; McDougall, 2021; Menzies & Raskovic, 2020; Sharma & Sharma, 2020). The New Zealand Government response to COVID-19 has received praise from various sources, including the World Health Organization (WHO) (Beattie & Priestley, 2021; Blair et al., 2022; Craig, 2021; Gray et al., 2020). The New Zealand Influenza Pandemic Plan was updated in 2017 (Ministry of Health, 2017) and other three documents join the Aotearoa preparedness and response to pandemic: Health Act 1956, Epidemic Preparedness Act 2006, Civil Defence and Emergency Management Act 200228F28. Just learnt the news of the spread of a new virus of unknown aetiology from China to the rest of the world, on 3rd February 2020, the New Zealand Government immediately started its response to the pandemic and placed temporary entry restrictions into Aotearoa on all foreign nationals travelling from or transiting through mainland China29F29. The 28th of February 2020 the first case of COVID-19 was registered in New Zealand30F30. Immediately, the Government started a so-called "go hard and go early strategy" or "elimination strategy" (Beattie & Priestley, 2021; Cumming, 2022). The elimination strategy consists of orders introducing temporary strong measures at the start in an effort to prevent introduction and local transmission of an exotic pathogen such as COVID-19 (Baker Michael G et al., 2020). The measure of the elimination strategy could be resumed in test and trace, case isolation, quarantining of exposed people, strong border management, aggressive outbreak control, and vaccination (Oliu-Barton et al., 2022). From March 2020 a State of National Emergency was declared and the complete border closure ordinance made effect until the end of 2021. The switch into a mitigation strategy happened in October 2021 only (Blair et al., 2022). At health level, the Government and the Ministry of Health implemented the measures, supported by the Ministry of Finance and a scientific team. Indications and information were published on the official website of the Government and the new website implemented in the occasion of COVID-19: Unite Against COVID-1931F31. Special attention was placed on the composition of the New Zealand population including Māori, Pacific and Chinese or South Korean people implementing measures with respect to culture and translating information in multiple languages (Gilray, 2021; Menzies & Raskovic, 2020). At the local level, the Public Health Units managed COVID-19 patients, while hospitals took care of all other patients (Blair et al., 2022; Manning, 2021). Isolation of people entering the Country, quarantine of positive cases, and vaccination strategy, associated with high

[28] New Zealand Government, Legislation and key documents, About our COVID-19 response, Unite against COVID-19, https://COVID19.govt.nz/about-our-COVID-19-response/legislation-and-key-documents/, accessed 10th March 2023.
[29] New Zealand Government, Beehive.govt.nz, The official website of the New Zealand Government, New Zealand to restrict travel from China to protect against coronavirus, https://www.beehive.govt.nz/release/new-zealand-restrict-travel-china-protect-against-coronavirus.
[30] New Zealand Government, Official Government website dedicated to COVID-19 updates, https://COVID19.govt.nz/.
[31] Unite Against COVID-19, https://COVID19.govt.nz/

levels of health literacy within the population were key aspects of the New Zealand response to COVID-19 (Gray et al., 2020). The Government is responsible to specify the Alert Levels determining actions to protect public health and to take social measures in the fight against COVID-19[32]. The Alert System ended 2 December 2021, while the COVID-19 Protection Framework ended the 12th of September 2022. The Protective Framework replaced the Alert System, and it had three traffic light settings of Red, Orange and Green depending on the limitation of activities closures[33]. On 31 July 2022, the international borders reopened to all visitors.

The studies of this research doctoral project lie in a disaster risk reduction environment, with particular focus on pandemic planning. In a pandemic context, the misalignment between the theoretical and practical model about the preparation phase, the health literacy status, the administrative fragmentation, and the psychological aspects are the main points of this PhD research. The study of the resilience status of hospitals, the perception of healthcare workers and the operative emergency system should help in the implementation of guidelines for the preparation phase of pandemic emergency planning. Notwithstanding, it is not possible to identify a solution that might fit any potential scenario, the objective would be to do the groundwork which could be adaptable for every spatial area, from local to national level. It would be interesting to look for the utopian perfect pandemic emergency and communication model to reduce the overall consequences, and quickly curb the diffusion of viruses.

[32] Unite Against COVID-19, History of the COVID-19 Alert System, https://COVID19.govt.nz/about-our-COVID-19-response/history-of-the-COVID-19-alert-system/#about-the-COVID-19-alert-system.
[33] Unite Against COVID-19, History of the COVID-19 Protection Framework (traffic lights), https://COVID19.govt.nz/about-our-COVID-19-response/history-of-the-COVID-19-protection-framework-traffic-lights/

2. STATE OF THE ART ON PANDEMIC EMERGENCIES MANAGEMENT AND LEGISLATION

Our planet is alive, powerful, and hazardous. Earth's dynamics produce hazardous phenomena which might become disasters when interacting with human processes. With its anthropic footprint (e.g. building infrastructures in seismic zones, landsliding slopes, or contaminated areas) Humans created risks by exposing themselves and their built environment to these natural hazards (Barberi et al., 2005). At the global level, disasters are growing and consequently the number of victims and damages is increasing (Alexander, 2016; Guterres, 2021).

Specifically, disasters result from the interaction of components present in the same location at a particular time: the hazardous phenomenon, the vulnerable components, and the exposed elements. It is crucial to distinguish among these terms (Sendai Framework for Disaster Risk Reduction 2015 - 2030, 2015):

- Hazard (H) refers to an extreme event (natural, technological or social) that has the potential to cause harm to life, infrastructure, and resources;
- Vulnerability (V) denotes the susceptibility to such an extreme event;
- Exposure (E) represents the value exposed to the hazard;
- Resilience (Rs) embodies the adaptive capacity of individuals or groups to the hazard;
- Risk (R) encompasses the probable loss of life, resources, and infrastructure resulting from extreme events.

The conventional formula summarising the interactions among these elements is[34]:

$$R = H * V * E / \mathrm{Rs}$$

Communities exposed to the same hazard, but with different socio-economic characteristics will not necessarily be equally vulnerable, and consequently, the level of risk will vary (Le De et al., 2013; Navarro et al., 2021; Tan, 2021). A disaster can be defined as a situation or event that exceed the response capacity of the local community, necessitating the technical and operational intervention of the national and international community (Sendai Framework for Disaster Risk Reduction 2015 - 2030, 2015; Slovic, 1980; Wachinger et al., 2010). Indeed, a pivotal tool for DRR is emergency planning, which has become increasingly vital in the 21st century (Bogdan et al., 2021; Reddin et al.,

[34] European Commission, Disaster Risk Management Knowledge Centre, https://drmkc.jrc.ec.europa.eu/inform-index/InDepth/Methodology

2021). The goal of disaster planning is to reduce risk and limit loss of life, injuries, and suffering (Sendai Framework for Disaster Risk Reduction 2015 - 2030, 2015). Understanding the nature of the hazard and its potential impact in a specific area enables the accurate identification of necessary mitigation actions (Reddin et al., 2021; Wachinger et al., 2010). The identification of hazards in each area and their characteristics is a descriptive process. Biological agents can also pose hazards, leading to epidemic and pandemic emergencies when interacting with humans (Wannous et al., 2017). The impacts associated with the epidemics can be categorised as immediate (lasting days to weeks) and long-term (lasting weeks or months). Globally, influenza pandemics occur periodically, with cyclical intervals of approximately 30 to 40 years[35]. Looking back through history, one can cite the Black Death, which emerged in 1300 A.D. as an early example of an epidemic and pandemic. Originating in China, it spread westward, profoundly impacting all of Europe until its eventual extinction in 1400 A.D. (Cantor, 2001; Madsen et al., 2024; Monecke et al., 2009). Throughout the 20th century, several pandemics occurred in succession, including the Spanish fever of 1918, the H2N2 Asian Flu of 1957, the H3N2 Hong Kong influence of 1968, and the Severe Acute Respiratory Syndrome (SARS) of 2003, the Influenza A(H1N1) of 2009, the Middle East Respiratory Syndrome (MERS) in 2012 (Eftekhar Ardebili et al., 2021; European Commission, 2020; Kachali et al., 2022; Saunders-Hastings & Krewski, 2016; World Health Organization, 2017, 2018). The Spanish influenza globally broke out after the World War I, spreading across Southeast Asia, Russia, Europe, and North America reaching Africa and Oceania (Saunders-Hastings & Krewski, 2016), with an impact worse than the Black Death (or plague) and the War itself, but the origin still remains unclear (Rice, 2020; World Health Organization, 2017, 2018). The Asian and the Hong Kong influenza arise in southern China (Rice, 2020; World Health Organization, 2017), like SARS (Drosten et al., 2003). The first detection of H1N1 was in North America, and it subsequently spread globally (Fineberg, 2014; Kachali et al., 2022). MERS spread in Saudi Arabia, the United Arab Emirates, the Republic of Korea, and Africa, but smaller outbreaks of the disease have also been found in other countries[36,37](World Health Organization, 2018). Viral haemorrhagic fevers account for nearly the 70% of the outbreaks in Africa[38] (Mboussou et al., 2019). Since 1976, Ebola has been the most persistent disease, along with

[35] David Alexander, Protezione Civile, Influenza pandemica: situazione e sfide, https://protezione-civile-italia.blogspot.com/2009/01/influenza-pandemica-situazione-e-sfide.html?fbclid=IwAR1h3ChFIN40WSOaa73peea5Vb2J5FQTPdKucSXbbqY2rbk5G9m1n5hkxxc.

[36] Italian Ministry of Health, infectious diseases, Middle East Respiratory Syndrome, https://www.salute.gov.it/portale/malattieInfettive/dettaglioSchedeMalattieInfettive.jsp?lingua=italiano&id=128&area=Malattie%20infettive&menu=indiceAZ&tab=1 (last consultation 29.12.2023).

[37] World Health Organization, African Region, Disease outbreaks, https://www.afro.who.int/health-topics/disease-outbreaks (last consultation 29.12.2023).

[38] United Nations, Africa Renewal, Health, World Health Organization, 14.07.2022. "In Africa, 63% jump in diseases spread from animals to people seen in last decade", https://www.un.org/africarenewal/magazine/july-2022/africa-63-jump-diseases-spread-animals-people-seen-last-decade (last consultation 29.12.2023).

plague and monkeypox[39]. The last global pandemic is COVID-19 O'Connor et al., 2021). The United Nations, after the emergencies of the 21st century of SARS and MERS, updated the Sendai Framework including the definition of biological hazard (Fearnley & Dixon, 2020; Merianos & Peiris, 2005; Sendai Framework for Disaster Risk Reduction 2015 - 2030, 2015). Because of the problematic upcoming from epidemics and pandemics, the study of hazards started to include biological hazards and specific plans should be implemented by disaster risk reduction researchers and managers (Wannous et al., 2017). It means threatening source, causing agents, and duration, identifying the virus, reducing the transmission risk, especially limiting mortality, identifying adequate structures and medical specialisations, maintaining essential health and social services, maintenance of health efficiency, specifying correct and updated information to the community and monitoring the foreseen actions (Beaglehole et al., 1997; Djalante et al., 2020; Fineberg, 2014; Oshitani et al., 2008; Peleg et al., 2021). The measures and actions provided for the response to a pandemic should be adaptable to different types of infectious agents and continuously monitored to optimise the effects (Peleg et al., 2021). In a pandemic context, the sanitary sector is the most impacted and consequently the political, economic, and social ones. During a pandemic, the Health System is overwhelmed by a heavy afflux of patients, which necessitates of specific medical tools and specialised healthcare workers (EU Expert Group on Health System Performance Assessment, 2020; Olu, 2017; S. Thomas et al., 2020), in addition to adequate structures and organised hospitals (Marmo et al., 2022; Sharma & Sharma, 2020; World Health Organization, 2014). Furthermore, researchers are involved in the vaccine discovery, which is the principal solution for a pandemic, but requires a long time (World Health Organization, 2020a; Yuen, 2022). The Government has the responsibility to implement a pandemic plan and has the coordinating role during a pandemic emergency (Sendai Framework for Disaster Risk Reduction 2015 - 2030, 2015). At the same time, the population has the responsibility to respect the Government's decisions and protect themselves and the whole community. Therefore, preparedness and response phases for a pandemic event should be characterised by a multi-composition of stakeholders and multi-disciplinary approach (Ekenberg et al., 2021; Fakhruddin et al., 2020; United Nations Office for Disaster Risk Reduction & Regional Office for Asia and the Pacific, 2020) as shown in figure 2.1.

[39] Centre for Disease Control and Prevention (CDC), Viral Hemorrhagic Fevers (VHFs), Ebola Disease, Outbreaks, https://www.cdc.gov/vhf/ebola/history/distribution-map.html (last visited 29.12.2023).

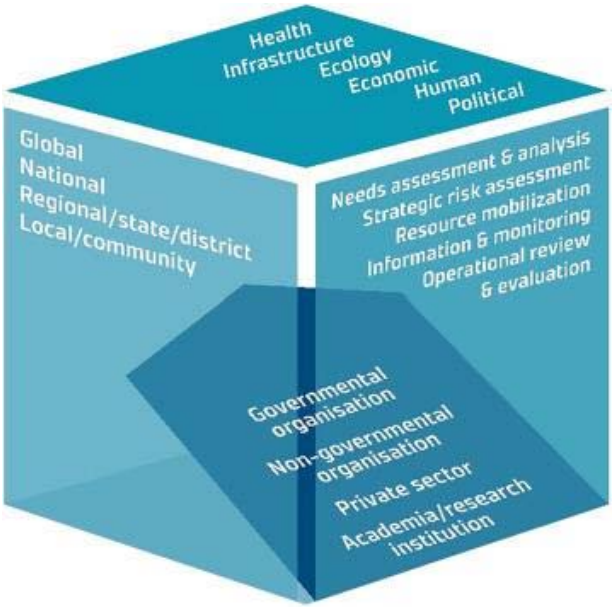


Figure. 2.1: *Response and recovery measures for pandemic events requiring the coordination of multi-stakeholder at various temporal intervals*

Source: Are we there yet? The transition from response to recovery for the COVID-19 pandemic https://doi.org/10.1016/j.pdisas.2020.100102 (Fakhruddin et al., 2020)

Stakeholders comprise experts, managers, physicians, payers, and self-governing institutions, who have to collaborate, share their expertise and make decisions on behalf of those affected (Ekenberg et al., 2021; Mühlbacher & Kaczynski, 2016). The exclusive objective of stakeholders should be preventing pandemic events and mitigating contagion with a high level of preparedness (Alexander, 2016; Araz, 2013). The coordination of pandemic planning pertains to the global level, while the planning and management actions are at national level, with implication for regional and local level (Alexander, 2016; Kachali et al., 2022; Kisilowski & Kunikowski, 2018). The World Health Organization (WHO) serves as the international coordinator of pandemic planning and management. The WHO's Health Emergencies Programme (WHE) assists countries in preparing for large-scale outbreaks and pandemics[40], while the International Health Regulation is a framework that delineates countries' rights and obligations in managing public health events and emergencies that may transcend borders (Merianos & Peiris, 2005). After 2005, the WHO encouraged member nations and regions to implement pandemic plans (Alexander, 2016; Peleg et al., 2021; Sundararaman et al., 2021). Indeed, past pandemics play a crucial role in updating pandemic plans both for experience and a constant joined up approach to emergencies (Alexander, 2016; Bogdan et al., 2021; George & Anilkumar, 2021; Shmueli et al., 2020). This is the reason why plans have to be updated frequently (Alexander, 2016;

[40] World Health Organizartion, WHO Health Emergencies Programme, https://www.who.int/westernpacific/about/how-we-work/programmes/who-health-emergencies-programme#:~:text=When%20outbreaks%2C%20conflicts%20or%20disasters,from%20any%20emergency%20health%20threat.

Wang, 2021; World Health Organization, 2014). At the local level, hospitals and other healthcare facilities play a crucial role in responding to pandemic emergencies (World Health Organization, 2014). Therefore, maintaining an operational health system is essential to ensure resilience, and specific guidelines are fundamental within pandemic plans (EU Expert Group on Health System Performance Assessment, 2020; Haldane et al., 2021; Jovanović et al., 2020). Nevertheless, it is fundamental to focus on previous experiences, which teach a series of uncertainties to consider in pandemic planning implementation and that have been summarised by David Alexander in is "How to write an Emergency Plan" (2016):

- "the infectiousness of the disease and its rate of spread by contagion (the "R" or reproduction number);
- the role and importance of asymptomatic transmission of the virus;
- the proportion of infected people who die (the case-fatality rate);
- whether there will be a second or third wave of infection after the first peak;
- the differential impact of the disease by ethnicity, gender and age-group (including issues of who is most exposed to the risk of infection);
- the acquisition of immunity (individual and collective, or 'herd', immunity);
- the role of an eventual vaccine (its effectiveness, rate of mass production, ease of distribution and acceptability to potential recipients);
- the relationship of the disease to environmental factors (such as air pollution and human-animal interactions);
- the role of personal protective equipment in reducing infection rates among the public".

Pandemics, by their nature, necessitate international collaboration to limit and stop transmission, particularly in the early stages (George & Anilkumar, 2021; Kachali et al., 2022; Reddin et al., 2021). This condition coupled with trust in government and among people within countries, can make the difference in the pandemic response (Fakhruddin et al., 2020; Rana et al., 2021; Siegrist & Gutscher, 2008). During emergencies events, governments or private agencies typically provide funds, and in the case of a pandemic, it could be crucial to deploy healthcare workers teams, procure specific tools for the management of the virus, and support public or private enterprises (Okan et al., 2019; Saunders-Hastings & Krewski, 2016; Sendai Framework for Disaster Risk Reduction 2015 - 2030, 2015).

Unlike other types of hazards that typically necessitate evacuation from the crisis point, during epidemics and pandemics, people are advised to stay where they are to limit the transmission (Fearnley & Dixon, 2020). Furthermore, during emergencies, people are usually required to gather in

groups, but in case of pandemics, physical distancing is the best response to limit the contagion, including personal protective equipment (Acosta et al., 2021; Araz, 2013; Kisilowski & Kunikowski, 2018).

Demographic characteristics of a community can influence the spread of a pandemic: population density promotes the virus transmission, as does the commuting for work or study; the presence of a large elderly population may exacerbate the overall health status of the community (Ekenberg et al., 2021; Riveccio et al., 2020; Rovetta & Castaldo, 2020; Saunders-Hastings & Krewski, 2016).

Among the crucial aspects for the management of an epidemic is the application of communication activities (Presta & Luca, 2011). Information and communication should be clear, timely, and direct (Beattie & Priestley, 2021; European Union, 2020; Vaughan & Tinker, 2009; Warren & Lofstedt, 2022; Yuen, 2022). In both instances, updates and instructions should be communicated in the national language and English, or any other languages spoken in a particular region (Aabdi et al., 2022; Presta & Luca, 2011). Information should originate from a single representative, such as a government official, or an appointed individual in a top-down model. Having multiple individuals disseminating information may lead to misinformation, infodemic and confusion among recipients (Barua et al., 2020; Beattie & Priestley, 2021; Hansson et al., 2020; Tian & Yang, 2022). For what that concerns communication, within a pandemic plan, it should be facilitated among emergency responders using common and straightforward languages (Muselli et al., 2021). Good communication should be inclusive for people with special needs and marginalised population (Hansson et al., 2020; Tian & Yang, 2022). The community should be engaged in communication efforts, and a bottom-up approach should be incorporated into planning and response activities (European Union, 2020; Vaughan & Tinker, 2009; WHO, 2017). The complexity of the messages, the characteristics of broadcasters and receivers, and the type of channels used greatly influence the communication of the emergency plan (Glik, 2007; Reynolds & Seeger, 2005).

Culture and experience of other epidemics and pandemics could have a heavier impact on pandemic response (Eftekhar Ardebili et al., 2021; Kieu & Senanayake, 2023; Saunders-Hastings & Krewski, 2016). Culture can drive action during a pandemic, affecting both for the government response which should respect cultural principle and the population' adherence to new guidelines (Fernandez-Perez et al., 2021; Gokmen et al., 2021; Kakol et al., 2018).

Previous experiences can be shared among countries or represent a starting point of a country's knowledge (Kakol et al., 2018).

Multi-criteria decision analysis could be fundamental when numerous aspects, criteria and factors need to be included and analysed within an ideal roundtable for pandemic planning (Dunke & Nickel,

2021). Multi-Criteria Decision Analysis (MCDA) allows one to manage different data types and weights or score different decision criteria (Mühlbacher & Kaczynski, 2016). The healthcare system is inherently uncertain and usually it is characterised by the presence of multiple conflicting objectives, but MCDA has the potential to enhance the decision-making process of governments or healthcare providers by determining optimal solutions (Dunke & Nickel, 2021; Marsh et al., 2014; Mühlbacher & Kaczynski, 2016). The application of MCDAs to pandemics and healthcare is relatively recent: the first studies were conducted in 1990, but most were published after 2011. However, current practice does not provide sufficient guidance (Marsh et al., 2014). Possibly, the more suitable methods are Analytic Hierarchy Process (AHP), Preference Ranking Organization METHod for Enriched Evaluation (PROMETHEE) and Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), because these methods all deal with different indicators comparing them on a ratio scale, the weight of indicators is unknown, the indicators are independent (Ishizaka & Nemery, 2013a). The MCDA technique becomes functional by simulating a mix of the top-down and bottom-up approaches (Dunke & Nickel, 2021). Through MCDA, different areas become comparable by analysing qualitative and quantitative data and performing normalisation calculations (Sadeghi et al., 2021). The application of multi-criteria decision analysis to pandemics could involve defining criteria for guidelines to limit the infection capacity and the spread of the virus, as well as implementing preparedness for pandemic events (Ortiz-Barrios et al., 2020; Pamučar et al., 2020).

3. RESEARCH FRAMEWORK

3.1 Research objectives, hypotheses, and questions

The overall objective of this Ph.D. project is to gain insight into the most important aspects of pandemic emergency planning and provide a list of guidelines in order to assess local and national Health Systems Resilience to a biological hazard such as a Coronavirus.

Aiming to achieve this objective, a bibliographic review of scientific and technical texts was carried out, which allowed the following hypotheses and research questions to be deduced. The hypotheses refer to the health resilience at the national, regional, and local level, encompassing political, healthcare, and psychological dimensions.

Epidemics and pandemics have not impacted different parts of the world equally (Riveccio et al., 2020). Eastern countries appear to be better prepared compared to European or American countries, possibly due to their previous experiences (Wu, 2023). The COVID-19 pandemic highlighted Italy's lack of preparedness in handling pandemics. Examples include the outdated pandemic plan, healthcare system crisis such as hospital overcrowding and the insufficient level of health literacy among the population (Cicchetti Americo et al., 2021; Jovanović et al., 2020; Merianos & Peiris, 2005). The previous observations give rise to the principal hypothesis and related research questions.

Principal Hypothesis: In Italy, the not always adequate answer to the pandemic emergency has originated from the lack of preparedness and low Health System Resilience at the local level.

The ensuing research questions are:

- What is the status in terms of Pandemic Health System Resilience worldwide?
- What makes a Health System resilient to pandemics?
- Which Countries showed a good Health System Resilience during COVID-19?

The non-homogeneous spread of the novel Coronavirus characterised the diffusion of COVID-19 not only globally but also within the national territory of Italy. The impact of Covid-19 varies among Italian Regions in terms of timing, with the northern regions being initially affected before the Southern ones. This discrepancy is influenced by population characteristics and resources availability (Casti & Riggio, 2022). Upon observing the heterogeneity of the virus spread among regions and their responses to the pandemic, the first sub-hypothesis emerged.

Sub-Hypothesis 1: Fragmentation and differences of public health policies across the regional government bodies of Italy caused dissimilar responses to the COVID-19 emergency ensuing in inconsistent effectiveness.

In order to support this hypothesis, the following research questions will be investigated.

- What are the healthcare workers' perception of efficacy of the pandemic response in Italy and in New Zealand?
- What are the significant differences in the pandemic response between the public and private healthcare structures in Italy and in New Zealand?
- Which institutions and local organisations/stakeholders provided support for the health systems to cope with the pandemic emergency in Italy and in NZ?

During the COVID-19 pandemic, the crisis in Italy's health sector was exacerbated by previous cuts of the health system and the limited funds allocated during the last pandemic (Cartabellotta et al., 2019). Consequently, the preparedness of the health sector for pandemic emergencies was restricted (Sanfelici, 2020). After these considerations, the second sub-hypothesis emerged together with related research questions.

Sub-Hypothesis 2: Small financing for pandemic preparation in Italy undermined the update of pandemic emergency plans to face COVID-19.

- How the economic restrictions (budget cuts) imposed on the healthcare system affected the ability to respond to COVID-19 in Italy?
- How much the current political structure and the existing economic model in Italy and New Zealand are influencing the overall ability of the local health care system to respond to (and endure through) the emergency?
- What is the situation in terms of knowledge exchange among Government, scientific institutions, and the population at large?

The pandemic emergency involved many sectors, including politics, economics, health and social. The political sector at the national, regional, and local level was responsible for the overall management of the response to the COVID-19 pandemic, but hospital healthcare workers have been the direct responders of the emergency. Consequently, psychological support for healthcare workers becomes essential to face stressing activities, unknown viruses, and long shifts (Gorini et al., 2020). Starting from these observations, it derived the third sub-hypothesis.

Sub-Hypothesis 3: The psychological burden connected to the pandemic strained healthcare workers, particularly those without previous pandemic management experience.

The third sub-hypothesis is supported by the following research questions.

- How much does the psychological aspect influence the healthcare workers' activities?
- How much the professional culture, within the galaxy of medical specialties, affected the response?
- Is there evidence that training and educational programs during the COVID-19 pandemic improved Health System Resilience?
- Did healthcare workers in Italy and New Zealand participate in pandemic drills prior COVID-19? And if so, how often, or how consistent was the training for pandemic emergencies?

In the following chapters the implemented study attempts to answer the research questions and achieve the set objective.

3.2 Study area

3.2.1 The case study of the Marche Region (Italy).

Before entering the detailed discussion of the study area, the Italian Region called Marche, let us provide a quick overview of Italy and its population of nearly 60 million (58.997.201)[41]. From a demographic standpoint, after Japan and Korea, Italy is the country experiencing the fastest population ageing in the world[42,43] (Sanfelici, 2020; Santeramo et al., 2021), with a life expectancy at birth of approximately 80 years for males and 84 years for females 46. Italy has relatively high population density, ranking among the top in European countries[42,44] and 51st globally[42,45] (Associazione Italiana Insegnanti di Geografia, n.d.; Murgante et al., 2020). The health literacy of the Italian population is quite low as reported in the state of health report (Organization for Economic Co-operation and Development (OECD) & European Observatory on Health Systems and Policies, 2019). Italy is a founding member of the European Union, part of the G7 (an informal forum for dialogue bringing together seven highly industrialised countries)[42, 46], and a major global exporter, standing as the eighth-largest economy in the world[43,47] (Sanfelici, 2020).

The Marche Region is located on the eastern side of central Italy covering an area of approximately 9401.18 km^2 and borders on the North with the Emilia-Romagna Region and the Republic of San Marino, to the East with the Adriatic Sea, to the West with Umbria and Tuscany Regions, whereas to the South is bounded by the Abruzzo and Lazio Regions[47]. Marche Region ranks 11th in terms of population density among Italian regions[47]. The Capital City of Marche is Ancona, and it is the most populated province (471,228), followed by Pesaro and Urbino (358,886), Macerata (314,178), Ascoli Piceno (207,179) and Fermo (173,800)[47]. The population is more concentrated along the coast than in the less populated internal zones[47]. It is characterised by a significant percentage of people commuting for study or work within the Marche Region provinces and between the Marche Region and other northern Italian regions, which can be among the cause of the COVID-19 transmission (Casti, 2021; Casti & Riggio, 2022; Gioia et al., 2022). From a socio-economic perspective, the Region holds a position just above the national average in terms of both per capita income and the limited conditions of poverty and deprivation (Marche Region, 2019). The overall productive sector is characterised by small-sized enterprises scattered throughout the Region and not concentrated in few heavily industrialised areas (Marche Region, 2020; Marchetti & Marincioni, 2022). This region

[41] National Institute of Statistic – Istat, https://esploradati.istat.it

[42] Ministero degli Affari Esteri e della Cooperazione Internazionale, Home>Foreign Policy and Italian Development Cooperation>International Organisations and Global Forums>G7, https://www.esteri.it/en/politica-estera-e-cooperazione-allo-sviluppo/organizzazioni_internazionali/g7/

[43] Italy Economy, https://www.focus-economics.com/countries/italy/

was swiftly affected by the pandemic probably due to its close ties with the Northern Italy (Casti & Riggio, 2022; Gioia et al., 2022). While it is difficult to pinpoint a single cause for the spread of COVID-19 in the Marche Region, indeed the combined effect of multiple factors greatly contributed to the region's high contagion rate (Amato et al., 2021; Casti & Riggio, 2022; Gioia et al., 2022). The collected data from Marche was classified as follows: i) Domestic and close contacts, meaning infections occurring within families or among relatives; ii) Educational setting, indicating infections occurring at any school or university level; iii) Workplace environment, referring to infections occurring at the workplace; iv) Recreational setting, meaning infections occurring in gathering places such as squares, bars, restaurants, gyms; v) Care setting, indicating infections occurring in care facilities; vi) Healthcare setting, referring to infections within hospitals and healthcare facilities; vii) Returns from abroad or from another region, meaning infections occurring during stays in a location outside the Marche Region (Amato et al., 2021). In general, until the restrictions on mobility daily commuting for work or study between the provinces of the Marche Region and the other Regions is common, and this could be one of the factors contributing to the introduction and spread of SARS-CoV-2 into the region (Casti & Riggio, 2022). The recreational setting can be considered partly responsible for the spread of Covid-19 as many activities had been suspended. Shortly before and during the emergence of the first COVID-19 positive cases, numerous public events were held in the region, exacerbating the spread of the virus. Examples include Carnival parades in various cities in February, the Coppa Italia Final Eight 2020 basketball tournament, and various village celebrations (Casti & Riggio, 2022). The workplace and educational settings were where the virus had the opportunity to infect a greater number of people, likely due to the presence of gatherings in an enclosed environment for an extended period. However, the domestic and close contacts setting had been the most dangerous overall, as precautions were inevitably lowered there, and the time spent in the same spaces is increased, sharing objects and areas (Amato et al., 2021). The factors previously described, along with the likely higher population density in the northern province compared to the southern province, had played a role in the spread of contagion within the Marche Region. Specifically, the contagion appears to have evolved from the northern province of Pesaro and Urbino to the southern Ascoli Piceno province (Gioia et al., 2022). The Marche Region overcomes the national old age index with a value of 202,3 (updated to the 1st of January 2020) than the Italian index of 178,4. This aspect contributed to the COVID-19 morbidity and mortality impact in the region (Casti & Riggio, 2022). The healthcare system in the Marche Region is overseen at the regional level by the Marche Regional Health Agency (ASUR). It is organized into five distinct “Vast Areas,” each closely aligned with the jurisdiction of the five provinces within the region (Casti & Riggio, 2022;

Gioia et al., 2022). Health Residential Facilities encompass various types of care settings designed to meet the needs of different patient populations. Let's delve into the specifics:

I. Intermediate Care (IC): These facilities accommodate patients who have been discharged from hospitals or are in prehospitalization situations. IC provides a bridge between acute care and home-based care.
II. Nursing Homes (NHs): NHs offer continuous nursing care within residential units. They cater to patients who are not self-sufficient and have pathologies requiring intensive health protection. For instance, NHs may host individuals receiving artificial nutrition.

On the other hand, Social Residential Structures serve distinct purposes:

I. Protected Residences for the Elderly (PREs) and Protected Residences for Dementia (PRDs): These facilities integrate social and health services. PREs accommodate patients with physical-psychological pathologies, while PRDs cater to those with cognitive deficits that cannot be managed at home.
II. Retirement Homes (RHs): RHs provide accommodation with community services for self-sufficient older adults.
III. Community Housing for the Elderly (CH): CH comprises small lodgings that allow independent living for seniors.
IV. House Hotels (HHs): HHs are self-managed or semi-self-managed facilities where self-sufficient elderly individuals choose a communal family-style life.

Additionally, there are semi-residential structures: Day Centres for people with Dementia (DCDs), which occasionally accommodate elderly individuals with cognitive deficits but minimal behavioural disturbance; and Day Centres for the Elderly (DCEs), that cater to not self-sufficient elderly individuals with physical and psychological pathologies. The distribution of health and social structures in the Marche Region for the year 2018 reveals a substantial capacity in the North-Central provinces for the number of beds and the number of social residential facilities compared to the inhabitant. However, an intriguing observation arises: the distribution of these structures in the Marche Region does not align proportionally with the aging index (i.e., the number of individuals aged over 65 per 100 people). Curiously, the aging index increases as we move southward. One hypothesis suggests that this anomaly could be attributed to the distribution of the resident population, which tends to be smaller in the southern areas. Alternatively, it might reflect unbalanced public health policies. A more intriguing possibility is rooted in socio-cultural traditions. The southern provinces, with their higher percentage of semi-residential health and social structures, often host the elderly only for a few hours during the day. In contrast, the northern provinces prioritize full-time residential care facilities. This divergence in community life practices between the northern and

southern regions could have contributed to the higher prevalence of COVID-19 infections among the elderly residing in Marche. The elderly residing in health and social facilities faced heightened exposure to COVID-19 contagion. As documented, during the initial phases of the epidemic, operators, employees, family members, and visitors inadvertently acted as vectors, introducing the virus into these 'confined' facilities. Subsequently, the National Institute of Health implemented rules mandating progressive isolation of these residences from their surrounding context (Casti & Riggio, 2022; Gioia et al., 2022).

Observing the population distribution within the Marche Region, we find that in the northern provinces, the population density is notably higher than in the southern provinces. This trend extends from the inland areas toward the coastline. Additionally, the urban areas predominantly define the northern provinces, while the southern provinces exhibit a greater dispersion of rural areas (Casti & Riggio, 2022; Gioia et al., 2022).

In conclusion, the analysis of COVID-19 spread in the Marche Region has highlighted the influence of territorial and social components on contagion patterns. The province of Pesaro and Urbino serves as a true frontier zone between the socioeconomic models of Northern Italy, characterized by intense exchange and mobility, and those of Central-Southern Italy and the internal areas of Marche, which remain closely tied to local production realities. The more globalised lifestyle in the Central-North of Marche leads a significant number of individuals to move for study and work, creating substantial connections with the hard-hit regions of Northern Italy, such as Lombardy and Veneto.

Once the virus entered the province of Pesaro and Urbino, it subsequently spread throughout the region via an organised road infrastructure, running parallel to the coastline and a transversal network along the river valleys. However, the speed and pathways of virus transmission in the Marche region were also influenced by other critical socioeconomic factors. For instance, uneven distribution and utilization of healthcare facilities exposed elderly residents differently in the northern and southern parts of the region. Mobility patterns and interactions related to different production models played a crucial role in either amplifying or reducing the virus's circulation. In summary, the spread of infections and mortality trends during the first wave of COVID-19 in the Marche Region highlighted how territorial differences, corresponding to varying lifestyles (rural vs. urban; agrarian vs. industrial), result in different levels of exposure and vulnerability to biological hazards (Casti & Riggio, 2022; Gioia et al., 2022).

3.2.2 Comparing Italy with New Zealand

New Zealand, also known as Aotearoa, is located in the southern hemisphere, in the southern Pacific Ocean. It is a country within the Oceania group of islands, and its territory extends across two islands formed by the action of volcanoes and glaciations: the North Island and the South Island[44]. The capital Wellington, in the North Island. The land size is 268.021 km^2 (similar to Italy which extends for 302.070,8 km^2 [48]), with a population corresponds to 5.151.600 people, with an annual growth rate of 0,69% and a life expectancy at birth of 82,25 years old[63]. New Zealand is a Unitary parliamentary constitutional monarchy and a member of the Commonwealth of Nations.

The information about i) geographic position, ii) governance, iii) population distribution and composition, iv) socio-cultural characteristics and v) health system and historical experiences of epidemic and pandemic events are displayed below.

The map in figure 3.1 describes the geographical position of Italy and New Zealand, located in the Northern and Southern hemisphere respectively.

[44] StatsNZ, Tatauranga Aotearoa, New Zealand Government, https://datafinder.stats.govt.nz.

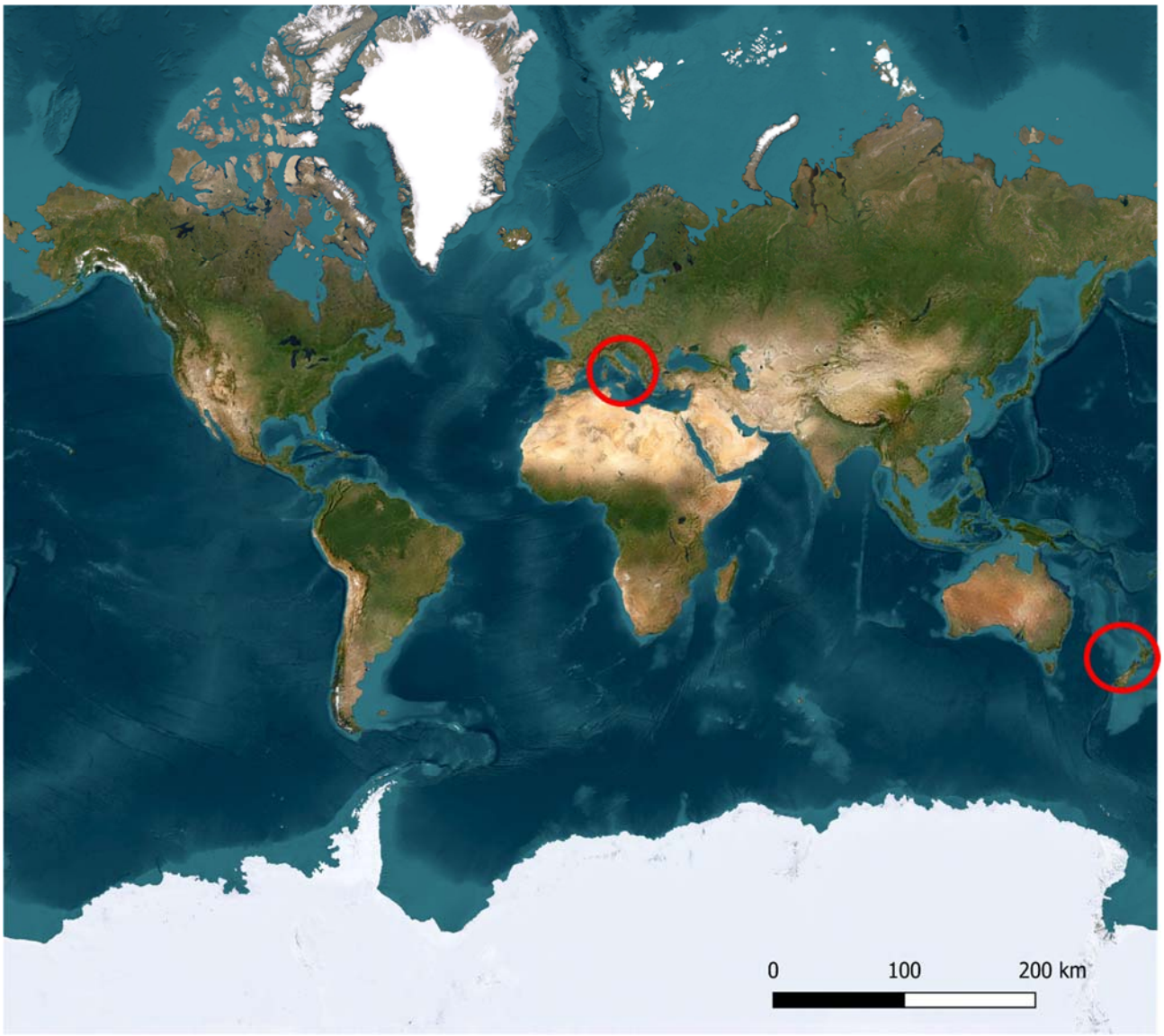


Figure 3.1: *Italy and New Zealand on the planisphere*

Source: Elaboration from GIS – ESRI Satellite Web Map Services

Italy is situated in the centre of the Mediterranean region and in the southern part of Europe. It is a peninsula partially connected with the mainland and surrounded by the sea on the other sides. New Zealand is an island located in the southern Pacific Ocean.

The relationship in geographical positioning between Italy and New Zealand can be observed through the geographical illustration of the antipodes, namely what is located on the exact opposite side of the Earth.

Figure. 3.2: *World map illustration of geographical antipodes*

Source: Elaboration from ArcGIS Hub – Antipodes World Countries (https://hub.arcgis.com/datasets/nation:antipode-world-countries/about)

Figure 3.2 represents in natural colour the conventional European perspective of the planisphere, and in light blue the reversed planisphere. This map shows that Italy and New Zealand are situated nearly at the Antipode, at the opposite sides of the world.

Table. 3.1: *demographic and political characteristics of Italy and New Zealand*

	Italy	**New Zealand**
Population (residents)	59.030.133	5.151.600
Population male	28.818.956	2.556.100
Population female	30.211.177	2.595.500
Median age (years)	46,2	38,2
Life expectancy at birth male (2021)	80,3	80,5
Life expectancy at birth female (2021)	84,8	84
Land size km²	302.070,8	268.021
Formation Government	2 June 1946	25 November 1947

Government	Unitary parliamentary republic	Unitary parliamentary constitutional monarchy
Legislature	Parliament: Upper House (Senate of the Republic); Lower House (Chamber of Deputies)	Parliament (House of Representatives)

Source: Elaboration of the author from official websites, Istat (https://esploradati.istat.it/databrowser/#/it/dw/categories) and Stats NZ (https://nzdotstat.stats.govt.nz/wbos/index.aspx) respectively for Italy and New Zealand.

Observing the demographic and political characteristics of Italy and New Zealand in table 3.1, it emerges that the countries have similar land areas, Italy covers 302.070,8 km^2 while New Zealand covers 268.021 km^2. However, New Zealand (5.151.600 people) has only about a twelfth of the population of Italy (59.030.133 people). The male and female population ratio is similar in the two countries (28.818.956 male and 30.211.177 female in Italy; 2.556.100 male and 2.595.500 female in New Zealand). In both countries life expectancy is longer for women (80,3 years for male and 84,8 years for female in Italy; 80,5 years for male and 84 years for female in New Zealand).

Both Countries have democratically elected governments (since 1946 in Italy and 1947 in New Zealand). However, the Italian Government operates a parliamentary republic with a President as the highest authority and two chambers, the Senate of the Republic, and the Chamber of Deputies. The New Zealander Government operates as a parliamentary monarchy, part of the Commonwealth of Nations alliance recognizing as Head of State the Monarch of the United Kingdom, with a locally elected Prime Minister acting on behalf of the King, with the support of the House of Representatives.

From a social perspective, the ethnic fabric of the two countries is rather different. The Italian population is predominantly composed of Italian natives, tracing their origin back to ancient times. Just over 8% of the current resident population of Italy comprises immigrants, primarily hailing from other European Union countries (such as Albania, Romania, and Ukraine), and descending order from North and Central Africa nations, and Central-South and East Asia (mainly China) (data referring to 2019 available in the ISTAT database https://esploradati.istat.it/databrowser/#/it/dw/categories).

New Zealand is instead composed by a multi-ethnic population, predominantly composed by European and minority groups descending from native Māori (16,66%), Asian (15,72%), Pacific (8,32%), Middle Eastern/Latin American/African (1,57%) (data refers to the last updated census of 2018 available in the Stats NZ database https://nzdotstat.stats.govt.nz/wbos/index.aspx#).

Given the subject matter of this research project, comparisons between Italy and New Zealand focused on the organisation of the health system, the health literacy status, the health resilience, and the occurrence of previous epidemic and pandemic events in the two countries.

The Italian National Health System (Servizio Sanitario Nazionale – SSN) is a public service organised on three levels: national, regional, and local as described in the scheme of figure 3.3.

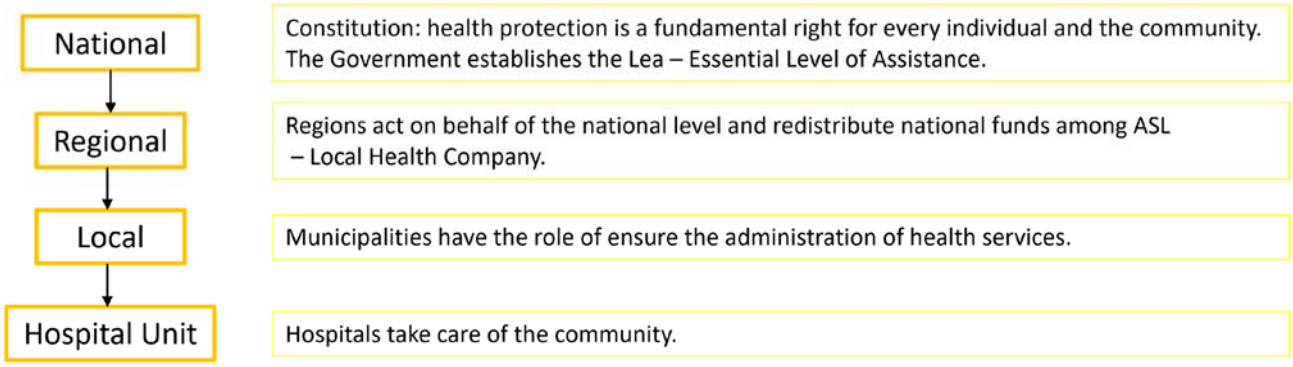


Figure. 3.3: *Italian National Health System structure*

Source: National Law of 23rd December 1978 (Legge 23 Dicembre 1978, n. 833, 1978)

Figure 3.3 illustrates the primary roles of the three administrative levels within the Public Health System of Italy. Decision-making occurs at the national level, and these decisions are then cascaded down to the regional and local levels for implementation. The provision of health services to the entire population is mandated by specific laws and enshrined in the national Constitution (Legge 23 Dicembre 1978, n. 833, 1978). The three-tiered organisation of the health system ensures widespread access to the services, but there are some disparities among regions, particularly between the Norther and the Southern Regions (Organization for Economic Co-operation and Development (OECD) & European Observatory on Health Systems and Policies, 2019; Schiavone & Attena, 2020). First aid services are provided free of charges to everyone, including non-Italian residents. In general users of the health services are required to contribute a minimal sum towards the health care costs. This contribution is called a "ticket".

The current status of the Italian Public Health System exhibits a significant lack of personnel in various categories, such as medical specialists, physicians, nurses, which is disproportionate to the number of patients requiring care (Organization for Economic Co-operation and Development (OECD) & European Observatory on Health Systems and Policies, 2019; Rodeschini, 2021; Ruiu, 2020). Additionally, the quality of services, the distribution of hospitals and the adequacy of structures and facilities are not evenly distributed on the national territory (Jurgensen et al., 2021; Schiavone & Attena, 2020). The resilience of the Health System adapted to the needs of the

population including a growing percentage of elderly people, and an increasing number of serious illnesses. The available beds in hospitals have decreased, while day-hospital surgeries have increased, along with improvements in the quality of drugs and medicines available at hospitals and pharmacies (Organization for Economic Co-operation and Development (OECD) & European Observatory on Health Systems and Policies, 2019). Despite the implementation of policies and strategies to enhance awareness and knowledge of health protection and preservation, the level of the Health Literacy Status (HLS) of the population in Italy remains quite low (Lorini et al., 2017; Okan et al., 2019; Palumbo et al., 2016; Schiavone & Attena, 2020). Italy has not experienced many epidemics and pandemics throughout its history, and consequently its preparation for such emergencies is not at its best.

The structure of New Zealand's Health System can be reassumed in the figure 3.4 below.

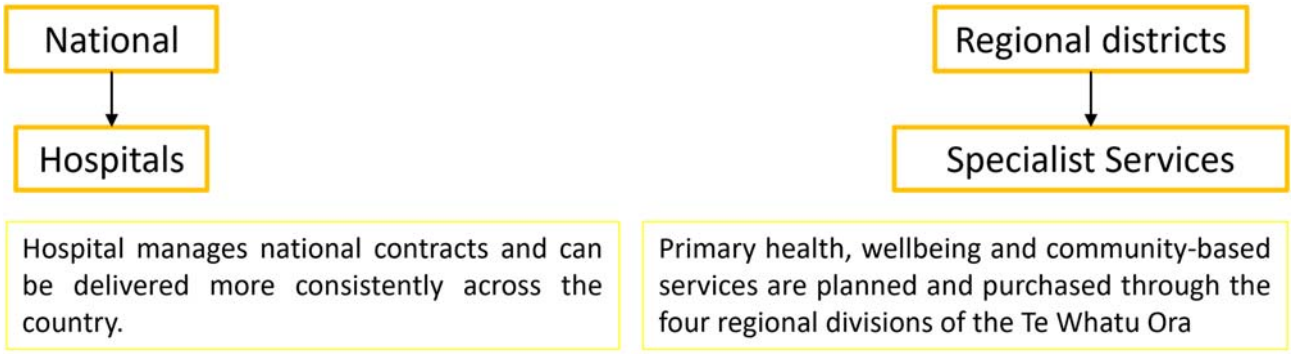


Figure 3.4: *New Zealand National Health System structure*

Source: elaboration of the author from Te Whatu Ora – Health New Zealand available at the website https://www.tewhatuora.govt.nz/our-health-system/health-system-overview/#:~:text=Hospital%20and%20specialist%20services%20are,divisions%20of%20Te%20Whatu%20Ora

The Health and Disability System in New Zealand is administered at the national level (figure 3.4) with regional districts controlling the implementation of national directives. Hospitals are directly administered at the national level, while other specialised services are provided by different institutes, such as Public Health Institutes or primary health services. The New Zealand Health system is publicly funded, but there are specific criteria for eligibility[45]. Non-eligible individuals may be charged for the full costs of any medical treatment or disability support service received during the visit. The eligibility criteria are described in the Eligibility Direction and on the official website of the Health New Zealand – Te Whatu Ora. The system mainly includes New Zealand citizens or

[45] Te Whatu Ora – Health New Zealand website: Eligibility for publicly funded health services. Being eligible gives a person a right to be considered for free or subsidised health or disability services.
https://www.tewhatuora.govt.nz/our-health-system/eligibility-for-publicly-funded-health-services

residents, work visa holders for two years or more, refugees or protected persons and victims of people trafficking, students, and the United Kingdom and Australian citizens or residents[46].

As described in the previous paragraph, the availability of beds in hospitals and the number of healthcare personnel are generally adequate (Blair et al., 2022). Since 2008, a health literacy programme has been implemented and funded by the Health Ministry to address inadequate health literacy status among the population, particularly on Māori and Pacific population (Okan et al., 2019). The interest in health literacy by the whole population has been facilitated through "services being easy to access and navigate; effective health worker communication; clear and relevant health messages that empower everyone to make informed choices"[47]. The New Zealand Health Survey is a module designed to evaluate the level of understanding health and the utilisation of health information and healthcare services serving as a mean to enhance implementation of health literacy education strategies[48]. This survey is periodically distributed to the population, contributing to New Zealand' reputation for a good level of health literacy among the population. Furthermore, the succession of numerous epidemics and pandemics in New Zealand over the past decade, have increased the experience and awareness of biological risks by the Government and the population.

[46] Te Whatu Ora – Health New Zealand website: Eligibility checklists and decision trees. These lists can help you understand if someone meets the eligibility criteria and guide you in asking them for the right proof of eligibility. https://www.tewhatuora.govt.nz/our-health-system/eligibility-for-publicly-funded-health-services/resources-for-service-providers-to-check-eligibility/eligibility-checklists-and-decision-trees/

[47] Manatū Hauora - Ministry of Health, Our work, Making services better for users, Health literacy https://www.health.govt.nz/our-work/making-services-better-users/health-literacy

[48] Manatū Hauora - Ministry of Health, Understanding health and healthcare 2017/18: New Zealand Health Survey https://www.health.govt.nz/nz-health-statistics/surveys/new-zealand-health-survey/understanding-health-and-healthcare-2017-18-new-zealand-health-survey.

3.3 Methodology

This chapter serves as a connection between the theoretical underpinnings of the study and its empirical execution. The research aims to shed light on critical aspects of pandemic preparedness, resulting in a comprehensive set of guidelines for evaluating the resilience of health systems to biological hazards such as the Coronavirus.

To enhance pandemic preparedness, this chapter outlines the methodological framework used to address research objectives and test proposed hypotheses.

The multifaceted nature of pandemic emergencies, which span political, healthcare, and psychological realms at national, regional, and local levels, require a rigorous and nuanced approach that integrates diverse methodologies to capture the complexities of preparedness strategies. This study aims to investigate pandemic preparedness using both quantitative and qualitative research methods.

Six steps have been carried out for the implementation of the methodology: (i) selecting macro-areas and indicators for pandemic preparedness; (ii) evaluating the macro-areas and indicators using Multi-Criteria Decision Analysis; (iii) analysing the perception of Italian healthcare workers regarding pandemic emergencies; (iv) analysing the New Zealand pandemic management using PRISMA statement and interviews; (v) comparing the Italian and New Zealand pandemic management; and (vi) validating the selected indicators through the Field Exercise EU MODEX.

The selection of indicators aims to evaluate the resilience of the health system in a pandemic environment. The goal is to identify the key focal points for a pandemic response that could be effective at every administrative level. The indicators have been analysed using Multi-Criteria Decision Analysis (MCDA), which involves collecting and analysing both quantitative and qualitative data. This method considers various indicators and compares them on a ratio scale. The objective of the MCDS is to assess the importance of each selected indicator and determine their relative importance. The aim of the Multi-Criteria Decision Analysis is to investigate the effects of the fragmentation of public health policies and the characteristics of the Health System Resilience at local level. Moreover, questionnaires have been designed trying to gauge pandemic risk perception of healthcare workers engaged in the first aid wards and critical care units during the COVID-19 emergency. The aim of this step is to address the research question of the third sub-hypothesis, which concerns the influence of psychological factors, cultural aspects, training activities, and the current healthcare situation in the Marche Region. This region serves as a representative case of what occurs

in Italian regions at the healthcare level. The PRISMA statement phase is crucial to investigate the successful aspects of one of the most performing countries in the fight against the COVID-19 pandemic. This will allow the comparison between Italy and New Zealand, highlighting similarities and differences in the handling of the COVID-19 pandemics. The final scope of the six-step process is to identify the principal factors that can be useful for pandemic planning and response guidelines.

3.3.1 Selection of indicators

The indicators for evaluating pandemic preparedness were identified through the bibliographic review of scientific articles, pandemic and emergency plans, and pandemic guidelines from the World Health Organization. In particular, the state of the art regarding pandemics and the measures implemented during the last COVID-19 pandemic were examined. The investigation of scientific articles, and global and national documents such as national pandemic plans led to collect information about the status of Pandemic Health System Resilience worldwide. The primary documents analysed, serving as the starting point for the research, include the Italian National Pandemic Plan of 2006 (Ministero della Salute, 2006) and the subsequent updated National Strategic-Operational Plan for Preparedness and Response to an Influenza Pandemic (PanFlu) 2021-2023 (Piano Strategico-Operativo Nazionale di Preparazione e Risposta a una Pandemia Influenzale (PanFlu) 2021-2023, 2021), and the Marche Region Pandemic Plan (Deliberazione della Giunta Regionale 1515_09 Piano Operativo per la Risposta Pandemia Influenzale nella Regione Marche, 2009). Other Italian national documents analysed include the Statistical Yearbook of the National Health Service (Ministero della Salute, 2019), the National Prevention Plan 2020-2025 (Ministero della Salute, 2020), the Italian National Civil Protection Code (Decreto Legislativo 2 Gennaio 2018, n. 224. Codice della Protezione Civile, 2018) and, at the regional level, the Marche Region Civil Protection Plan (Deliberazione della Giunta Regionale 1210_19 Approvazione degli "Indirizzi per la predisposizione del Piano Provinciale di Protezione Civile," 2019).

At a global level, the main points of reference were: the International Health Regulations (Merianos & Peiris, 2005); the Ethical Guidelines in Pandemic Influenza - Recommendations of the Ethics Subcommittee of the Advisory Committee to the Director (Centers for Disease Control and Prevention, 2007); the Public Health Emergency of International Concern (PHEIC) (World Health Organization, 2020); pandemic plans of the most performing countries in the fight against COVID-19 such as New Zealand (Ministry of Health, 2017).

The compilation of indicators derived from the analysis of chosen articles and documents, coupled with the observation of shared patterns, metrics, and actions related to the preparedness and emergency phases of biological hazards, has been incorporated within the framework of disaster risk reduction in the context of biological risk environments. The incorporation encompassed the political, socio-psychological, economic, and health dimensions. However, indicators pertaining to alternative hazard types were deliberately excluded. From a more scientific standpoint, the selection of these indicators often relies on systematic and well-defined processes. Despite this, it is crucial to recognise that the complex interactions between the components of biodiversity, the anthropogenic dimension, and the interaction of different types of hazards can pose challenges when applying such indicators in specific contexts.

A total of 64 indicators have been selected and based on their relevance, categorised into five macro areas: i) Health & Safety, with 17 indicators; ii) Political & Economic, with 6 indicators; iii) Socio – psychological, with 7 indicators; iv) Demographic, with 11 indicators; v) Pandemic, with 23 indicators. The macro areas correspond to the diverse composition of stakeholders who should be engaged in a health emergency, particularly in the context of a pandemic. Specifically, the Health & Safety macro area describes the components of the local Health Systems, such as structure, personnel, and resources, that contribute to the overall health of the population. The Political & Economic macro area encompasses the governance of institutions and stakeholder interactions, focusing on the development of ordinances and actions to achieve objectives related to the economic and social sphere. The Socio-Psychological macro area is dedicated to ensuring mental health and psychosocial well-being within the community. The Demographic macro area focuses on the structure of the population, considering aspects like composition, development, and commuting. The Pandemic macro area revolves around addressing the needs created by specific biological hazards within the health system. The table below displays the selected indicators along with their respective macro areas.

Table 3.2: *List of selected indicators collected in the literature review to assess the Health System Resilience and grouped in the five macro areas including Health & Safety; Political & Economic; Socio – psychological; Demographic; Pandemic*

Macro area	**Indicator**	**Description**
Health & Safety Components of local Health Systems like structure, personnel, resources, that take	Number of hospitals	Hospitals distributed in the province.
	Number of residential services	Residential services distributed in the province.

assistance to health of the whole population.	Emergency network	Presence of a coordinated network among hospitals, administrations, and stakeholders.
	Information quality	Level of accuracy, clarity, and dissemination of the official information.
	Coordination	Coordination among the Health System and administrations.
	Medical specialist	Number of medical specialists working in a hospital.
	Physician	Number of physicians working in a hospital.
	Nurse	Number of nurses working in a hospital.
	Social worker in public health service	Number of social workers in public health services working in a hospital.
	Interdisciplinarity	Interdisciplinary preparation of healthcare workers.
	Medicine/patient	Availability of effective medicine per patient.
	Triage tag	Effective and functional triage procedures.
	Tent	Availability of tents to support hospital's departments.
	Number of vehicles	Number of emergency vehicles.
	Helipad space	Presence of helipad space near a hospital.
	Accessibility (roads)	Number of roads entering and exiting from a hospital.
	Flexibility in the use of facilities	Flexibility of procedures and structure of a hospital.
Political & Economic Governance of institutions and stakeholders' interactions developing ordinance and	Partnership / international / interregional cooperation	Cooperation among different administrational levels.
	Governance (strength stability)	Population trust in the Government and its stability.

actions to reach the objectives related to the economic and social sphere.	Human rights	Respect for human rights.
	Aid support	Aid received in terms of funds and personnel.
	Aid continuity	Long-lasting aid received during the emergency.
	Multi-stakeholders' engagement	Multi-sectoral approach during planning, preparing, and responding to emergency activities.
Socio – psychological Mental health and psychosocial wellbeing guaranteeing mental health and psychological wellbeing.	Availability of green areas	Presence of green areas in a hospital.
	Common area with sufficient physical distance	Presence of wide common areas in a hospital.
	Sport / relaxing spaces	Presence of sport or relaxing spaces in a hospital.
	Psychological support	Presence of psychologists in a hospital.
	Psychological training	Courses for healthcare workers about emergency management.
	Ethical principles	Respect for ethics during procedures and choices.
	Social organisation in the territory (volunteer)	Availability of the support of volunteers.
Demographic Structure of population like composition, development, and commuting.	Mean age	Mean age in the analysed province.
	Gender male	Percentage of male gender within the resident population.
	Gender female	Percentage of female gender within the resident population.
	Residents	Number of inhabitants in a province.
	Population density	Number of inhabitants per square kilometre (ab./km^2)
	Active population (school / job)	Percentage of population working or studying.

	Commuting for studying (2019) into the Municipality	Percentage of population commuting for studying into the Municipality.
	Commuting for studying (2019) outside the Municipality	Percentage of population commuting for studying outside the Municipality.
	Commuting for working (2019) into the Municipality	Percentage of population commuting for working into the Municipality.
	Commuting for working (2019) outside the Municipality	Percentage of population commuting for working outside the Municipality.
	Population in good health (Marche Region)	Health status of a population including factors such as birth and death rates, life expectancy, quality of life, morbidity from specific diseases.
Pandemic Needs created by the specific biological hazard in the health system.	COVID-19 positive cases (per province)	Percentage of people getting COVID-19 disease in a province.
	Updated pandemic national plan	Presence of an updated national plan.
	Updated pandemic regional plan	Presence of an updated regional plan.
	Updated hospital emergency plan	Presence of an updated hospital emergency plan.
	Maximum hospital capacity	Number of hospitalised patients that a hospital can manage.
	COVID-19 ward	Presence of a department for the management of pandemic patients.
	Convertible bed for COVID-19 patients	Number of beds that can be converted for pandemic's patients.
	Contingency staff (% increase)	Percentage of healthcare personnel employed in the pandemic department.
	Overtime working hours	Percentage of increase in hours per shift.

	Personal protective equipment	Availability of adequate equipment.
	Pandemic emergency training	Training for the management of emergencies.
	Previous experience	Pandemic events previously experienced by healthcare workers.
	Distinct roads for COVID-19 and non-COVID-19 patient	Division of paths for positive and non-positive patients.
	Supply chain of medicines and medical supplies (diversified)	Availability of drugs, tools, and personnel supply specific for pandemic.
	Health literacy status	Status of knowledge about good health and well-being preservation.
	Contact-tracing	System to trace virus transmission.
	Vaccination (rate)	Percentage of people vaccinated.
	Communication	Effective emergency communication.
	Funds (per healthcare workers or tools)	Availability of funds to increase resources.
	Flexibility	Capacity of procedure to be adapted to different emergencies.
	Timeliness	Time to manage patients.
	Remote medical support	Presence of telemedicine.
	Emergency number	Presence of a telephone number to call in case of emergency.

Collecting data on all these indicators should provide support in evaluating the preparedness of Italy and the level of the Health System Resilience at local level as described in the principal hypothesis. Numerical values related to the population were standardised dividing them with a common value of 10.000 inhabitants. The indicators listed in the Health & Safety macro area represent the key elements that should ideally be abundant in an area. The more of these elements present, the better equipped the health system is to handle potential health impacts and to ensure care and attention for all potential

patients. The indicators included in the Political & Economic macro area should represent the level of fragmentation and differences of public health policies across governmental bodies of Italy as assumed in the first sub-hypothesis.

Considering the second sub-hypothesis, some of the indicators included in the Pandemic macro area should provide indications of the lack of funding for pandemic preparation in Italy, hampering the updating of pandemic emergency plans to address COVID-19.

The third sub-hypothesis is supported by the indicators in the Socio – psychological macro area: if all the indicators are present in an area, the psychological burden on healthcare workers should be manageable.

3.3.2 Multi-Criteria Decision Analysis

The Multi-Criteria Decision Analysis (MCDA) is a decision-making process used to compare, weigh, and evaluate multiple criteria, even if they are potentially in conflict with each other. This methodology aims to facilitate the identification of the most optimal decision concerning a specific procedure. The purpose is to present a ranking of options, ordered from the most to the least favourable, to assist decision-makers in the selection of alternatives based on different decision variables. The MCDA techniques are applied to solve complex problems and, when coupled with a sensitivity analysis, provide a valuable tool to simplify the decision-making process (Ishizaka & Nemery, 2013). This approach finds applications in various research domains. According to Roy (1981), decision making processes can generally be categorised into four primary types of problems, as outlined below:

1. the choice problem, which involves selecting the single "best action" or reducing a group of options into a subset of a feasible choices;
2. the ranking problem, which involves ranking options from best to worst in order of satisfaction or preference;
3. the sorting problem, which involves grouping options into categories with similar behaviours or characteristics;
4. the description problem, which involves describing options and developing a cognitive procedure based on their consequences.

Numerous methods have been developed to address the four types of multi-criteria problems, and this number is steadily increasing (Ishizaka & Nemery, 2013). These methods vary in the problems they target, the underlying philosophies guiding them, the assumptions they lean on, and the information they necessitate. The selection of the most suitable method to employ depends primarily on the input data and the decision problem characteristics. Although many MCDA methods share common characteristics, such as using rankings to evaluate alternatives based on multiple criteria, they vary in terms of how they generate scores for these alternatives (Ishizaka & Nemery, 2013; Roy, 1991; Saaty, 1987). Some methods aggregate scores from individual criteria to provide an overall score (aggregated scores). Others use pairwise comparisons to determine which alternative is better than the other in certain aspects (outranked scores). Still, others involve comparing the performance of alternatives against a baseline or default benchmark (referenced scores).

Table 3.3 delineates the most frequently employed MCDA methods linked to the specific problems they address (Ishizaka & Nemery, 2013). Most of the methods are suitable for both choice and ranking problems, while some can also be used for sorting and description problems with specific extensions. For instance, the Analytic Hierarchy Process (AHP) involves structuring decision problems hierarchically and deriving priorities through pairwise comparisons, making it applicable to choose, ranking, and sorting problems. The Analytic Network Process (ANP) is an extension of AHP that enables the modelling of dependencies and interactions among criteria, and it can be used for both choice and ranking problems. Another feasible method for addressing multiple problems is the Multi-Attribute Utility Theory (MAUT), which includes the UTilities Additives (UTA) and Utilities Additives DIScriminantes (UTADIS) extensions. This method involves modelling preferences and trade-offs through utility functions and analysing the overall utility of alternatives. Additionally, the Measuring Attractiveness by a Categorical Based Evaluation Technique (MACBETH) enables qualitative evaluation and preference modelling in choice and ranking problems. Also suitable for choice and ranking problems is the Preference Ranking Organization Method for Enrichment Evaluations (PROMETHEE), which ranks alternatives based on partial pre-orders and allows for sensitivity analysis. PROMETHEE allows for two types of extensions: FlowSort, which classify alternatives based on the flow of outranking relations for sorting problems, and GAIA and FS-Gaia, which are suitable for constructing a global model for the decision problem. To eliminate unsuitable alternatives and express the remaining ones in choice, ranking, and sorting scenarios, the Elimination and Choice Expressing Reality (ELECTRE) method can be applied. The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) identifies the best alternative in choice and ranking problems based on proximity to the ideal solution and to the anti-ideal solution. Furthermore,

Goal Programming, generally employed for choice problems, aims to minimise deviations from predefined goals. On the other hand, Data Envelopment Analysis (DEA) is employed in choice and ranking problems to evaluate the efficiency of decision-making units based on input and output criteria. In recent years, multi-method platforms have emerged to combine various methods, enhancing interoperability, and enabling users to choose and apply methods tailored to the specific nature of their decision problems.

Table 3.3: *List of Multi-Criteria Decision Analysis (MCDA) methods and their applications across different types of decision problems, including choice, sorting, ordering, and description problems*

Choice problems	**Ranking problems**	**Sorting problems**	**Description problems**
AHP	AHP	AHPSort	
ANP	ANP		
MAUT/UTA	MAUT/UTA	UTADIS	
MACBETH	MACBETH		
PROMETHEE	PROMETHEE	FlowSort	GAIA, FS-Gaia
ELECTRE I	ELECTRE III	ELECTRE-Tri	
TOPSIS	TOPSIS		
Goal Programming			
DEA	DEA		
Multi-methods platform that supports various MCDA methods			

Source: elaboration from (Ishizaka & Nemery, 2013)

This research project uses the Multi-Criteria Decision Analysis to examine the characteristics that contribute to pandemic preparedness and planning in local Health Systems, making them more resilient. In order to achieve this, the set of indicators described in the previous paragraph have been used. To ensure a comprehensive analysis of hospital systems, it is crucial to objectively examine the interaction between such indicators, evaluate their relevance within the context of the analysis, and determine their respective weight in the decision-making process. These issues fall into the category of the MCDA ranking problems.

Selecting the most suitable approach for resolving a decision problem can be a daunting task for decision-makers. Furthermore, these problems may change and develop over time, necessitating a more appropriate approach (Ishizaka & Nemery, 2013). Therefore, if the input conditions permit and the assumptions are valid, employing various methods that are suitable for different problems can enhance confidence in the outcomes.

For these reasons, two types of MCDA methods have been applied: the Technique of Order Preference Similarity to the Ideal Solution (TOPSIS) and the Analytic Hierarchy Process (AHP). The TOPSIS approach is used to evaluate the functionality of the selected indicators and their effectiveness in generating a meaningful ranking of hospitals. The Analytic Hierarchy Process (AHP) is used to further validate the selected indicators by incorporating expert judgement. This coupled approach enhances the reliability and robustness of the Health System resilience assessment.

The following paragraphs will delineate the methodology governing the process of data collection for the indicators and expound upon the TOPSIS and AHP analyses.

3.3.2.1 Data collection for MCDA indicators

Data collection for the indicators was systematically structured across multiple time periods, each corresponding to different waves of the COVID-19 pandemic: the first, second/third and fourth waves. The key distinction among these data lies in the number of COVID-19 positive cases recorded during each wave.

The three time periods have been identified after a bibliographic review on the division in waves of the COVID-19 pandemic in Italy (Bartolucci & Farcomeni, 2022; Bonetti & Melani, 2022; Casti & Consolandi, 2021; Jurgensen et al., 2021; Marmo et al., 2022):

- the first wave corresponds to the period from February to May 2020;
- the second and the third waves correspond to the period from the second half of September 2020 to June 2021;
- the fourth wave corresponds to the period from August 2021 to March 2022, which is the end of the state of emergency (Gazzetta Ufficiale della Repubblica Italiana, 2022).

The second and third waves were united because it is not very clear when the second ended and the third wave started.

The analysis was performed for each of the selected hospitals in the Marche Region.

Most of the data for the indicators were obtained through interviews with the Head of the Emergency Department of the selected hospitals. These interviews were conducted through face-to-face meetings, with questions specifically related to the indicators. The structure of the interview

administered to the Head of the Emergency Departments is provided in table 3.4. The interviews with the Head of the Emergency Departments represent seven out of the nine selected hospitals: Ancona for the Ospedali Riuniti of Ancona; Camerino for a cluster of three hospitals (Santa Maria della Pietà in Camerino, Enrico Mattei in Matelica, and Bartolomeo Eustacchio in San Severino Marche); Civitanova Marche for the Santa Lucia civil hospital; Fabriano for the Engles Profili civil hospital; Jesi for the Carlo Urbani hospital; Pesaro for the Territorial Health Agency (A.S.T.); San Benedetto del Tronto for the Madonna del Soccorso hospital. The interviews were conducted between March and April 2022 and then again between October and November 2022. The questions focused on gathering information to complete the data for the selected indicators (especially for indicators pertaining to Health & Safety, Pandemic, and Socio-psychological macro areas) and delved into the emergency within the emergency department. The questions were designed to elicit specific responses: closed-ended, open-ended, and Likert scale (ranging from one to five, where one corresponds to the worst option and 5 to the best). For each answer, Heads of Emergency Departments were free to provide additional information. The interviews lasted approximately thirty minutes.

Table. 3.4: *Interview scheme for the head of the emergency department. In the first column it is reported the questions, while in the second column it is described the type of expected answer (closed-ended, open-ended; Likert scale)*

Question	**Type of answer**	
Role	Head of emergency medicine	
Name and surname		
Hospital		
Health & Safety and Pandemic		
1. How much has the COVID-19 pandemic surprised the health system in terms of preparedness?	Yes/No	Likert scale
2. Have you had previous experience in managing epidemic or pandemic emergencies? If so, how important has your experience been in dealing with COVID-19?	Yes/No	Likert scale
3. What do you think was missing in the management of COVID-19 pandemic emergency?	Open-ended	
4. What were the positive aspects in the management of COVID-19 pandemic emergency? (lessons learnt)	Open-ended	
5. In general, is the preparation of the population to face a pandemic adequate?	Yes/No	

6. During the early stages of the COVID-19 pandemic, how important was the emergency chain and how much it influences the collaboration between health facilities and out-of-hospital operations (e.g., emergency number, general practitioners, volunteers) in the successful management of the pandemic?	Likert scale		
7. Have the internal and external communication services been adequate?	Yes/No	Likert scale	
8. During the time of COVID-19 pandemic, was the number of specialists in your entourage adequate? How many specialists were there?	Yes/No and number		
9. How many doctors work in the emergency room?	Number		
10. How many nurses work at the emergency room?	Number		
11. How many health social workers work at the emergency room?	Number		
12. How many hours does a healthcare worker work per each shift? Did the hours increase during the COVID-19 period? How much?	Number	Yes/No	Percentage
13. Emergency room staff have multidisciplinary preparation; how much is it important in the pandemic management?	Likert scale		
14. Do you have an adequate stock of drugs to fight a pandemic? Or does it depend too much on the type of pandemic virus?	Yes/No	Open-ended	
15. Are the triage procedures suitable for managing a pandemic or can they be improved?	Yes/No	Open-ended	
16. Are you equipped with tents to use in an emergency (e.g., triage tents, patient waiting tents…)?	Yes/No	Number	
17. During the early period of the COVID-19 pandemic, did you have an adequate number of resources to deal with a pandemic? How many?	Yes/No	Likert scale	
18. How many roads of access and exit are there to reach the hospital?	Number		
19. Is the rescue system flexible? How important is it to manage a pandemic?	Yes/No	Likert scale	

20. What is the weight of ethics in pandemic emergency situations?	Likert scale	
21. How important is the cultural background in pandemic emergency situations?	Likert scale	
22. What is the average of positive cases accepted (between early stage of pandemic, intermediate stage, and current stage)?	Number	
23. At hospital level, was a pandemic management plan available? now?	Yes/No	Likert scale
24. Do you have a positive COVID-19 ward? At the beginning of the pandemic?	Yes/No	
25. How many intensive or sub-intensive beds are convertible for COVID-19 positive patients?	Number	
26. Is the COVID-19 ward staff different from the rest of the ward and how many healthcare workers are expected?	Yes/No	Number
27. Was the emergency room sufficiently fitted with personal protective equipment during the first wave?	Yes/No	Likert scale
28. Has the staff taken a course on pandemic emergency management?	Yes/No	Likert scale
29. Has the emergency room ever had epidemic/pandemic management experience before COVID-19?	Yes/No	Likert scale
30. Were the supply of drugs suitable for the management of COVID-19 easily available and with adequate availability?	Yes/No	Likert scale
31. What is the health literacy status of the population and how important is it in the management of a pandemic?	Likert scale	
32. Is the contact-tracing system available and useful in the management of the pandemic?	Yes/No	Likert scale
33. How important is the vaccine for pandemic management?	Likert scale	
34. Has pandemic communication been effective and how important is it?	Yes/No	Likert scale
35. Did you have access to specific funds for pandemic management? How useful/fundamental have they been?	Yes/No	Likert scale

36. How important is the timing of intervention in the final return of the pandemic management?	Likert scale	
37. Is the remote emergency support used or could it be useful (e.g., blog, telemedicine, remote medical consultation…)?	Yes/No	Likert scale
38. How useful is the emergency number support?	Likert scale	
Socio & Psychological		
Are in the first aid area:		
Green areas	Yes/No	Number
Commons areas with sufficient space to maintain the safety distance	Yes/No	Number
Space to practise sports or relaxing areas	Yes/No	Number
Psychological support	Yes/No	Number
Training support available	Yes/No	Number
Social organisations present in the territory	Yes/No	Number

Other data were acquired through a review of the national and regional health databases as the online portal of the Italian Ministry of Health[49] and the Regional Health Agency portal and report[50]. Demographic data were sourced from the National Institute of Statistic (ISTAT – Istituto Nazionale di Statistica)[51]. Information about the pandemic in Italy was gathered from national and regional pandemic plans, as well as official updated websites[52].

Both quantitative and qualitative data were collected and reported as normalised numbers, to facilitate data comparison and avoid any bias based solely on larger numerical value. In particular, for what concern quantitative data, the study normalised the number of hospitals or residential services by dividing it by a factor of 1.000 square kilometres. Population data, as well as the number of specialists, doctors, nurses, and social health operators, were also normalised by dividing residents by a common

[49] National Health Service database available at the link published at March 2013 and constantly updated https://www.salute.gov.it/portale/documentazione/p6_2_8_1_1.jsp?lingua=italiano&id=6 (last consultation 9th February 2021).
[50] Database of Demographic Data for Services, Organizations, and Social Actors in the Marche Region (Banca Dati Anagrafica Servizi, Enti e Attori Sociali delle Marche) available at the link http://serviziorps.regione.marche.it/leggeventiserv and the Report on the financial statements' management (Relazione sulla gestione bilancio d'esercizio anno 2020), appendix of the report for 2020 drafted by the Single Regional Health Company (ASUR – Agenzia Sanitaria Unica Regionale).
[51] Database of the National Institute of Statistic (Istituto Nazionale di Statistica) consulting the "Population and families" category https://esploradati.istat.it/databrowser/#/it/dw/categories.
[52] Database of the National Department of Civil Protection about COVID-19 cases divided by province https://github.com/pcm-dpc/COVID-19/tree/master/dati-province.

standard of 10.000 inhabitants. Additionally, the study normalised the active population (population aged 15 to 64) by dividing it by residents and then multiplying by 100. Finally, the number of positive cases was divided by the resident population. On the other hand, qualitative data obtained from interviews, or official national and regional sources were normalised using codes: 0 for "no" and 1 for "yes", in the case of closed questions with only two possible responses (yes-no questions), and numbers from 1 (complete agreement) to 5 (complete disagreement) for questions that required to express the degree of agreement or disagreement with a statement using the Likert scale. Data have been normalised in order to make comparable the different geographical areas of interest of the selected hospitals. Since not all hospitals in each province or *Area Vasta* were activated as COVID-hospital during the pandemic, it is assumed that patients sought care at the nearest hospital, and if necessary, they were transferred to the nearest COVID-hospital.

3.3.2.2 TOPSIS analysis

The Technique of Order Preference Similarity to the Ideal Solution (TOPSIS) method is used to assess the distance of a set of indicators from both an ideal and an anti-ideal solution to the decision problem (Ishizaka & Nemery, 2013; Millek, 2019; Wang & Lee, 2009). The application of the TOPSIS in this research project aims to provide insights into the hospital's performance during the COVID-19 pandemic. Here, the ideal solution represents the most performing and, consequently, the most resilient hospital to pandemic emergencies, among those selected in the Marche Region.

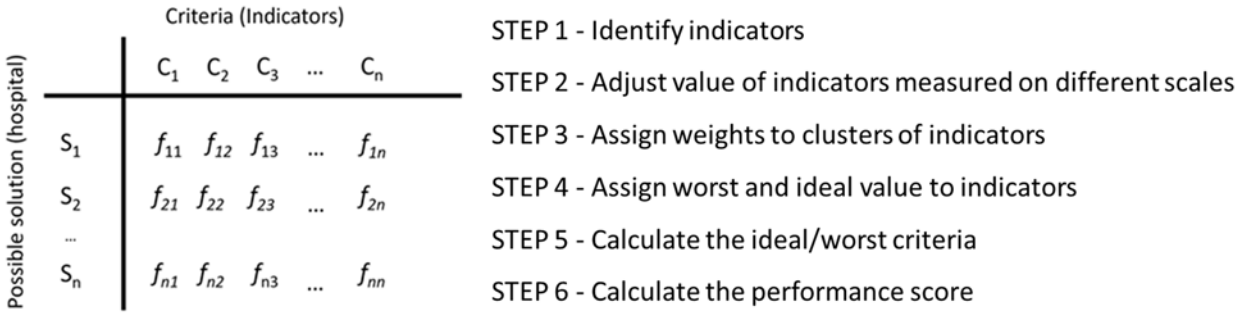


Figure 3.5: *Basic structure of the TOPSIS analysis. On the left side, the interaction between criteria (indicators for this research project) and possible solutions (hospitals for this research project) with specific normalised data. On the right side, the phases (steps) of the analysis*

The figure 3.5 illustrates the interaction between selected indicators or criteria (C_n) and selected hospitals or possible solutions (S_n). Data corresponding to the interaction between criteria and possible solutions (f_{nn}) are normalised to be comparable. On the right side of the figure, the process

of the TOPSIS analysis to obtain the final rank describing the best performing hospital is described according to six computational steps:

- STEP 1 - Identify indicators;
- STEP 2 - Adjust value of indicators measured on different scales;
- STEP 3 - Assign weights to clusters of indicators;
- STEP 4 - Assign worst and ideal value to indicators;
- STEP 5 - Calculate the ideal/worst criteria;
- STEP 6 - Calculate the performance score.

In step 1 of the TOPSIS analysis, each macro area, which represents a cluster of indicators, is given equal weight by dividing 1 (a complete unit) by 5 (the number of macro areas). Similarly, uniform weights for indicators (w_j) are obtained by dividing the weight of each macro area by the number of indicators within a particular macro area. Furthermore, in this phase, it was specified whether each indicator should have a maximum or a minimum value (or performance) to align with the ideal conditions. For instance, in the context of a pandemic, it would be advantageous if the number of hospitals in a given area is high (maximum), while the population density is low (minimum).

The step 2 of TOPSIS analysis provides for the normalisation of data to enable comparison across different units. Several normalisation methods can be found for this purpose. Specifically, distributive normalisation is chosen. This is achieved by dividing each indicator's performance by the square root of the sum of each squared indicator performance:

$$\bar{X}_{ij} = \frac{\bar{X}_{ij}}{\sqrt{\sum_{i=1}^{n} X_{ij}^2}}$$

The distributive normalisation index thus obtained ($\bar{X}_{ij}$), is then multiplied by the data from step 1 in order to derive normalised data for each hospital.

In the step 3, a weighted normalised decision matrix is created by multiplying the normalised scores from step 2 by their corresponding weights from step 1:

$$v_{ij} = \bar{X}_{ij} \cdot W_j$$

Step 4 investigates which of the normalised data of step 3 reflects more the ideal condition established in step 1. Thus, the weighted scores have been compared to an ideal option (maximum value v^+) and anti-ideal option (minimum value v^-) through the following formula:

$v_{+j} = max_i(v_j)$ if the criterion j is to be maximised

$v_{-j} = min_i(v_j)$ if criterion j is to be minimised.

The ideal and anti-ideal points are typically determined by the decision-maker or the investigator conducting the analysis. In this research project, the ideal point was considered to be close to 1, while the anti-ideal point is close to zero.

Once identified the references for the ideal and anti-ideal points, in step 5 the objective is to calculate the Euclidean distance for each criterion (S_i^+) to the ideal and anti-ideal point.

$$S_i^+ = \left[\sum_{j=1}^{m}(V_{ij} - V_j^+)^2\right]^{0,5}$$

$$S_i^- = \left[\sum_{j=1}^{m}(V_{ij} - V_j^-)^2\right]^{0,5}$$

The function corresponds to the sum of the squared differences between the data in step 3 and the ideal or anti-ideal point in step 4 for each criterion and indicator.

Step 6 seeks to calculate the relative closeness coefficient (P_i), named also performance score, and obtain the final rank of performances. The closeness coefficient of each hospital is determined by dividing the anti-ideal point by the difference between the ideal and anti-ideal point.

$$P_i = \frac{S_i^-}{S_i^+ + S_i^-}$$

The closeness coefficient falls within a range of 0 to 1, with 1 representing the ideal solution. The final rank provides a scale from the most to the least performant score corresponding to the most resilient and the least resilient hospital.

3.3.2.3 AHP analysis

The Analytical Hierarchy Process (AHP) is used in Multi-Criteria Decision Analysis to systematically evaluate and prioritise multiple criteria and sub-criteria by pairwise comparisons, synthesising complex judgments to derive a consistent and rational overall ranking of possible alternatives for decision making (Araz, 2013; Ishizaka & Nemery, 2013; Saaty, 1987). In this research project has been employed as an integration of the TOPSIS method to assign weights to criteria and sub-criteria

(Németh et al., 2019; Ortiz-Barrios, Borrego-Areyanes, Gómez-Villar, Felice, et al., 2021) by incorporating expert judgement (Lootsma, 1990). Specifically, if the TOPSIS method has been used to calculate the resilience level, the AHP assists in evaluating the utility function and establishing priorities of analysed criteria (Bernasconi et al., 2010a, 2010b). The utility function represents the decision-maker's preferences or satisfaction levels associated with different outcomes or choices. The process of assigning weights and identifying the best possible options must be objective, as it can significantly impact the results of the analysis (Odu, 2019). Therefore, when the judgements are accepted from a single expert a bias can be introduced. For this reason, various experts have been consulted to assign weights to criteria and sub-criteria by pairwise comparison.

The Analytical Hierarchical Process, it may be important to highlight the advantages and disadvantages of this analysis. Probably, the AHP represents the most frequently applied method (Frazão et al., 2018; Ortiz-Barrios et al., 2021) thanks to the ability to relate quantitative and qualitative criteria on a multi-dimensional scale (Araz, 2013; Lootsma, 1990; Ortiz-Barrios, Borrego-Areyanes, Gómez-Villar, De Felice, et al., 2021). Paying attention to the disadvantages, it can be highlighted that the AHP method is a pairwise comparison and the more numerous are the criteria, the more the comparisons that need to be performed; as a result, the decision-making process can be time consuming. Furthermore, if the researcher decides to add a new alternative to the model or remove the old alternative, the preferential order of alternatives can change sensibly. It is possible to affirm that AHP method is based on probability and subjective measures: for example, human emotions inevitably influence decisions, and if emotions change, it is possible that the weights may also change (Karthikeyan et al., 2016; Oguztimur, 2015). These observations suggest that the results of the AHP cannot be considered definitely true or absolute.

The Analytical Hierarchy Process breakdown the decision process into two phases (Ishizaka & Nemery, 2013; Németh et al., 2019; Saaty, 1987):

- the problem structuring;
- the elicitation of priorities through pairwise comparisons.

The problem is structured according to a three-level hierarchy where the top level is the goal of the decision, the second level represents the criteria (or macro-areas) and the sub-criteria (or indicators) considered in making the final decisions, and the lowest level represents the alternatives to be ranked based on their perceived desirability. An example of the basic structure of the AHP is represented in the figure 3.6 below. Each lower level is prioritised according to its immediate upper level. For example, in order to prioritise a criterion (level 2) the decision maker or expert should ask himself

which criterion is most important for meeting the goal and to what extent. The prioritisation depends on the context and on the decision makers.

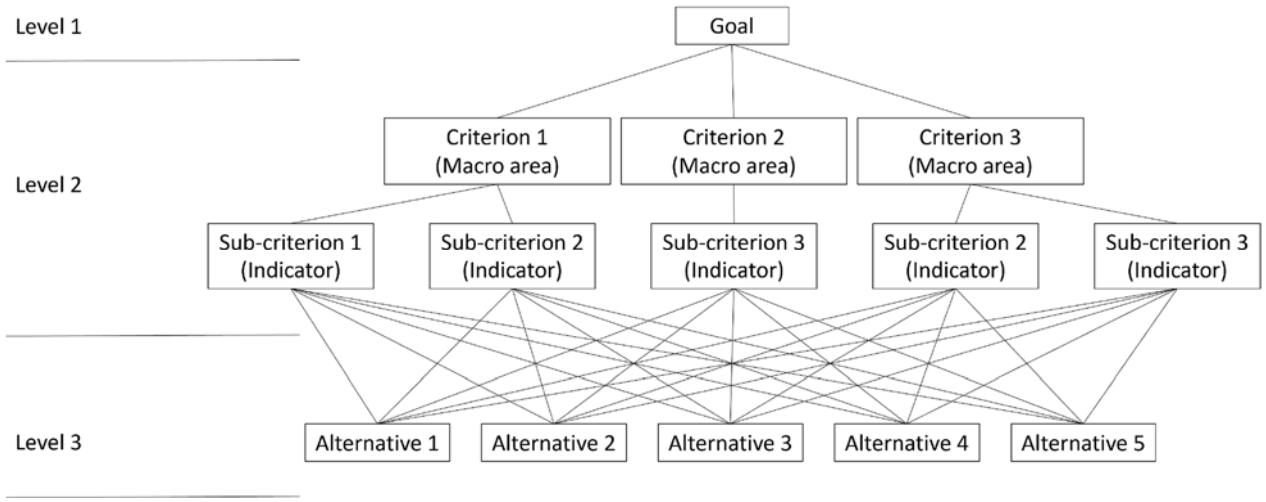


Figure. 3.6: *The basic structure of the Analytic Hierarchy Process. At the first level, the objective is defined; at the second level, there are the general groups of criteria (or macro areas) and the corresponding sub-criteria (or indicators); the third level represents the best alternative resulting from the comparison of indicators*

In this research project, the first step of the TOPSIS method addressed the problem structuring phase of AHP. For what concerns the prioritisation phase, the macro-areas and indicators pairwise comparison was conducted by a pool of six experts.

The experts were selected based on different backgrounds and expertise in fields such as disasters, pandemics, public health, emergencies, civil protection, and emergency medicine. The experts' contribution consisted of assigning relative importance weights to proposed pairs of macro areas or indicators. Experts should indicate which of the two macro areas or indicators they consider more important in terms of the pandemic emergency. The comparison weights are based on the fundamental scale of Thomas Saaty (1987) which ranges from extremely less important (weight = 1/9) to extremely more important (weight = 9) (Figure 3.7 and table 3.5).

	A	B	C	n
A	1			
B		1		
C			1	
n				1

Figure 3.7: *Comparison matrix for the criterion (macro areas) or sub-criterion (indicators) quality. Cells must be filled with numbers from 1/9 to 9, where 1 represents equal value between elements in comparison*

Table 3.5: *Fundamental scale of importance and related weights used to compare macro-areas and indicators in the AHP analysis*

Fundamental Scale (Row vs Column)	
Extremely less important	1/9
	1/8
Very strongly less important	1/7
	1/6
Strongly less important	1/5
	1/4
Moderately less important	1/3
	1/2
Equal Importance	1
	2
Moderately more important	3
	4
Strongly more important	5
	6
Very strongly more important	7
	8
Extremely more important	9

The experts were provided with instructions on how to assign weights to macro areas and indicators and the figure and table 3.5 shown above. The macro areas (and indicators) being compared were organised into a matrix, following the same order; in this way, the macro-area (or indicator) in the first row has been weighed in pairs against each of the other macro-areas (or indicators) in the columns. The pairwise comparison resulted in a matrix where equal weights of the two macro areas or indicators indicate equal contribution to the final goal (Pauer et al., 2016; Saaty, 1987). When completing the table, values less than 1 (fractions) indicate greater importance for the value in the column, whereas values greater than 1 (whole numbers) indicate greater importance for the value in the row. Fractions correspond to reciprocal values or lesser importance between two criteria.

Once all experts have provided their analyses, data have been normalised to determine the relative priority of each criterion and sub-criterion over the others. In this step, a transformation of all values

into whole or decimal numbers (instead of fractions) was carried out. Dealing with a consistent matrix, namely a matrix with values directly assigned to criteria, normalisation was possible by summing up the values in the row and normalising them against the total of rows:

$$W_i = \frac{a_{ij}}{\sum_k a_{kj}}$$

In the formula described above, a_{ij} stands for the experts' judgement in the comparison between indicators or macro areas (a_i and a_j), while W_i is the relative priority obtained for a_i.

Organising the resulting scores of this final analysis in growing order provided a classification of the priority given to indicators by experts. The procedure was repeated for each result of the experts weighting process and then the outcomes were compared. The comparison aimed at investigating the similarities and differences among experts' evaluations about the importance given to selected indicators and macro areas.

3.3.3 Perception analysis

A questionnaire about COVID-19 risk perception was administered to the Emergency Room's healthcare workers of the studied hospital in the Marche Region. The analysis of the collected information should help in demonstrating the third sub-hypothesis, inferring that "the psychological burden related with the pandemic strained healthcare workers, particularly those without previous pandemic management experience". The aim was to gain insight into healthcare workers' view of the management of the current pandemic event. Furthermore, this perception analysis should highlight the importance of some of the indicators selected.

The questionnaire was administered to all the Emergency Room's healthcare workers (specialists, doctors, nurses, social health operators, and 118 operators too), and it was written in Italian language to simplify the compilation (see Appendix 1.a, translation in appendix 1.b). The Heads of the Emergency Rooms asked for a paper questionnaire so that it could be easier to fill out and involve the staff in the compilation. The period of administration was between December 2021 and March 2023, with different steps among the selected hospitals depending on the first meeting with the Heads and the availability of the Emergency Room wards. Each Emergency Room of the selected hospitals had about one month to fill out the questionnaires and give them back.

The structure of the questionnaire provides for an introduction of the scope of the questionnaire, the hypotheses of this research, the information for the processing of personal data, and the question part. The questionnaire was completely anonymous, voluntary, and it takes about fifteen minutes to complete. It was specified that the information would only be processed by the responsible of the research and that the researcher would be available for any questions, curiosities, or clarifications. The questionnaire was constructed based on hypotheses and indicators, with particular emphasis on the third sub-hypothesis related to the psychological burden experienced by pandemic-affected healthcare workers. The primary objectives were as follows: i) to explore how the psychological aspect influenced the activities of healthcare workers; ii) to assess the impact of professional culture within the diverse realm of medical specialties on their responses; iii) to determine whether evidence exists that training and educational programs during the COVID-19 pandemic contributed to enhancing Health System Resilience; and iv) to investigate whether healthcare workers participated in pandemic drills prior to the COVID-19 outbreak. Additionally, the questions were systematically organised to evaluate healthcare workers' perceptions regarding the selected indicators.

The questions in the questionnaire, were of different types: open questions, closed questions (mainly multiple-choice), psychometric questions (Likert scale). The advantages of the open questions are that they offer much information, in-depth results, do not influence the respondents, and often highlight the personal perception of the respondent.

After the collection, the questionnaires have been analysed by means of IBM SPSS Statistics (Statistical Package for the Social Sciences) version 19 (https://www.ibm.com/products/spss-statistics).

SPSS is an advanced statistical software used for high and accurate quantitative analysis of complex data.

The questionnaires have been enumerated in order to maintain a correspondence between the paper and the digital version. The identification number was made up of seven characters among letters and numbers: the first two letters representing the Marche Region (MA), the second two letters representing the name of the city where is the hospital (TO for Torrette of Ancona; CA for Camerino; CM for Civitanova Marche; FA for Fabriano; JE for Jesi; MA for Matelica; SB for San Benedetto del Tronto; SS for San Severino Marche), the last three numbers represent the number of filled out questionnaire in sequence for each Emergency Room (the examples of the identification numbers is shown in the table 3.6. below).

Table 3.6: *Construction of the identification number of questionnaire*

	Identification number of questionnaire		
Hospital	First two letters	Second two letters	Last three numbers
University Hospital Ospedali Riuniti of Ancona – Medical device Umberto I	MA	TO	001
Santa Maria della Pietà hospital in Camerino	MA	CA	001
Santa Lucia civil hospital in Civitanova Marche	MA	CM	001
Engles Profili civil hospital in Fabriano	MA	FA	001
Carlo Urbani hospital in Jesi	MA	JE	001
Enrico Mattei hospital in Matelica	MA	MA	001
Madonna del Soccorso hospital in San Benedetto del Tronto	MA	SB	001
Bartolomeo Eustacchio hospital in San Severino Marche	MA	SS	001

For the purpose of analysis, the questionnaires have been organised in rows and the questions in columns. If a question was composed of correlated questions and multiple answers, each option was divided in different columns. In this study the open questions were analysed by highlighting key words and recurrent topics among different questionnaires. For closed or multiple-choice questions, the answers have been number coded. For instance, "0" has been used to represent the option "no answer"; "1" as "Yes"; "2" as "No"; "3" as "Uncertain". The five scale options of the psychometric questions have been replaced by a number scale from one to five, "1" represents "Completely disagree"; "2" is "Disagree"; 3 as "Uncertain"; 4 is "Agree"; "5" as "Completely agree", and "0" as "no answer". Figure 3.8 shows an example of the work sheets used in SPSS: the visualisation of data or "Data view" and the visualisation of variables or "Variable view".

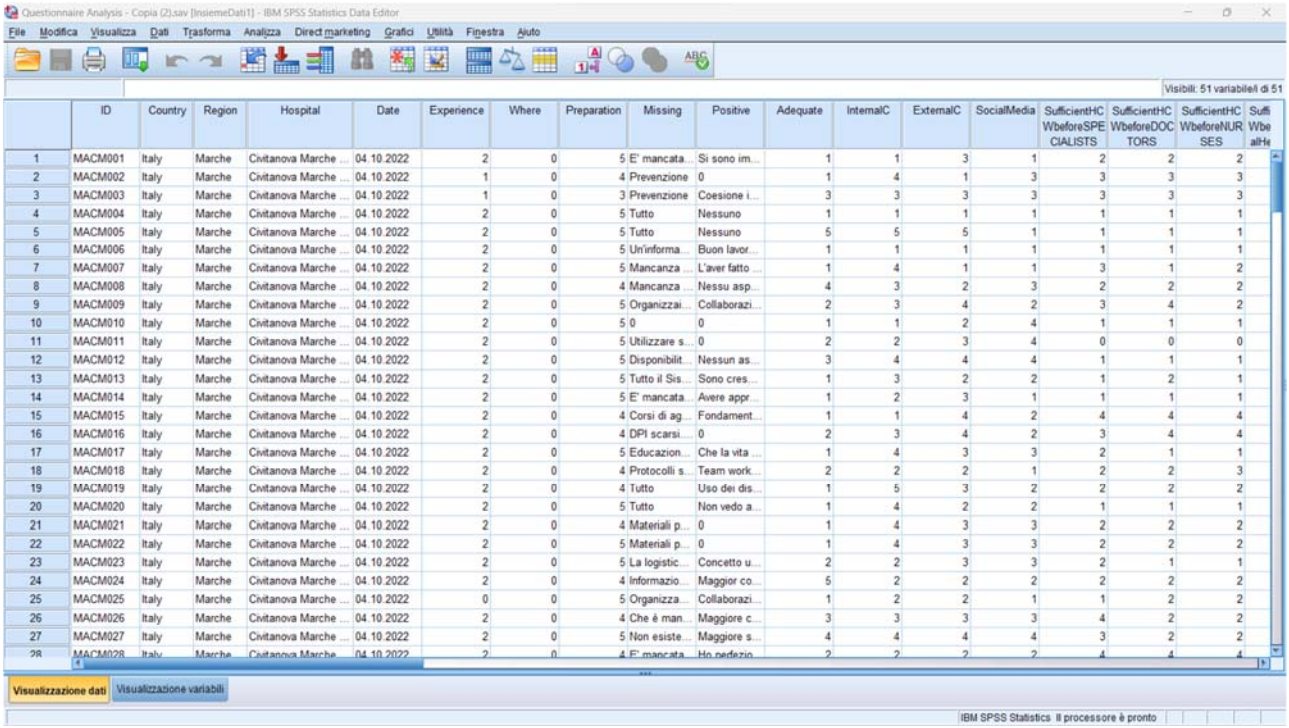


Figure 3.8: *Visualisation of the Data Editor in SPSS software*

The variables used in this study were nominal, ordinal, or scale:

- Nominal: the value of the variable represents categories with no intrinsic ranking;
- Ordinal: the value of the variable represents categories with some intrinsic ranking;
- Scale: the value of the variable represents ordered categories with a meaningful metric.

The types of data collected in this research are numeric (the value is a number), date (calendar-date format), or string (alphanumeric variable).

The method consisted of statistical descriptive analysis of the questions individually or by crossing one question with another. The most used functions were “frequency” and “contingency table”. The function “frequency” was useful to investigate how many times the options of a questions have been chosen; the function "contingency table” called also cross tabulation or crosstab is a type of table in a matrix format that displays the multivariate frequency distribution of the variables (Pagano, 2010), essentially it is a double-entry table used in statistic to represent and analyse the relations among two or more variables. A control variable is specified, and the outputs represent the measures associated with each value of the variables.

In particular, the outputs have been consulted both in frequency and in percentage and the visualisation in bar charts. Different statistics have been performed depending on the variables analysed each time. For nominal data the statistics were Contingency coefficient, Phi (coefficient) and Cramér’s V; for ordinal data Gamma (zero-order for 2-way tables and conditional for 3-way to 10-way tables), Kendall’s tau-b, and Kendall’s tau-c, Somer’s d. If the outputs of the statistics and measures association were near zero (0 for nominal value) or less than one (-1 for ordinal value) there was correlation between the two options. The Contingency coefficient is contemplated in the evaluation of results, and it is a coefficient of association that tells whether two variables or data sets are independent or dependent of each other.

3.3.4 PRISMA Statement

Another segment of the research project entailed a comparative analysis between the Italian pandemic management model and that of a Country with a strong track record in managing epidemic and pandemic events. This country should be a model of effective performance in handling these types of

hazards, taking into consideration factors such as geographical area, population, administration, and culture. The research was carried out through comprehensive literature review, encompassing scientific articles, reports, and documents related to countries that excelled in managing a specific type of hazard: epidemic and pandemic. The bibliographic review was conducted through official and scientific databases, including the World Health Organization website, Science Direct, Google Scholar, and Scopus. The keywords used in the selection process were related to the specific hazard under investigation: “pandemic”, “epidemic”, “COVID-19” along with terms like “management”, “experience” and “hazard”. This step was essential to gain a broad understanding of which countries had dealt with pandemic events and how different nations had managed their impacts.

Upon identifying the most performing Countries in terms of pandemic management, New Zealand emerged as a very interesting case worth further investigations, owing to its characteristics, including geographical position, demographic distribution, and a historical record of dealing with epidemics and pandemics.

The methodology employed to analyse data pertaining to New Zealand’s pandemic management was the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). This statement provides for a systematic review based on meta-analysis using statistical methods to summarise the results of various studies (http://www.prisma-statement.org/). The guidelines to carry out this statement were published for the first time in 2009 and designed primarily for health studies (Moher et al., 2015). The update arrived in 2020, following the purpose of authors and scientists coming from different study areas to provide syntheses about the state of knowledge in a specific field (Page et al., 2021). A systematic review is characterised by “well-defined research questions; transparent search terms and database selection; exclusion/inclusion criteria with evaluation of search findings; a research project structure with elements such as Introduction, Method, Result, Discussion” (https://aut.ac.nz.libguides.com/systematic_reviews).

The PRISMA statement is made up of a checklist of 27 items (see table 3.7 and in appendix 2 with the aim of guiding the authors fulfilling better systematic reviews and meta-analysis.

Table 3.7: *Sections and topics to be implemented for the PRISMA statement*

Section	**Topic**
TITLE	
ABSTRACT	

INTRODUCTION	Rationale Objectives
METHODS	Eligibility criteria Information sources Search strategy Selection process Data collection process Data items Study risk of bias assessment Effect measures Synthesis methods Reporting bias assessment Certainty assessment
RESULTS	Study selection Study characteristics Risk of bias in studies Results of individual studies Results of syntheses Reporting biases Certainty of evidence
DISCUSSION	
OTHER INFORMATION	Registration and protocol Support Competing interests Availability of data, code, and other materials

The image below (figure 3.8) reassumes the principal points characterising the procedure of the PRISMA statement.

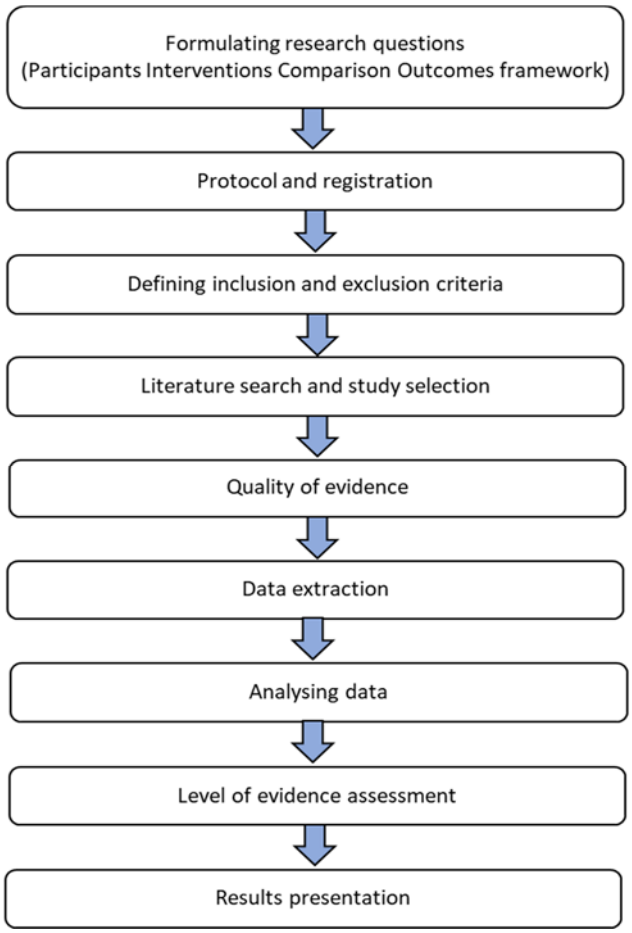


Figure 3.8: *Flowchart of a systematic review*

Source: Elaboration of the flowchart illustrating a systematic review from Ahn, E., & Kang, H. (2018). Introduction to systematic review and meta-analysis. *Korean Journal of Anesthesiology*, *71*(2), 103–112. https://doi.org/10.4097/kjae.2018.71.2.103 (Ahn & Kang, 2018)

The core of the statement or the "Literature search and study selection" up to the "Results presentation" may be summarised in the flow diagram in figure 3.9.

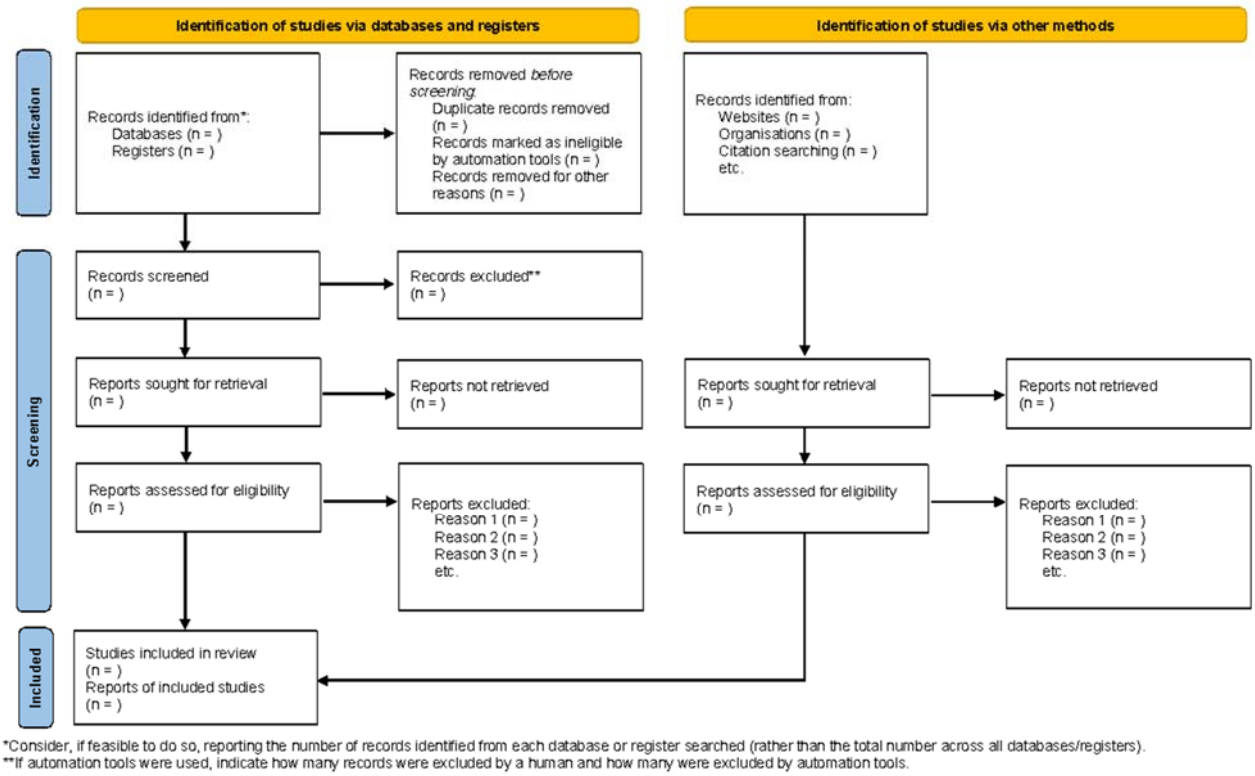


Figure. 3.9: *Flow diagram for new systematic reviews, precisely for the PRISMA statement*

Source: PRISMA 2020 flow diagram for new systematic reviews which included searches of databases, registers and other sources from Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. For more information, visit: http://www.prisma-statement.org/

The PRISMA statement establishes a framework for researchers to offer recommendations. Its aim is to utilise the best available evidence from a range of databases to reach conclusions related to a specific problem or intervention. The analysis starts formulating research questions and selecting key words, which are then searched across chosen scientific databases, registries, and grey literature. The final screening of paper and documents responds to exclusion and inclusion criteria with evaluation of search findings.

The objective of the PRISMA statement aligns very well with the goal of this doctoral research project in trying to identify the factors contributing to the success of New Zealand's response to COVID-19 pandemic. The systematic review investigated the evolution of the strategies leading up to the outbreak of the COVID-19 pandemic. Starting from the possible guiding principles that should have informed the decision-making process, as mentioned earlier, the analysis collects information related to institutional management (politic and health), social and cultural approach, historical experiences, and short- and long-term impacts.

A framework encompassing the key elements of the successful strategy implemented by New Zealand, was developed through the following research questions:

- How did prior experiences influence the management of the COVID-19 pandemic?
- What type of strategies and actions were implemented at the national, regional, and local level to manage COVID-19 pandemic?
- How did guidelines evolve over the time leading to the final pandemic plan's implementation?
- What is the strategy of the Health System?
- What role did the population and the socio-cultural approach play?
- What are the potential impacts of the implemented strategy?

The review includes articles and documents published up to the year 2023 and the following specific inclusion criteria were used: i) the geographical focus of documents was New Zealand; ii) the articles had to contain keywords related to pandemic response, pandemic strategies, pandemic management, or COVID-19; iii) the subject matter encompassed institutional management (policy and healthcare), social and cultural approaches, historical experiences, and short- and long-term impacts. Other documents or articles that did not address these three points have been excluded for lack of focus.

The inclusion criteria for institutional documents and data encompassed: i) documents and legislation related to pandemics and COVID-19; ii) documents and legislation pertaining to health in pandemic situations; iii) geographic and demographic data of New Zealand.

The selected articles were sourced from official and scientific databases, including EBSCO (Elton B. Stephens COmpany) information services; New Zealand Research database (NZ research); Auckland University of Technology library (AUT library), New Zealand Government official websites (e.g. Government Unite Against COVID-19; Government Beehive; Ministry of Health; Ministry of Business, Innovation & Employment; Immigration and Tourism; Statistics NZ); World Health Organization; Global Health Security Index; The World Bank. All searches were implemented between February and March 2023, whereas the search period ranged from 1965 to 2023. It was decided to begin with the year 1965 when the first Health Act in New Zealand was signed (Ministry of Health, 1956).

The investigation began with the Identification of relevant documents through databases and registers. The initial search term was "COVID-19 New Zealand", followed by sequential searches using keywords such as "Pandemic preparedness New Zealand", "Pandemic strategies New Zealand", "Pandemic response New Zealand". Filters applied in the databases included "journal article",

"academic journal" and "New Zealand". Subsequently, articles resulting from the search were filtered by country (New Zealand or Aotearoa), automatically excluding international literature. Articles were also filtered to exclude other types of works (such as books, or speeches) and by their position in the search results, excluding articles beyond the first ten pages of the databases. This process was repeated for each keyword searched. Subsequently, the identification of relevant documents continued through institutional documents referring to Government and Health Ministry laws and documents related to pandemic management or the COVID-19 pandemic. The keywords used were "pandemic" and "COVID-19 pandemic". Geographic and demographic data were exclusively focused on New Zealand, as were all the filtered documents.

To minimise bias searches had been conducted solely on official databases and websites, limiting the search using the same keywords across all the databases, and excluding duplicate articles. Undoubtedly, the use of additional terms in similar keywords may have yielded additional or different results. The PRISMA statement, which outlines guidelines for reporting systematic reviews and meta-analyses, necessitates collaborative efforts among multiple researchers. However, in the context of this study, a potential limitation arises from the fact that only one researcher conducted the systematic review. Despite this limitation, the utilization of multiple filters and specific keywords aligned with the focus of the PhD research is expected to enhance the quality of the systematic analysis.

3.3.5 Direct interviews to experts and selected residents of Auckland

A risk perception analysis was also carried while in New Zealand. This phase involved conducting interviews with four disaster studies experts as well as some residents of Auckland. The consulted experts are three Professors from Auckland University of Technology. One has substantial experience in public health and international humanitarian assistance; another primarily focuses on the Pacific Region, working on the development participatory tools for disaster risk management, transnational community support in disaster, community-based disaster response and sustainable recovery post-disaster; while the third led research on childhood health services, vaccine attitudes and behaviours, and community-based pandemic planning. Additionally, one Professor of Geography from The University of Auckland was consulted.

The interviews were recorded and conducted as a dialogue about the situation in New Zealand during the COVID-19 pandemic. The questions addressed to the participants were as follow:

- What is your personal and professional view on the COVID-19 pandemic?

- How do you assess the management of the most recent pandemic in your country?
- Based on your experience, what are the strengths and weaknesses in the approach used to manage COVID-19 in New Zealand?

The responses from the interviews were transcribed and collected in a single database. Subsequently the responses were compared to identify commonalities as well as divergent observations related to personal experiences. Findings of all the above data gathering activities will be presented in the Results chapter.

3.3.6 Comparative analysis of pandemic management in Italy and in New Zealand

This comparative analysis was aimed at highlighting similarities and differences in the two Countries' approach to pandemic management, with the goal to define a list of key points that should be carefully considered during (future) pandemic planning. The analysis encompassed i) geographic position, ii) political administration, iii) population distribution and composition, iv) socio-cultural characteristics and v) health system and historical experiences of epidemic and pandemic events. The information collected in all the above-described methodologies, from the Multi-Criteria Decision Analysis to the PRISMA statement were used for this comparison, along with data directly gathered from the two Countries official statistical databases: Istat (National Institute of Statistic) for Italy (https://esploradati.istat.it/databrowser/#/), and Stats NZ – Tatauranga Aotearoa for New Zealand (https://www.stats.govt.nz/). Both databases offer access to up to date information, encompassing details on population, geographic characteristics, and health. In both instances, filters could be applied to scrutinise information at the national, regional, and local scale.

Tracking of the Covid-19 epidemiology at the International level was gathered online at the "Coronavirus Resource Center" of the Johns Hopkins University and Medicine (https://coronavirus.jhu.edu/map.html), and at the "Coronavirus pandemic (COVID-19)" section of the Our World in Data publication (https://ourworldindata.org/covid-cases).

The epidemiology details in Italy were gathered through the official portal of the Italian Ministry of Health (citation, 2024)[53] whereas in New Zealand the data source was: "Unite against COVID-19"[54].

3.3.7 Field Exercise EU MODEX

Coincidentally with the third year of the doctoral research activity the European Civil Protection organised a field exercise (Module Exercise – MODEX) on an emergency scenario which included epidemics. The exercise was held in the Marche Region, city of Arcevia, in June 2023, and the Disaster Risk Reduction Laboratory at the Università Politecnica delle Marche was involved in the activities. This was a very timely opportunity to assess whether the lessons learned during the two years of COVID-19 emergency produced changes of protocols and modus operandi. The EU MODEX (https://www.eu-modex.eu) is a consortium commissioned to conduct Module Exercises within the Union Civil Protection Mechanism (UCPM) aimed at enhancing prevention, preparedness, and disaster response. The program fosters the development of different types of exercises.

[53] Ministry of Health, Rules, circulars and ordinances, https://www.salute.gov.it/portale/nuovocoronavirus/archivioNormativaNuovoCoronavirus.jsp?lingua=italiano&anno=2020&anno=2020&anno=2020&anno=2020&area=213&testo=&tipologia=&giorno=&mese=02&anno=2020&btnCerca=cerca&iPageNo=2

[54] New Zealand Government, Unite Against COVID-19, https://covid19.govt.nz/

Table 3.8: *Scale of exercises and relative descriptions which can be implemented for civil protection preparedness and response*

Exercises	**Description**
Table-top exercises (TTX)	Discussion-based sessions
	Focus on strategic decision-making and managerial preparation during a deployment (coordination, procedures, reporting and communication arrangements)
	There is no deployment of equipment or resources
Command post exercises (CPX)	The field response and deployment are simulated the headquarters intervening in an emergency
	All the activities performed are conducted, with exception of field activities
Full-scale exercise (FSX)	The most complex and resource-intensive operation-based exercise
	Involvement of agencies, organisations, jurisdictions, international player
	Inclusion of political, strategic, operational and/or tactical aspects with the coordination of local, regional, national, European, and international response
	Real-time and stressful environment as a real emergency
	Many activities occur simultaneously
Plug-in exercises	Implementation outside Europe
	Multi-organisation response
	Implementation of the UCPM response assistance and test of operational procedures and agreements
	Integration in the affected country
Host nation support table-top exercises	Integration, coordination, and international assistance on the response operations of an affected country

MODEX training focuses on different kinds of activities, called lots:

Lot 1: Table-Top Exercises

Lot 2: Water Hazards and Forest Fire Fighting

Lot 3: Urban Search And Rescue (USAR) – Search & Rescue

Lot 4: EUCPT – Expert teams + TAST – Technical support teams

Lot 5: Medical Modules

The 2023 edition medical EU MODEX exercise was hosted in the Town of Arcevia (Marche Region) from 6 to 10 June. The Arcevia 2023 EU MODEX simulated an emergency scenario consisting of a seismic and epidemic impact. In particular, the actors involved in the exercise simulated the activities following a 6.8 magnitude earthquake with an epicentre located nearby, while an epidemic outbreak of meningo-encephalitis was already underway. The drills enacted complex field exercises for all kinds of urban search and rescue along with medical emergency response. The exercise was carried out across a dedicated area of 126 km^2 and engaged about 250 stagers per day mimicking hundred different medical conditions. These stagers/simulators came from expert groups, but also from the population of Arcevia, including adults, youngsters, and children. The participants were Emergency Medical Teams (EMTs) expert in disaster medicine, coming from Austria, Germany, and Romania. Each EMT was composed by a field structure (field hospital), health materials, healthcare personnel and logistic personnel (about 30/40 people per hospital). Furthermore, a team from Lithuania, healthcare personnel from Andorra, and European experts in Civil Protection from Greece, Italy, Norway, Romania, and Sweden participated. The main referent is the European Civil Protection Team (EUCPT), whose objective is to improve team skills in preparation for real mission. The Technical Assistance Support Team (TAST) supported the EMTs, whereas the Exercise Control structure (EXCON), located at the Cultural Centre Saint Francesco in Arcevia, coordinated the activities. The event's organisation required about one year of work under the supervision of the European Commission (responsible of the coordination and financing of the training), the Department of Italian National Civil Protection, who selected the Marche Region Civil Protection Department, the World Health Organization (WHO), the Administration of the Municipality of Arcevia, voluntary group (ARES Onlus, Civil Protection of Arcevia) and the Università Politecnica delle Marche (Medical and Surgery Science Faculty and Life and Environmental Science Faculty) and Università del Piemonte Orientale (with CRIMEDIM – Research Centre of medical science of disaster). During the MODEX Arcevia the Port Captaincy, the Municipal Police, the Prefecture, the Ancona Airport, the Firefighters from the Province of Ancona and three Hospitals Fabriano, Jesi, Senigallia had been involved in some fundamental activities.

The exercise scenario was implemented in a fictitious Country called Modulistan, which profile is shown in table 3.9. The Modulistan became a nation-state in 1861 united under King Victor Emmanuel II. The Democratic Republic was established in 1946 replacing the monarchy. Modulistan is composed by two Regions, Marche whose capital is Ancona and Umbria whose capital is Perugia. Modulistan is a charter member of NATO and the European Economic Community (EEC). In 1999,

joined the Economic and Monetary Union. Persistent problems include sluggish economic growth, high youth and female unemployment, organized crime, corruption, and economic disparities between southern Modulistan and the more prosperous North.

Table 3.9: *Characteristics of Modulistan*

MODULISTAN: **2 Regions: Marche and Umbria**	
Capital Marche	Ancona 
Chief town Umbria	Perugia 
Government	
2 Presidents	Luca Ceriscioli (PD) and Catiuscia Marini (PD)
Area: Total	17.822 km^2
Population (2012-10-30)	2.427.227
Density	260/km^2
Time zone	CET (UTC+1)
Summer (DST)	CEST (UTC+2)
GDP/ Nominal	€63.7 billion (2010) €21.8 billion (2008)
GDP per capita	€26.500 (2008) €24.400 (2008)
NUTS Region	ITE

Source: MODEX experts' documents

The scenario in Arcevia simulated an emergency after an earthquake of 7.2 magnitude and a subsequent appearance of an epidemic (figure 3.10).

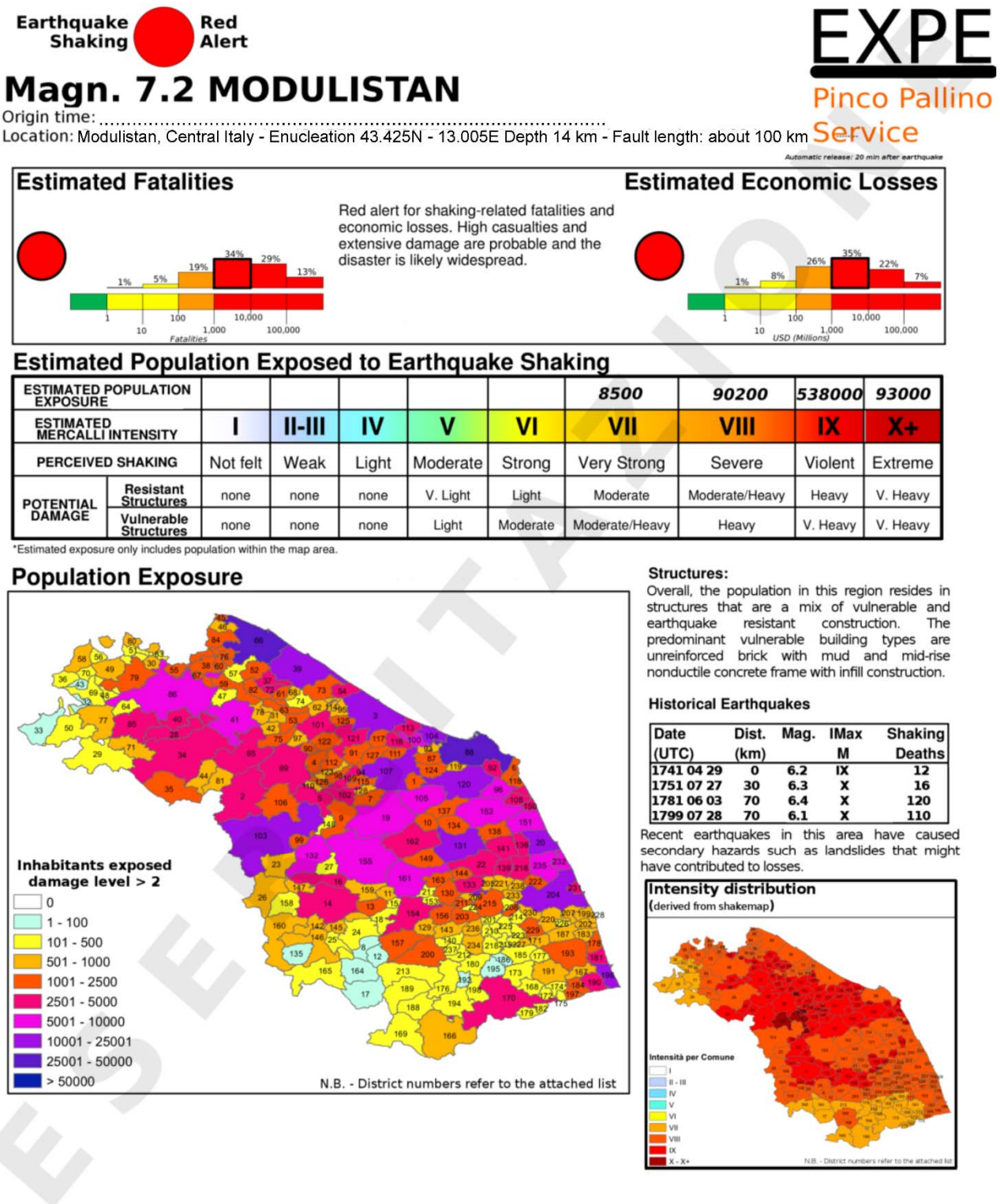


Figure 3.10: *Report of data related to the earthquake of Arcevia – Modulistan 2023*

Source: MODEX experts' documents

The principal activities to perform during the drill were called injects and were distributed into four phases corresponding to the four operational days of the exercise, from the 6th to the 9th of June. A summary of these activities is reported in the table 3.10.

Table 3.10: *Description of Arcevia MODEX 2023 phases*

Phase and day	**Description of activities**
Phase 1 – Day 6 June 2023	Arrival of the teams in Ancona
	Placement in the designed area in Arcevia and setting up of the field structures
	Local coordination
	First arrival of patient with traumatological and severe problems at the Advanced Medical Post
Phase 2 – Day 7 June 2023	Coordination with the local health authorities
	Institution of the cordon sanitaire
	Collaboration with the intermediate residential or semi-residential structure of Casa della Salute
	Coordinated management of suspected meningoencephalitis patients
	Cooperation of EMTs with Urban Search and Rescue (USAR) and Firefighters
Phase 3 – Day 8 June 2023	Removal of cordon sanitaire
	MEDical EVACuation (MEDEVAC) of the Hospitals of Fabriano, Jesi and Senigallia with the activation of Internal Emergency Plan Massive Influx of Injured (PEIMAF - Piano Emergenza Interno Massiccio Afflusso di Feriti)
Phase 4 – Day 9 June 2023	Blood pressure campaign to the population
	Data collection and transmission to the local Authorities
	Handover of EMTs

In relation to the doctoral research, the various injects have been studied from the planning to the implementation phases. The objective was to investigate the presence of selected indicators (table 3.11), thus verifying whether they have been contemplated by the organisers and whether the response teams took them into proper consideration. The study involved a comprehensive examination of each training phase, spanning from planning to implementation. The primary objective was to ascertain whether the identified points, aspects, and characteristics were effectively observed during the training activities and measures. It is worth underlining that during a simulation, many activities are already planned and obviously it is not a real emergency. Nonetheless, in the MODEX training the actors are not previously informed about the different activities, and they are carefully monitored to verify their actions and attitudes. As a matter of fact, during the Arcevia exercise, the Emergency Medical Teams (EMTs) were tested to obtain the international certification.

The table 3.11 below lists the indicators from the MCDA (see chapter 3.4.1 Multi-Criteria Decision Analysis). The selection of indicators for the MODEX exercise depends on the applicability of indicators selected for the research study to field hospitals and the training area. Established activities, training conditions, and involved participants suggested which indicators are included in a European training unrolled at local level.

Table 3.11: *Indicators analysed during the MODEX Arcevia 2023*

INDICATOR FOR HEALTH & SAFETY MACROAREA	**Description**	**What observe?**
Number of hospitals	Number of hospitals in the studied areas.	Field hospitals involved in the exercise.
Number of residential services	Number of residential services for elderly people in the studied areas.	Residential services in the training area.
Emergency network	Organisation of the emergency network among hospitals, public administrations, population and all the different stakeholders involved in the emergency.	Organisation of the emergency chain (field hospitals, public administration, fireman, civil protection, voluntaries).
Information quality	Quality of the information received by the hospital's emergency room from public administrations and stakeholders involved in the emergency.	Characteristics of information during the emergency.

Coordination	Coordination among hospitals, public administrations and stakeholders involved in the emergency.	Coordination between field hospitals and stakeholders.
Medical specialist	Number of medical specialists working in the emergency room of the selected hospitals.	Number of medical specialists per patient in the field hospitals.
Physicians	Number of physicians working in the emergency room of the selected hospitals.	Number physicians per patient in the field hospitals.
Nurse	Number of nurses working in the emergency room of the selected hospitals.	Number of nurses per patient in the field hospitals.
Social worker in public health service	Number of social workers in public health service working in the emergency room of the selected hospitals.	Number of social workers in public health service per patient in the field hospitals.
Interdisciplinarity	Level of interdisciplinary skills requested in the emergency room of the selected hospitals.	Type of preparation characterising the healthcare workers of the field hospitals.
Medicine/patient	Ratio between available specific drugs and patients in the emergency room of the selected hospitals.	Availability of drugs per patient in the field hospitals.
Triage tag	Adequacy of triage procedures in the emergency room of the selected hospitals.	Adoption of European instructions for the triage procedures.
Temporary tent structures	Availability of temporary tent structures used by the emergency room of the selected hospitals (used as waiting/isolating rooms for patients needing care).	Number of tents and organisation for the field hospitals.
Number of vehicles	Adequate number of emergency vehicles to deal with many emergency calls.	Number of vehicles per field hospital.
Helipad availability	Availability of helipads near the hospitals.	Presence of a helipad in the training area.
Hospital accessibility	Easiness to both enter and exit the hospital area.	Accessibility and position of field hospitals.

Emergency room layout	Flexibility in rearranging the layout of the emergency room of the selected hospitals.	Flexibility in rearranging when the first suspected cases appear.
INDICATOR FOR POLITICAL & ECONOMIC MACROAREA		
Partnership/ international/ interregional cooperation	Activation of the subsidiarity principles.	Characteristics of the administrational cooperation.
Governance (strength and stability)	Citizens' trust in the government.	Population's trust in the Arcevia Mayor.
Human rights	Respect of human rights in the emergency directives.	Strategies to respect human rights during the emergency.
Aid support	Aptitude of Government in receiving or giving support during the emergency.	Arcevia requests for international help.
Aid continuity	Aptitude of Government in giving continuity to aid during the emergency.	Duration of received aids.
Multi-stakeholders' engagement	Involvement of many stakeholders to deal with the emergency.	Stakeholders involved.
INDICATOR FOR SOCIO-PSYCHOLOGICAL MACROAREA		
Availability of green areas	Presence of green areas near the emergency room accessible by healthcare workers.	Availability of green areas in the field hospitals.
Common area with sufficient physical distance	Presence of lounges with adequate physical distancing accessible by healthcare workers.	Availability of adequate spaces for physical distancing in the field hospitals.
Sport/relaxing spaces	Presence of sport/relaxing spaces accessible by healthcare workers.	Availability of sports/relaxing areas in the field hospitals.
Psychological support	Provision of psychological support dedicated to healthcare workers	Availability of psychologists to support healthcare workers in the field hospitals.

Psychological training	Exercise programs for the management of psychological stress specifically designed for emergency room healthcare workers.	Characteristics of training followed by healthcare workers to be psychologically prepared for the management of emergencies.
Ethical principles	Decision making during emergencies driven by ethical principles.	Strategies implemented to respect ethical principles during emergency activities.
Social organisation in the area	Presence of voluntary organisations supporting the emergency rooms of the selected hospitals.	Type of social organisation involved in the exercise.
INDICATOR FOR DEMOGRAPHIC MACROAREA		
Average age	Average age of the population living in the areas served by the studied hospitals.	Average age of the population of Arcevia.
Male	Number of male individuals in the areas served by the studied hospitals.	Male individuals in the population of Arcevia.
Female	Number of female individuals in the areas served by the studied hospitals.	Female individuals in the population of Arcevia.
Resident	Number of residents in the area served by the studied hospital.	Number of residents in Arcevia
Population density	Population density in the areas served by the studied hospitals.	Population density of Arcevia.
INDICATOR FOR PANDEMIC MACROAREA		
COVID-19 positive cases (per province)	Number of individuals positive to COVID-19 in the areas served by the studied hospitals.	Number of patients with suspected meningoencephalitis per field hospital or in Modulistan.
Updated pandemic national plan	Updating status of the pandemic national plan.	Presence of an updated pandemic national plan.
Updated pandemic regional plan	Updating status of the pandemic regional plan.	Presence of an updated pandemic regional plan.
Updated hospital emergency plan	Updating status of the hospital emergency plan.	Presence of an updated pandemic hospital plan.

Maximum hospital capacity	Maximum beds capacity of the selected hospitals.	Number of beds in the field hospitals.
COVID-19 ward	Presence of a COVID-19 ward in the emergency room of the studied hospitals.	Presence of a meningoencephalitis ward in the field hospitals.
Bed assigned to COVID-19 patients	Number of beds that can be dedicated to "COVID-19 patients" in the studied hospitals.	Number of beds dedicated to meningoencephalitis suspected patients in the field hospitals.
Contingency staff	Possibility to temporarily increase the emergency personnel during pandemics.	Meningoencephalitis dedicated healthcare worker in the field hospitals.
Overtime working hours	Possibility to ask for overtime working hours during the pandemic.	Possibility of overtime working hours.
Personal protective equipment	Availability of protective gears in the emergency room of the studied hospitals.	Availability of adequate number of personal protective equipment.
Pandemic emergency training	Pandemic training and drill designed for healthcare workers.	Healthcare workers preparedness for different emergencies.
Previous experience	Healthcare workers previous experience with pandemic emergencies (before the COVID-19 emergency).	Participation of healthcare workers on other exercises.
Different paths for COVID-19 and non-COVID-19 patients	Availability of different paths specially designed for COVID-19 patients in the emergency room of the studied hospitals.	Presence of different paths dedicated to meningoencephalitis suspected patients in the field hospitals.
Dedicated supply chain of medicines and medical supplies	Availability of specially designed pandemic procurement plans for medicines and medical supplies.	Availability of medicine for meningoencephalitis in the field hospitals.
Contact tracing	Availability of a plan to identify and notify people who have been exposed to someone with an infectious disease.	Type of contact tracing implemented.
Vaccination	Availability of vaccination plan.	Availability of vaccines.
Communication	Adequacy of the emergency communication among hospitals, public administrations, population, and stakeholder involved in the emergency.	Presence of shared technical and common terms used during emergency communication among stakeholders.

Funds (per healthcare workers or tools)	Extra-funds, per healthcare workers or gears, provided to the emergency room of the studied hospitals.	Availability of funds.
Flexibility	Capacity of health care workers to adapt their skills/activities to the specific needs created by the pandemic emergency.	Observation of how to change the activities when the suspected meningoencephalitis overcomes.
Timeliness	Readiness of the emergency room of the selected hospitals.	Speed of activities during the emergency.
Remote medical support	Availability of remote medical support.	Implementation of remote medical service.
Emergency number	Efficiency of emergency number response.	Involvement of the emergency number.

Figure 3.11: *Emergency control room of the MODEX Arcevia 2023*

4. RESULTS

4.1 Multi-Criteria Decision Analysis for the Selected Hospitals in the Marche Region

4.1.1 TOPSIS analysis

The results of the TOPSIS analysis display which of the studied hospitals presents the closest approximation to the ideal resilience to a pandemic emergency (according to the selected indicators) (Annexix 3). The final ranking remains consistent across the various contagion waves when all indicators are considered, whereas when the indicators with equal value are excluded from the computation the ranking varies. The possible meaning of this finding will be discussed in the chapter discussion and interpretation. Table 4.1 below shows the differences among the four waves. The hospitals have been signified with the name of their location and assigned a distinctive colour (for the diagrams):

- ***Ancona*** for Ospedali Riuniti of Ancona (violet colour);
- ***Camerino*** for a cluster of three hospitals: Santa Maria della Pietà in Camerino, Enrico Mattei in Matelica, and Bartolomeo Eustacchio in San Severino Marche (purple colour);
- ***Civitanova Marche*** for Santa Lucia civil hospital (green colour);
- ***Fabriano*** for Engles Profili civil hospital (grey colour);
- ***Jesi*** for Carlo Urbani hospital (light blue colour);
- ***Pesaro*** for Territorial Health Agency (A.S.T.) (yellow colour);
- ***San Benedetto del Tronto*** for Madonna del Soccorso hospital (orange colour).

Table 4.1: *Comparing resilience to pandemic emergency among the studied hospitals. Ranking of the TOPSIS analysis in each of the four waves of contagion is displayed in descending order; at the top are the hospitals closest to the ideal resilience to a pandemic emergency. Insignificant differences are visible across the 4 waves when the analysis considers all the indicators, whereas sensible differences emerge when indicators with equal values are removed from the analysis*

Consistent Ranking for 1st, 2nd-3rd, 4th wave with all indicators	**Ranking for 1st wave without indicators with equal values**	**Ranking for 2nd-3rd wave without indicators with equal values**	**Ranking for 4th wave without indicators with equal values**
Pesaro	Pesaro	Civitanova Marche	Pesaro
Jesi	Jesi	San Benedetto del Tronto	Jesi
San Benedetto del Tronto	Ancona	Pesaro	Ancona
Civitanova Marche	Civitanova Marche	Jesi	Civitanova Marche
Ancona	San Benedetto del Tronto	Ancona	San Benedetto del Tronto
Fabriano	Fabriano	Fabriano	Fabriano
Camerino	Camerino	Camerino	Camerino

Outputs of the final steps of the TOPSIS analysis have been rendered through radar and histogram diagrams, and to maintain a scale from 0 to 1, as described in the TOPSIS methodology, the diagrams are drawn using the reciprocal (1/n) of the ranking obtained. Hospitals scoring values closer to 1 have a high level of pandemic resilience (approaching the ideal value of resilience) while those closer to 0 have a low level of pandemic resilience. By examining the radar diagrams depicted in the following figures it is possible to observe the distance (closeness or remoteness) of each hospital from the ideal level of pandemic resilience. Results show that the hospitals in Fabriano and Camerino consistently tallied the lowest level of resilience among the studied hospitals, while on the contrary those in Pesaro and Jesi tallied the highest level of resilience. In the following pages are presented the TOPSIS final results in the four waves of contagion.

The 1st wave of COVID-19 contagion, from February to May 2020, (figure 4.1) presents a radar diagram with blue segments extending towards the hospitals of Pesaro and Jesi, which also have the longest bars in the histogram. The hospital of Pesaro (yellow colour) ranks the most resilient in the final classification with a relative closeness coefficient of 0,617. The hospital of Jesi (light blue colour) ranks second with a relative closeness coefficient of 0,606. San Benedetto del Tronto (orange

colour) is third with a relative closeness coefficient of 0,563. Continuing the downward ranking, Civitanova Marche (green colour) is fourth with a relative closeness coefficient of 0,547, Ancona (violet colour) is fifth with a relative closeness coefficient of 0,507, and Fabriano (yellow colour) is sixth with a relative closeness coefficient of 0,451. The hospitals of the Camerino cluster (purple colour) appear to have the lowest resilience capacity with a relative closeness coefficient of 0,402.

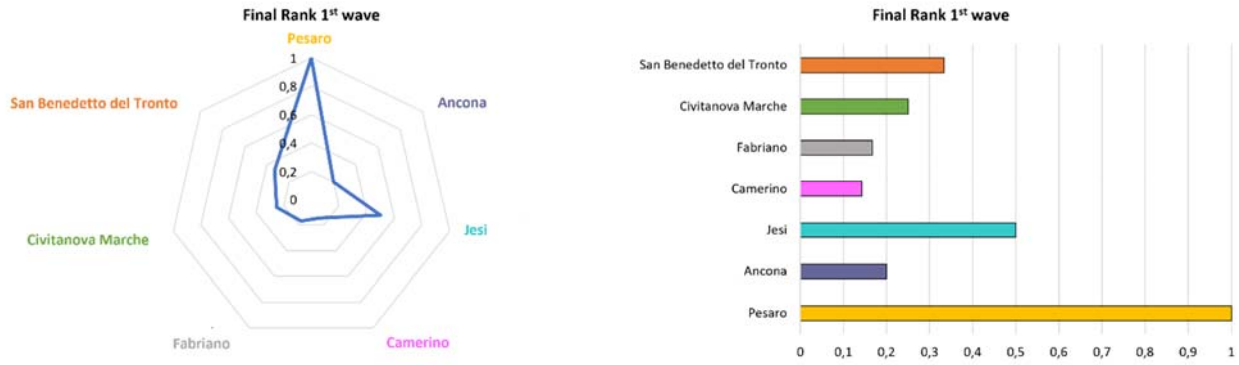


Figure 4.1: *1st wave final rank obtained by the studied hospital calculating their relative closeness coefficient (Pi) or performance score*

This ranking scale changes slightly when the indicators with equal value are excluded from the TOPSIS analysis. The diagrams in figure 4.2 represent the classification of the selected hospitals, which is identical to the classification computing all indicators, except for the third and the fifth positions, which are inverted (Ancona vs San Benedetto del Tronto).

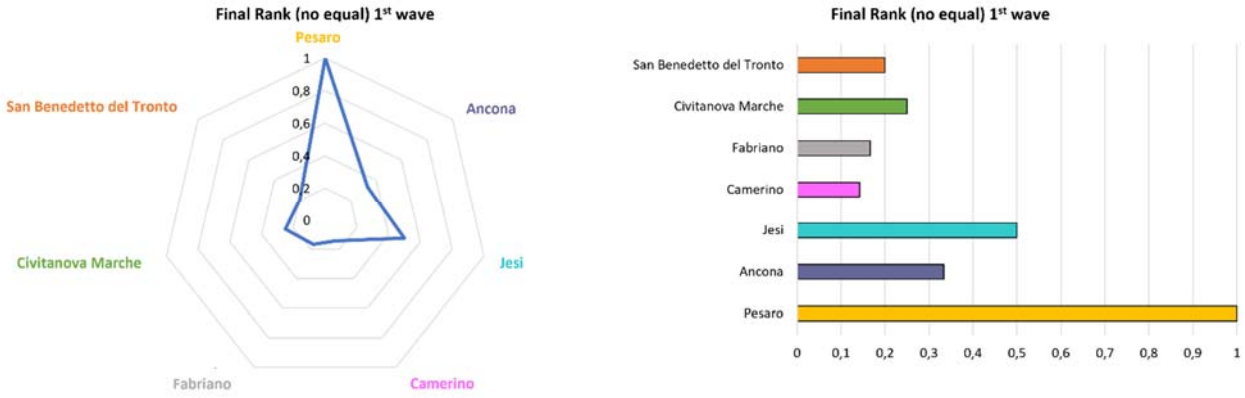


Figure 4.2: *1st wave final rank obtained excluding from the calculation indicators with equal values*

For what it concerns the 2nd and 3rd waves, which have been analysed together since temporally very close and overlapping (there was not a clear-cut distinction when one ended and the other began from

the second half of September 2020 to June 2021), the TOPSIS analysis including all the indicators outputted a ranking very similar to that of the first wave (figure 4.3). The radar and histogram diagrams depict the ranking in decreasing order starting with the Pesaro Hospital (relative closeness coefficient of 0,622) and ending with the hospital of Camerino (relative closeness coefficient of 0,396). In between are the hospitals of Jesi (relative closeness coefficient of 0,602), San Benedetto del Tronto (relative closeness coefficient of 0,567), Civitanova Marche (relative closeness coefficient of 0,547), Ancona (relative closeness coefficient of 0,509), and Fabriano (relative closeness coefficient of 0,447).

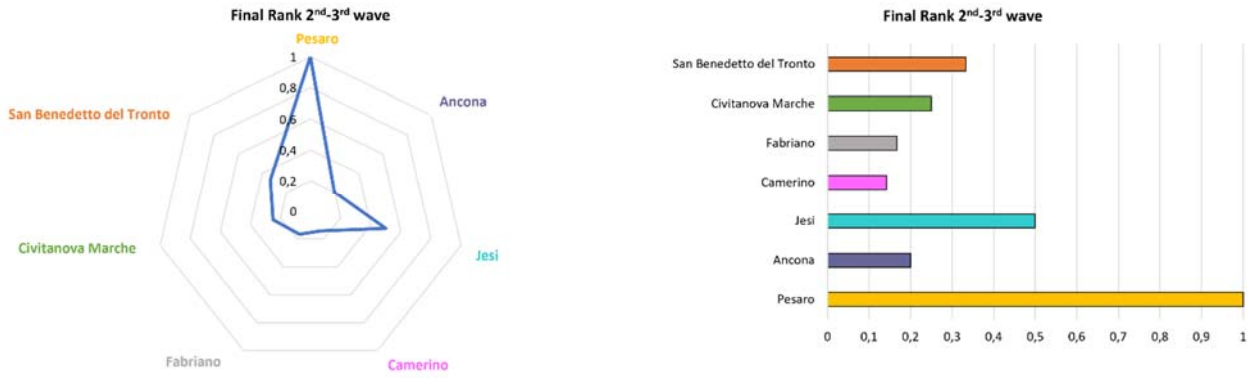


Figure 4.3: *2nd-3rd waves final rank obtained from the calculation of the relative closeness coefficient (Pi) or performance score*

Also, for the 2nd and 3rd waves the ranking scale changes slightly when the indicators with equal value are excluded from the analysis. Here, the blue segments in the radar diagram produce a completely different shape oriented in the left side of the diagram. The bars in the histogram appear longer in the part on the top of the diagram (figure 4.4). The less resilient hospitals are Camerino (relative closeness coefficient of 0,159), Fabriano (relative closeness coefficient of 0,182) and Ancona (relative closeness coefficient of 0,225). Conversely, the more resilient hospitals are Civitanova Marche (relative closeness coefficient of 0,802) and San Benedetto del Tronto (relative closeness coefficient of 0,795) with values sensibly higher than those of Pesaro (relative closeness coefficient of 0,251) and Jesi (relative closeness coefficient of 0,233).

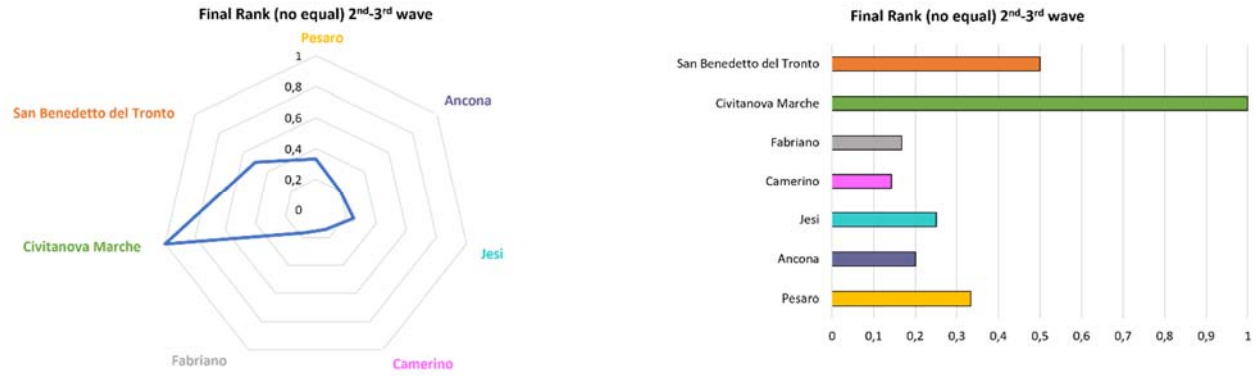


Figure 4.4: *2nd-3rd waves final rank obtained excluding from the calculation indicators with equal values*

Results of the TOPSIS analysis of the 4th wave of contagion, from August 2021 to March 2022, confirm a final ranking very similar to the other three waves, both in terms of consistency when all indicators are considered, and variations when the indicators with equal value are excluded from the computation (figure 4.5).

With all indicators computed Pesaro Hospital tallies the highest resilient level (relative closeness coefficient of 0,627). Consistently, the downward ranking in terms of pandemic resilience of the remaining hospitals shows: Jesi (relative closeness coefficient of 0,592 and a light blue colour); San Benedetto del Tronto (relative closeness coefficient of 0,567); Civitanova Marche (relative closeness coefficient of 0,550); Ancona (relative closeness coefficient of 0,510); Fabriano (relative closeness coefficient of 0,441) and the Camerino cluster (relative closeness coefficient of 0,391).

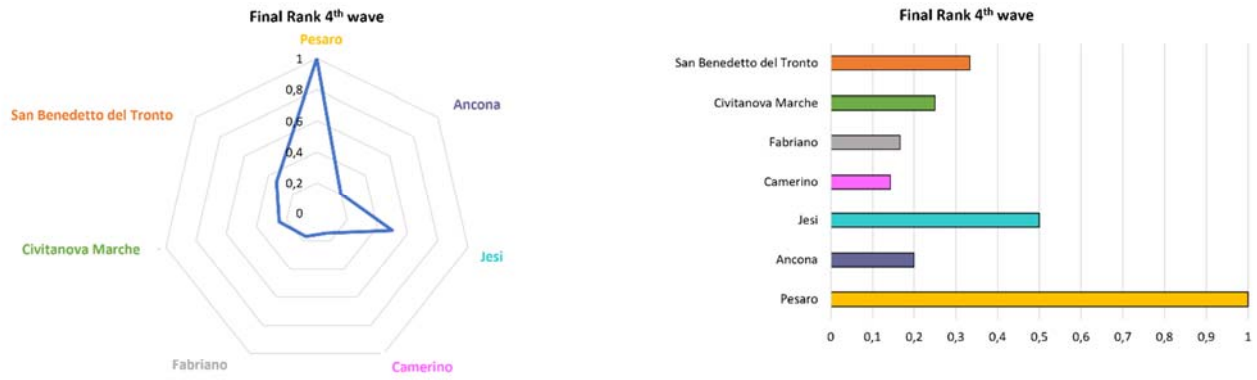


Figure 4.5*: 4th wave final rank obtained from the calculation of the relative closeness coefficient (Pi) or performance score*

As for the previous waves of contagion, the ranking scale changes slightly when the indicators with equal value are excluded from the analysis. Figure 4.6. shows these results for the 4th wave. The hospital of Pesaro displays the highest score in pandemic resilience (relative closeness coefficient of 0,580). In descending ranking are the hospitals of Jesi (relative closeness coefficient of 0,536),

Ancona (relative closeness coefficient of 0,510), Civitanova Marche (relative closeness coefficient of 0,507), San Benedetto del Tronto (relative closeness coefficient of 0,493), Fabriano (relative closeness coefficient of 0,419), the Camerino cluster in the last position (relative closeness coefficient of 0,367).

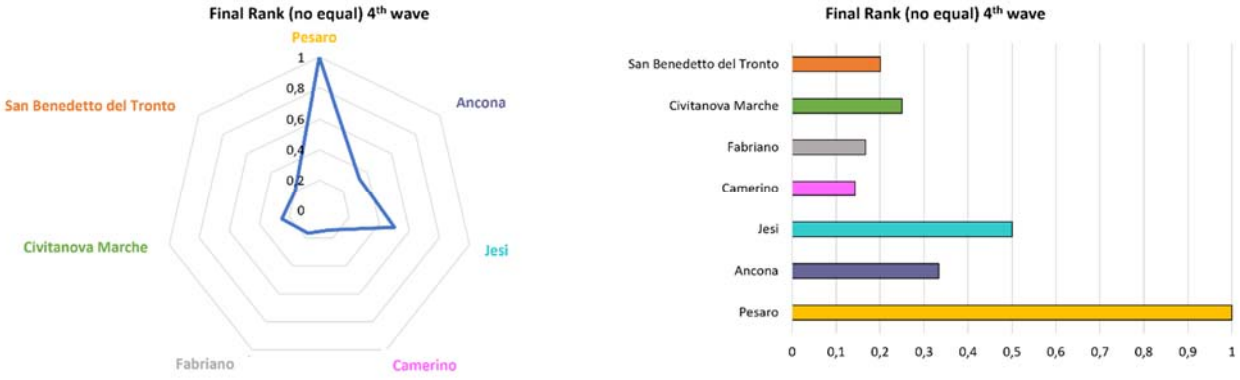


Figure 4.6: *4th wave final rank obtained excluding from the calculation indicators with equal values*

When comparing the final rankings of the waves on the same radar graph, excluding indicators with equal values from the calculation, the segments representing the first and fourth waves overlap (depicted in blue and grey in figure 4.7). These segments exhibit identical values to the final rankings obtained without excluding indicators. However, the final rank of the 2nd-3rd wave, calculated by excluding indicators with equal values (depicted in orange), assumes a different shape on the radar graph.

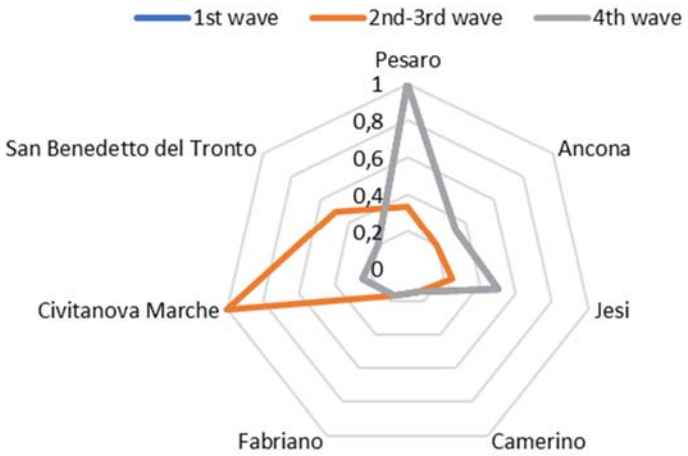


Figure 4.7: *Overlapping of 1st, 2nd-3rd, 4th waves final ranks obtained excluding from the calculation indicators with equal values*

4.1.2 AHP analysis

A total number of 21 experts have been invited to participate in the Analytical Hierarchy Process for this research, yet only 6 of them responded and completed the analysis module. These experts come from different professional backgrounds, yet they shared experience and expertise in emergency management.

Table 4.2: *List of experts participating in the Analytical Hierarchy Process, including their employment and area of expertise*

Expert	**Employment**	**Area of expertise**
1	Professional Emergency Manager from the Marche Region	Civil Protection
2	Head of the Emergency Room Department at the Hospital of Jesi and Regional Health Representative of the Marche Region	Emergency medicine
3	Research fellow at the Università la Sapienza in Rome	Risk perception and climate change response
4	Doctoral student at the Università Politecnica delle Marche	Artificial Intelligence
5	Full Professor at the Università Politecnica delle Marche	Environmental Geography
6	Professor at Rīgas Tehniskā universitāte (Latvia).	Eco-design and Life Cycle Assessment

The results of the AHP analysis were consolidated in a single datasheet showing the classification of indicators divided per macro areas (Appendix 4). The classifications of indicators are presented below, grouped into the respective macro area table. As reminder indicators were divided into 5 macro areas (Table 4.3).

Table 4.3: *Weight of indicators for the Health & Safety macro area*

Health & Safety macro area	**Relative priority**					
Indicators	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**
Number of hospitals	0,048	0,131	0,057	0,036	0,096	0,096
Number of residential services	0,069	0,083	0,045	0,028	0,077	0,013
Emergency network	0,069	0,101	0,108	0,071	0,044	0,062
Information quality	0,098	0,096	0,108	0,020	0,029	0,014
Coordination	0,092	0,102	0,108	0,073	0,025	0,071
Medical specialist	0,084	0,056	0,047	0,114	0,114	0,095
Physician	0,064	0,057	0,070	0,105	0,111	0,157
Nurse	0,103	0,066	0,072	0,101	0,096	0,079
Social worker in public health service	0,056	0,022	0,056	0,072	0,084	0,024
Interdisciplinarity	0,043	0,030	0,075	0,031	0,033	0,023
Medicine/patient	0,056	0,027	0,056	0,102	0,102	0,077
Triage tag	0,077	0,082	0,079	0,051	0,036	0,063
Tent	0,028	0,037	0,027	0,050	0,031	0,047
Number of vehicles	0,034	0,074	0,015	0,047	0,025	0,072
Helipad space	0,015	0,022	0,007	0,039	0,012	0,041
Accessibility (roads)	0,055	0,011	0,009	0,029	0,060	0,022
Flexibility in the use of facilities	0,011	0,004	0,060	0,032	0,024	0,044

Observing the results for the first macro area Health & Safety, it is possible to notice that the classifications vary and, in certain instances, only 33% of indicators hold the same position across the five classifications. In terms of relative priority, the ranking from the highest to the lowest is as follows:

1. Medical specialist
2. Physician
3. Medicine/patient
4. Nurse
5. (Each expert chosen a different indicator for this position)
6. Social worker in public health service
7. Emergency network

8. Triage tag
9. Emergency network
10. (Each expert chosen a different indicator for this position)
11. (Each expert chosen a different indicator for this position)
12. Number of hospitals
13. (Each expert chosen a different indicator for this position)
14. Interdisciplinarity
15. Accessibility (roads)
16. Accessibility (roads)
17. Flexibility in the use of facilities.

Table 4.4: *Classification of indicators for the Political & Economic macro area*

Political & Economic	**Relative priority**					
Indicators	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**
Partnership / international / interregional cooperation	0,034	0,312	0,144	0,308	0,108	0,239
Governance (strength stability)	0,145	0,268	0,303	0,282	0,173	0,039
Human rights	0,469	0,202	0,146	0,218	0,305	0,264
Aid support	0,143	0,136	0,219	0,088	0,142	0,182
Aid continuity	0,143	0,070	0,142	0,088	0,213	0,185
Multi-stakeholders' engagement	0,065	0,012	0,047	0,016	0,058	0,091

For what that concerns the macro area of Political & Economic, the common terms among different classifications are a little bit coherent compared to the previous macro area. The ranking from the highest to the lowest relative priority is as follows in the list below:

1. Human rights with the 50%
2. Governance with the 50%
3. Human rights with the 50%

4. Aid support with the 67%
5. Aid continuity with the 50%
6. Multi-stakeholders' engagement with the 67%

Table 4.5: *Classification of indicators for the Socio-Psychological macro area*

Socio-Psychological	**Relative priority**					
Indicators	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**
Availability of green areas	0,106	0,326	0,071	0,011	0,055	0,203
Common area with sufficient physical distance	0,138	0,236	0,120	0,077	0,086	0,063
Sport / relaxing spaces	0,138	0,156	0,038	0,053	0,136	0,152
Psychological support	0,090	0,158	0,195	0,205	0,125	0,144
Psychological training	0,069	0,052	0,234	0,211	0,089	0,135
Ethical principles	0,270	0,053	0,160	0,297	0,387	0,169
Social organisation in the territory	0,190	0,019	0,182	0,145	0,122	0,135

The results in tables 4.5 do not show consistent position across the classifications of experts. An idea of the comparison among classifications is as follows:

1. Ethical principles with the 50%
2. (Each expert chosen a different indicator for this position)
3. Psychological support with the 50%
4. Social organisation in the territory or Sport/relaxing spaces with the 33%
5. Common area with sufficient physical distance or Psychological training with the 33%
6. (Each expert chosen a different indicator for this position)
7. Availability of green areas with 33%.

Table 4.6: *Classification of indicators for the Demographic macro area*

Demographic	**Relative priority**					
Indicators	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**
Mean age	0,074	0,214	0,063	0,217	0,078	0,1
Gender male	0,018	0,091	0,014	0,011	0,034	0,1
Gender female	0,018	0,082	0,014	0,011	0,029	0,1
Population density	0,064	0,170	0,120	0,074	0,106	0,1
Active population (school / job)	0,100	0,110	0,099	0,159	0,091	0,1
Commuting for studying (2019) into the Municipality	0,112	0,090	0,111	0,087	0,118	0,1
Commuting for studying (2019) outside the Municipality	0,144	0,077	0,196	0,153	0,129	0,1
Commuting for working (2019) into the Municipality	0,126	0,075	0,111	0,087	0,109	0,1
Commuting for working (2019) outside the Municipality	0,161	0,066	0,196	0,153	0,095	0,1
Population in good health	0,184	0,026	0,077	0,048	0,211	0,1

Observing the various classifications for the Demographic macro area, it is evident that there is not a notable consistency, except for the last two positions (the lowest relative priorities) as show in the following list:

1. Mean age with 50% and Population in good health (Marche Region) with the 33%
2. Commuting for working (2019) outside the Municipality with the 33%
3. Commuting for studying (2019) outside the Municipality with the 33%
4. Commuting for working (2019) into the Municipality with the 33%
5. Commuting for working (2019) into the Municipality with the same position as Commuting for studying (2019) into the Municipality with the 33%
6. Commuting for studying (2019) into the Municipality with the same position as Active population (school/job) with the 33%
7. Commuting for studying (2019) outside the Municipality with the 33%

8. Commuting for working (2019) into the Municipality with the same position as Mean age with the 33%
9. Gender male with the 67%
10. Gender female with the 67%.

The indicators “Commuting for working (2019) outside/inside the Municipality” and “Commuting for studying (2019) outside/inside the Municipality” alternate their positions from the second to the eighth.

Table 4.7: *Classification of indicators for the Pandemic macro area*

Pandemic	**Relative priority**					
Indicators	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**
COVID-19 positive cases (per province)	0,061	0,165	0,024	0,003	0,068	0,036
Updated pandemic national plan	0,033	0,049	0,089	0,064	0,019	0,050
Updated pandemic regional plan	0,033	0,048	0,072	0,064	0,022	0,068
Updated hospital emergency plan	0,038	0,049	0,064	0,064	0,032	0,107
Maximum hospital capacity	0,028	0,030	0,017	0,051	0,036	0,090
COVID-19 ward	0,030	0,065	0,063	0,061	0,079	0,013
Convertible bed for COVID-19 patients	0,022	0,031	0,036	0,044	0,056	0,043
Contingency staff (% increase)	0,059	0,036	0,042	0,081	0,057	0,067
Overtime working hours	0,034	0,024	0,024	0,007	0,042	0,025
Personal protective equipment	0,061	0,025	0,084	0,075	0,091	0,060
Pandemic emergency training	0,017	0,042	0,038	0,032	0,040	0,028
Previous experience	0,028	0,029	0,049	0,013	0,047	0,021
Distinct roads for COVID-19 and non-COVID-19 patient	0,054	0,034	0,052	0,022	0,030	0,035
Supply chain of medicines and medical supplies (diversified)	0,054	0,036	0,072	0,071	0,031	0,061

Health literacy status		0,047	0,007	0,032	0,038	0,010
Contact-tracing	0,054	0,037	0,028	0,026	0,028	0,042
Vaccination	0,056	0,052	0,066	0,071	0,083	0,047
Communication	0,061	0,049	0,035	0,027	0,032	0,034
Funds (per healthcare workers or tools)	0,060	0,044	0,053	0,046	0,050	0,045
Flexibility	0,023	0,030	0,018	0,017	0,042	0,060
Timeliness	0,053	0,018	0,018	0,047	0,043	0,015
Remote medical support	0,032	0,038	0,026	0,037	0,013	0,022
Emergency number	0,054	0,023	0,024	0,047	0,023	0,021

There are some similarities in a few positions:

1. COVID-19 positive cases (per province) with 33%
2. Personal protective equipment with 50%
3. Supply chain of medicines and medical supplies (diversified) with 33%

13. Convertible bed for COVID-19 patients with 33%
15. Communication with 33%
19. Previous experience with 33%
20. Flexibility with 33%
23. Health literacy status with 33%

The other positions present single different values.

Table 4.8: *Classification of macro areas*

Macro areas	**Relative priority**					
Indicators	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**
Health & Safety	0,308	0,049	0,214	0,370	0,346	0,290
Political & Economic	0,308	0,118	0,310	0,203	0,230	0,169
Socio-Psychological	0,128	0,269	0,046	0,023	0,099	0,088
Demographic	0,054	0,318	0,120	0,091	0,141	0,084
Pandemic	0,201	0,245	0,310	0,313	0,183	0,369

The classification of macro areas is also inconsistent:

1. Health & Safety
2. Pandemic
3. Pandemic
4. Demographic
5. Socio-Psychological

Generally, the AHP outcomes show a not consistent ranking from the responding experts. The range of weighting seems to be very variable with some convergence for the indicators of the macro areas Political & Economic and Demographic and for the macro areas rank.

4.2 Risk Perception Analysis of Healthcare Personnel in the Marche Region

In this chapter it will be described the outputs of the questionnaire administered at healthcare personnel of the Emergency ward of the hospitals selected for this study. Table 4.9 below shows the number of collected questionnaires in each hospital. Unfortunately, the no response was obtained from the healthcare personnel of the emergency ward of the hospital of Pesaro. Furthermore, the hospital of Camerino included the data coming from the hospital of Matelica and San Severino Marche because during the COVID-19 pandemic the healthcare personnel moved from one hospital to another depending on the needs. These hospitals are quite near among them and in very strict coordination.

Table 4.9: *Selected hospitals and principal data*

Name of the Hospital		Number of healthcare personnel	Number of filled out questionnaires	Percentage of compiled questionnaires
Ospedali Riuniti of Ancona		84	38	45,24%
Camerino	Santa Maria della Pietà hospital in Camerino	13	13	100%
	Enrico Mattei hospital in Matelica	-	6	-
	Bartolomeo Eustacchio hospital in San Severino Marche	-	17	-
Santa Lucia civil hospital in Civitanova Marche		78	40	51,28%

Engles Profili civil hospital in Fabriano	-	24	-
Carlo Urbani hospital in Jesi	68	26	38,24%
A.S.T. - Territorial Health Agency in Pesaro e Urbino	-	-	-
Madonna del Soccorso hospital in San Benedetto del Tronto	59	59	100%
Total	307	223	72,64%

The missing results in table 4.9 depends on the lack of information coming from the Emergency Room of the corresponding hospital. Assuming that the number of healthcare personnel indicated by the head of the department is correct and observing table 4.9, it emerges that in the hospital of Camerino and San Benedetto del Tronto all the healthcare personnel filled out the questionnaire (100%). In the hospital of Ancona, less than half of personnel filled out the questionnaire (45,24%) as in the hospital of Jesi (38,24%). In the Santa Lucia civil hospital in Civitanova Marche, more than half of the staff members filled out the questionnaire (51,28%). Considering all the healthcare personnel involved, the 72,64% filled out the questionnaire. The results of the analysis of the collected questionnaires are shown through frequency or contingency tables (from now on "table").

Results of questions 1 to 4

Table 4.10 describes the cross-tabulation results of questions 1 and 2. The first question investigates previous experiences with epidemics and pandemics of the respondents: "Prior to COVID-19, did you have an epidemic or pandemic emergency experience in your workplace or other settings?". The second question investigates their perception about the preparedness of local and national Health System in dealing with epidemic and pandemic: "The local and national Health System was not prepared/organized to deal with the possibility of a pandemic emergency such as COVID-19".

Table 4.10: *Cross-tabulation of questions 1. Prior to COVID-19, did you have an epidemic or pandemic emergency experience in your workplace or other settings? and 2. The local and national Health System was not prepared/organised to deal with the possibility of a pandemic emergency such as COVID-19*

		2. The local and national Health System was not prepared/organized to deal with the possibility of a pandemic emergency such as COVID-19:						Total
		No answer	Completely disagree	Disagree	Uncertain	Agree	Completely agree	
1. Prior to COVID-19, did you have an epidemic or pandemic emergency experience in your workplace or other settings?	No answer	0	0	0	0	0	1	1
	Yes	0	0	1	5	13	19	38
	No	1	4	4	10	43	117	179
	I do not remember	0	0	0	2	2	3	7
Total		1	4	5	17	58	140	225

Symmetrical measures

		Value	Sig. approx.
Nominal per nominal	Phi	0,227	0,713
	V of Cramer	0,131	0,713
	Coefficient of contingency	0,221	0,713
N. of valid cases		225	

Results highlight that most healthcare personnel had never experienced important epidemic or pandemic events, and that most of the respondents think that the Health System was not prepared to deal with a pandemic like COVID-19 (179 among 225). Only few healthcare personnel experienced other epidemics (H1N1, SARS, HIV) and think the Health System was prepared (19 among 225), and very few healthcare personnel filling out the questionnaire think that the Health System was prepared to deal with COVID-19 and do not remember if they experienced other pandemic events (3 among 225). The symmetrical dimension shows that there is association between the variables (0,221).

Corroborating this finding, results of question number 3 “In organising the response to COVID-19, what do you think was missing and what could have been better prepared?” highlights some shortcomings perceived by the healthcare personnel. The flaws, repeated in most of the answers (open questions), are the absence of an updated plan and the requirement of defined procedures; education and training programs about pandemic hazard and risk should be constantly repeated; the emergency communication should be planned and functional in the whole Health System and should involve the politicians and the healthcare managers and the population; the highlighted needs for the health structures are adaptive capacity to certain emergency events, clear procedures and an adequate number of specialised personnel. In some answers, it is highlighted that underestimating epidemic

and pandemic hazard is one of the top causes of the disastrous impact of COVID-19; notwithstanding, the paramount problem was the lack of preparation and planning for this type of hazard.

Some positive outcomes of the ordeal were brought to light in question number 4: “What were the positive aspects that emerged from the experience in the field in the management of the COVID-19 pandemic? (Lessons learned)”. Although many responders did not think that the emergency nurtured positive aspects, the majority of respondents reported that during the COVID-19 emergency collaboration among colleagues increased, and in most cases healthcare personnel had the opportunity to validate their knowledge and preparedness capacity.

Results of question 5

Question number five was a psychometric question asking if the population living in the areas served by the hospital was prepared to face a pandemic. The healthcare personnel were asked to select their level of agreement with the statement: “Preparation of the population for a pandemic was adequate”.

Table 4.11: *Perception of the population’ preparedness for a pandemic*

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	No answer	3	1,3	1,3	1,3
	Completely disagree	111	49,3	49,3	50,7
	Disagree	68	30,2	30,2	80,9
	Uncertain	26	11,6	11,6	92,4
	Agree	11	4,9	4,9	97,3
	Completely agree	6	2,7	2,7	100,0
	Total	225	100,0	100,0	

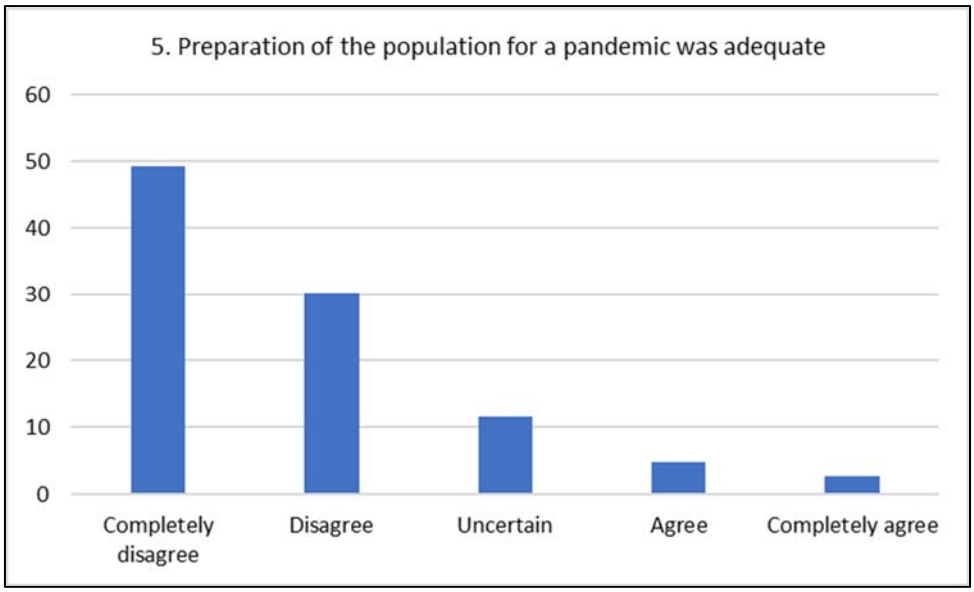


Figure 4.8: *Perception of the population' preparedness for a pandemic*

Observing table 4.11 and figure 4.8, it clearly appears that most participants disagree or completely disagree with the statement "Preparation of the population for a pandemic was adequate" (30,2% and 49,3% of respondents respectively).

Very few participants agree or completely agree, considering the population prepared to face pandemic (4,9% and 2,7% respectively).

Results of the questions 6 to 8

Three questions aimed at assessing the perception of how emergency management communication have been handled; one about the "internal communication" (the exchange of information among healthcare personnel in the same ward or among different wards inside the same hospital) and two about the "external communication" (the communication between hospitals and Public Administration or other Institutes; and the communication provided by social media to the population). Table 4.12 shows the crosstab of data from psychometric questions 6 and 7 of the questionnaire. The crossed results are about the adequacy of both the "external communication" (regulations, ordinances, mass media) and the "internal communication" during the emergency. It is possible to observe that most participants disagree or completely disagree with the statement, thinking that the emergency communications were inadequate (33 and 23 participants respectively among 225 total of both questions). Another sizable group of healthcare personnel are uncertain about the adequacy of the emergency communications (27 participants among 225) and very few participants considered such communications adequate (9 participants). The symmetric measures indicate a medium level of association and correlation between the two questions (over the zero).

Table 4.12: *shows the cross-tabulation between question 6.: The "internal communication" of the facility where you work has been adequate in the management of the emergency, and question 7.: The "external communication" (regulations, ordinances, mass media) was adequate in the management of the emergency*

		7. The "external communication" (regulations, ordinances, mass media) was adequate in the management of the emergency:						Total
		No answer	Completely disagree	Disagree	Uncertain	Agree	Completely agree	
6. The "internal communication" of the facility where you work has been adequate in the management of the emergency:	No answer	2	1	1	0	0	0	4
	Completely disagree	0	23	8	6	7	0	44
	Disagree	0	6	33	20	3	1	63
	Uncertain	0	11	27	22	10	2	72
	Agree	0	8	9	8	9	1	35
	Completely agree	0	1	0	2	2	2	7
Total		2	50	78	58	31	6	225

Symmetric measures

		Value	E.S. asynt.[a]	T approx.[b]	Sig. approx.
Ordinal per ordinal	Tau-b of Kendall	0,238	0,062	3,770	0,000
	Tau-c of Kendall	0,214	0,057	3,770	0,000
	Gamma	0,309	0,079	3,770	0,000
	Correlation of Spearman	0,275	0,071	4,267	0,000[c]
Interval per interval	R of Pearson	0,308	0,072	4,834	0,000[c]
N. of valid cases		225			

a. Without assuming the null hypothesis.
b. It is used the asymptotic standard error on the base of the assumption of the null hypothesis.
c. On the base of the normal approximation

In question number 8 it is asked the level of agreement with the statement “Social media helped clarify information on the pandemic”. Most participants completely disagree with such statements (86 among 225 participants or 38,2%) and disagree (64 participants among 225 or 28,4%), thus thinking that social media did not help clarifying the communications about the pandemic emergencies. Only few healthcare personnel thought that social media were useful information channels (22 participants among 225 or 9,8%) and the others are uncertain (52 participants among 225 or 23,1%).

Table 4.13: *Cross-tabulation between questions 6. The "internal communication" of the facility where you work has been adequate in the management of the emergency and 8. social media helped clarify information on the pandemic*

		8. Social media helped clarify information on the pandemic:					
		Completely disagree	Disagree	Uncertain	Agree	Completely agree	Total
6. The "internal communication" of the facility where you work has been adequate in the management of the emergency:	No answer	1	2	1	0	0	4
	Completely disagree	28	6	9	1	0	44
	Disagree	26	20	11	6	0	63
	Uncertain	22	25	18	6	1	72
	Agree	7	7	13	8	0	35
	Completely agree	2	4	0	1	0	7
Total		86	64	52	22	1	225

Symmetric measures

		Value	E.S. asynt.[a]	T approx.[b]	Sig. approx.
Ordinal per ordinal	Tau-b of Kendall	0,231	0,054	4,254	0,000
	Tau-c of Kendall	0,211	0,050	4,254	0,000
	Gamma	0,311	0,072	4,254	0,000
	Correlation of Spearman	0,272	0,063	4,228	0,000[c]
Intervallo per intervallo	R di Pearson	0,256	0,062	3,954	0,000[c]
N. of valid cases		225			

a. Without assuming the null hypothesis.
b. It is used the asymptotic standard error on the base of the assumption of the null hypothesis.
c. On the base of the normal approximation.

Results of questions 9 and 10

These questions concern about the adequacy of the number of healthcare personnel to manage patients respectively before and during the COVID-19 emergency. The questions focus on four categories: medical specialists, physicians, nurses, social health operators. In question number 9 the respondents have to choose their level of agreement about the statement “The healthcare personnel BEFORE COVID-19 was sufficient to manage the emergencies usually faced”; question number 10 deals with the changes brought by the COVID-19 emergency, asking whether the conditions worsened, remained unchanged or became better (when compared to the situation before the COVID-19 pandemic). The tables below show the crosstab between question 9 and 10, separating the answers of all healthcare personnel participating to the questionnaire, expressing their opinion about the

conditions for each of the four studied professional groups, including their own (medical specialists, physicians, nurses, social health operators).

Table 4.14: *Crosstab of psychometric question 9 "The number of MEDICAL SPECIALISTS BEFORE COVID-19 was sufficient to manage the emergencies usually faced," and question 10 "CURRENTLY, is the number of MEDICAL SPECIALISTS sufficient to manage the COVID-19 emergency, or has the condition worsened compared to the period prior to the pandemic?" Answers of all healthcare personnel about the specific group of MEDICAL SPECIALISTS*

		10. CURRENTLY, is the number of MEDICAL SPECIALISTS sufficient to manage the COVID-19 emergency, or has the condition worsened compared to the period prior to the pandemic?				Total
		No answer	Worsened	Unchanged	Better	
9. The number of MEDICAL SPECIALISTS BEFORE COVID-19 was sufficient to manage the emergencies usually faced.	No answer	3	3	1	0	7
	Completely disagree	3	31	12	1	47
	Disagree	0	30	26	5	61
	Uncertain	3	27	28	7	65
	Agree	1	15	16	6	38
	Completely agree	1	3	2	1	7
Total		11	109	85	20	225

Symmetric measures

		Value	S. E. asymp.[a]	T approx.[b]	Sig. approx.
Ordinal per ordinal	Tau-b of Kendall	0,196	0,058	3,350	0,001
	Tau-c of Kendall	0,180	0,054	3,350	0,001
	Gamma	0,283	0,082	3,350	0,001
	Correlation of Spearman	0,223	0,066	3,419	0,001[c]
Interval per interval	R of Pearson	0,229	0,068	3,514	0,001[c]
N. of valid cases		225			

a. Without assuming the null hypothesis.

b. It is used the asymptotic standard error on the base of the assumption of the null hypothesis.

c. On the base of the normal approximation

Table 4.15: *Crosstab of psychometric question 9 "The number of PHYSICIANS BEFORE COVID-19 was sufficient to manage the emergencies usually faced," and question 10 "CURRENTLY, is the number of PHSYCIANS sufficient to manage the COVID-19 emergency, or has the condition worsened compared to the period prior to the pandemic?" Answers of all healthcare personnel about the specific group of PHYSICIANS*

		10. CURRENTLY, is the number of PHYSICIANS sufficient to manage the COVID-19 emergency, or has the condition worsened compared to the period prior to the pandemic?				Total
		No answer	Worsened	Unchanged	Better	
9. The number of PHYSICIANS BEFORE COVID-19 was sufficient to manage the emergencies usually faced	No answer	0	2	1	1	4
	Completely disagree	2	40	11	3	56
	Disagree	0	49	20	7	76
	Uncertain	2	27	14	3	46
	Agree	2	25	5	6	38
	Completely agree	0	3	2	0	5
Total		6	146	53	20	225

Symmetric measures

		Value	S. E. asymp.[a]	T approx.[b]	Sig. approx.
Ordinal per ordinal	Tau-b of Kendall	0,028	0,060	0,468	0,640
	Tau-c of Kendall	0,023	0,050	0,468	0,640
	Gamma	0,045	0,095	0,468	0,640
	Correlation of Spearman	0,031	0,068	0,463	0,644[c]
Interval per interval	R of Pearson	0,027	0,069	0,407	0,684[c]
N. of valid cases					

a. Without assuming the null hypothesis.

b. It is used the asymptotic standard error on the base of the assumption of the null hypothesis.

c. On the base of the normal approximation.

***Table 4.16**: Crosstab of psychometric question 9 "The number of NURSES BEFORE COVID-19 was sufficient to manage the emergencies usually faced," and question 10 "CURRENTLY, is the number of NURSES sufficient to manage the COVID-19 emergency, or has the condition worsened compared to the period prior to the pandemic?" Answers of all healthcare personnel about the specific group of NURSES*

		10. CURRENTLY, is the number of NURSES sufficient to manage the COVID-19 emergency, or has the condition worsened compared to the period prior to the pandemic?				Total
		No answer	Worsened	Unchanged	Better	
9. The number of NURSES BEFORE COVID-19 was sufficient to manage the emergencies usually faced	No answer	2	0	1	0	3
	Completely disagree	1	43	14	7	65
	Disagree	1	49	14	13	77
	Uncertain	0	24	14	4	42
	Agree	2	20	3	9	34
	Completely agree	0	4	0	0	4
Total		6	140	46	33	225

Symmetric measures

		Value	S. E. asymp.[a]	T approx.[b]	Sig. approx.
Ordinal per ordinal	Tau-b of Kendall	0,047	0,061	0,764	0,445
	Tau-c of Kendall	0,040	0,052	0,764	0,445
	Gamma	0,072	0,094	0,764	0,445
	Correlation of Spearman	0,052	0,069	0,784	0,434[c]
Interval per interval	R of Pearson	0,057	0,070	0,848	0,397[c]
N. of valid cases					

a. Without assuming the null hypothesis.

b. It is used the asymptotic standard error on the base of the assumption of the null hypothesis.

c. On the base of the normal approximation.

Table 4.17: *Crosstab of psychometric question 9 "The number of SOCIAL HEALTH OPERATORS BEFORE COVID-19 was sufficient to manage the emergencies usually faced," and question 10 "CURRENTLY, is the number of SOCIAL HEALTH OPERATORS sufficient to manage the COVID-19 emergency, or has the condition worsened compared to the period prior to the pandemic?" Answers of all healthcare personnel about the specific group of SOCIAL HEALTH OPERATORS*

		10. CURRENTLY, is the number of SOCIAL HEALTH OPERATORS sufficient to manage the COVID-19 emergency, or has the condition worsened compared to the period prior to the pandemic?				Total
		No answer	Worsened	Unchanged	Better	
9. The number of SOCIAL HEALTH OPERATORS BEFORE COVID-19 was sufficient to manage the emergencies usually faced	No answer	2	3	0	0	5
	Completely disagree	3	37	15	5	60
	Disagree	0	45	21	11	77
	Uncertain	3	26	18	5	52
	Agree	1	14	6	6	27
	Completely agree	0	3	0	1	4
Total		9	128	60	28	225

Symmetric measures

		Value	S. E. asymp.[a]	T approx.[b]	Sig. approx.
Ordinal per ordinal	Tau-b of Kendall	0,106	0,060	1,766	0,077
	Tau-c of Kendall	0,094	0,053	1,766	0,077
	Gamma	0,160	0,089	1,766	0,077
	Correlation of Spearman	0,121	0,068	1,820	0,070[c]
Interval per interval	R of Pearson	0,130	0,070	1,958	0,051[c]
N. of valid cases					

a. Without assuming the null hypothesis.
b. It is used the asymptotic standard error on the base of the assumption of the null hypothesis.
c. On the base of the normal approximation.

Results show that the healthcare personnel answering the questionnaire think that before the COVID-19 pandemic the number of personnel for all four categories (medical specialists, physicians, nurses, social health operators) was not adequate for the management of patients. Moreover, during the last pandemic their conditions worsened. A sizeable number of respondents think that the situation was unchanged during the COVID-19 emergency. Only few respondents think that the number of personnel for all four categories was adequate before the pandemic. The different numbers in the four crosstab highlights that the category that suffer the most are those of Physicians and Nurse. The categories which "suffer less" but still suffer, is that of the medical specialists. Considering the

symmetric measures and the different coefficients for ordinal data, it is possible to observe that there is correlation between the two questions in all four categories analysed (Tau of Kendal over zero).

Results of questions 11 and 12

Question number 11 assessed the respondents' opinion about the adequacy of the quantity of stocked medical devices (personal protective equipment or PPE, helmets, ventilators, Continuous Positive Airway Pressure or CPAP, and others). The psychometric statement was: "At present, it is believed that the medical devices (PPE, helmets, ventilators, CPAP ...) available are superior/oversized to the needs". In the table below, it is analysed the frequency of the answers based on the Likert scale.

Table 4.18: *Question 11: At present, it is believed that the medical devices (PPE, helmets, ventilators, CPAP ...) available are superior/oversized to the needs*

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	No answer	2	0,9	0,9	0,9
	Completely disagree	14	6,2	6,2	7,1
	Disagree	70	31,1	31,1	38,2
	Uncertain	59	26,2	26,2	64,4
	Agree	67	29,8	29,8	94,2
	Completely agree	13	5,8	5,8	100,0
	Total	225	100,0	100,0	
N	Valid	225			
	Missing	0			
Mean		2,95			
Median		3,00			
Sum		664			

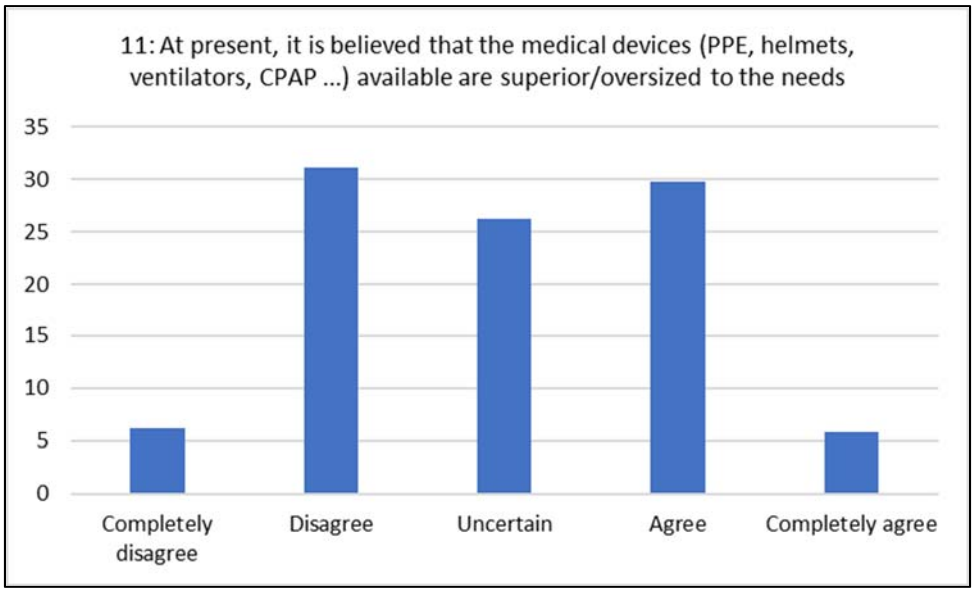


Figure 4.9: *Question 11: At present, it is believed that the medical devices (PPE, helmets, ventilators, CPAP ...) available are superior/oversized to the needs*

Results reported in table 4.18 and figure 4.9, display an almost even separation between those who consider the number of currently stocked medical device superior to the needs (80 participants) and those who consider the stocking inadequate (84 participants). However, an almost equal number of healthcare personnel filling out the questionnaire are uncertain about the answers (59 participants).

The following question 12, explores healthcare personnel idea on investing important resources for stocking costly medical devices and supply.

Table 4.19: *Question 12. Investing in prevention and planning, despite the high economic cost (not always sustainable), is important*

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	No answer	1	0,4	0,4	0,4
	Completely disagree	2	0,9	0,9	1,3
	Disagree	2	0,9	0,9	2,2
	Uncertain	9	4,0	4,0	6,2
	Agree	99	44,0	44,0	50,2
	Completely agree	112	49,8	49,8	100,0
	Total	225	100,0	100,0	
N	Valid	225			
	Missing	0			
Mean		4,40			
Median		4,00			

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	No answer	1	0,4	0,4	0,4
	Completely disagree	2	0,9	0,9	1,3
	Disagree	2	0,9	0,9	2,2
	Uncertain	9	4,0	4,0	6,2
	Agree	99	44,0	44,0	50,2
	Completely agree	112	49,8	49,8	100,0
	Total	225	100,0	100,0	
Sum		989			

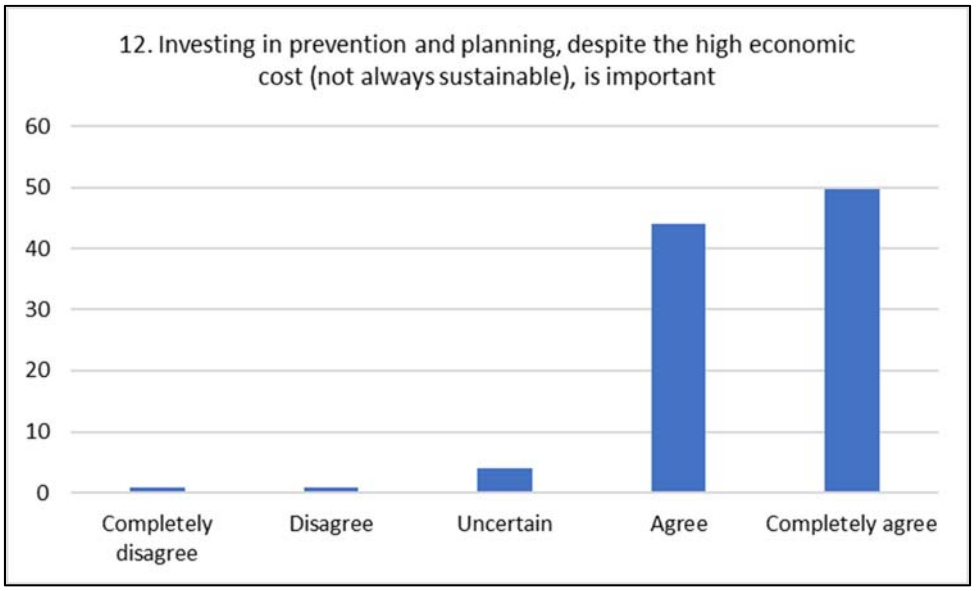


Figure 4.10: *Question 12. Investing in prevention and planning, despite the high economic cost (not always sustainable), is important*

Results shows that despite the high cost (thus requiring cutting other items), the vast majority of respondents think it is essential to invest in creating such a stocking.

Results of questions 13 and 14

Considering that before starting their career Healt6hcare personnel, particularly Physicians, have to read out the Hippocratic Oath (a formal promise to follow the standards set by their profession and seek to preserve life), question number 13 asked the respondents which principles prevailed during the COVID-19 pandemic (ethical vs. human, emotional or personal principles).

Table 4.20: *Question 13. During the management of the pandemic emergency, only professional ethics prevailed in the actions taken*

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	No answer	5	2,2	2,2	2,2
	Completely disagree	12	5,3	5,3	7,6
	Disagree	32	14,2	14,2	21,8
	Uncertain	83	36,9	36,9	58,7
	Agree	65	28,9	28,9	87,6
	Completely agree	28	12,4	12,4	100,0
	Total	225	100,0	100,0	
N	Valid	225			
	Missing	0			
Mean		3,22			
Median		3,00			
Sum		725			

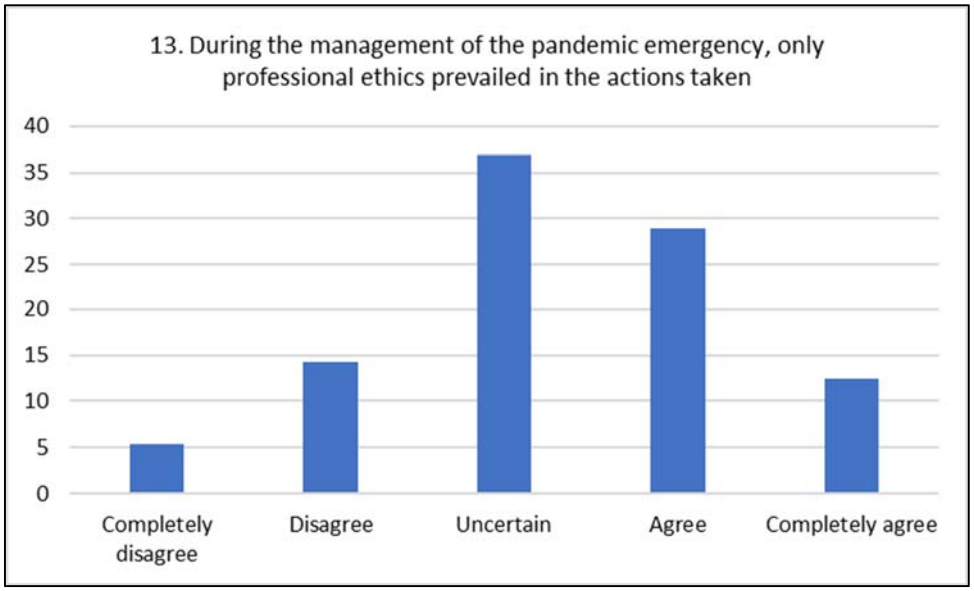


Figure 4.11: *Question 13. During the management of the pandemic emergency, only professional ethics prevailed in the actions taken*

Observing table 4.20. and figure 4.11, it appears that a sizeable number of respondents (36,9%) were uncertain about the prevalence of ethical principles in the management of patients during the pandemic emergency Yest, a slightly larger group of participants (41,3%) were convinced that professional ethics prevailed while making though decisions.

In addition to the ethic influencing the working activities, there are also the responsibilities related to the professional role which could influence the choices. Question number 14 investigates this aspect

in two different temporal stages of the pandemic; i) early phases and ii) current phases (at the time of the survey) when the pandemic emergency was much reduced in intensity.

Table 4.21: *Crosstab between questions 14a. In the EARLY PHASES of the pandemic emergency management activities, did you feel protected regarding the responsibilities and decisions to be made in carrying out your profession? and 14b. In the CURRENT PHASES of the pandemic emergency management activities, do you feel protected regarding the responsibilities and decisions to be made in carrying out your profession?*

		14. In the CURRENT PHASES of the pandemic emergency management activities, do you feel protected regarding the responsibilities and decisions to be made in carrying out your profession?						Total
		No answer	Completely disagree	Disagree	Uncertain	Agree	Completely agree	
14. In the EARLY PHASES of the pandemic emergency management activities, do you feel protected regarding the responsibilities and decisions to be made in carrying out your profession?	No answer	7	3	0	1	1	1	13
	Completely disagree	0	12	10	18	7	0	47
	Disagree	3	5	32	17	12	0	69
	Uncertain	2	0	4	35	8	4	53
	Agree	1	1	4	8	16	1	31
	Completely agree	1	1	1	0	1	8	12
Total		14	22	51	79	45	14	225

Symmetric measures

		Value	S. E. asymp.[a]	T approx.[b]	Sig. approx.
Ordinal per ordinal	Tau-b of Kendall	0,368	0,058	6,199	0,000
	Tau-c of Kendall	0,342	0,055	6,199	0,000
	Gamma	0,455	0,069	6,199	0,000
	Correlation of Spearman	0,419	0,066	6,892	0,000[c]
Interval per interval	R of Pearson	0,438	0,073	7,268	0,000[c]
N. of valid cases		225			

a. Without assuming the null hypothesis.
b. It is used the asymptotic standard error on the base of the assumption of the null hypothesis.
c. On the base of the normal approximation

Table 4.21 shows the crosstab between the two options of question 14. A sizeable group of healthcare personnel filling out the questionnaire do not feel protected (in terms of liability) in carrying out their

duties both in the early stage of the pandemic or at the time of filling out the questionnaire. It should be said that another considerable group is uncertain about it. Certainly, only few respondents feel protected in carrying out their duties. Considering the symmetric measures, it is possible to observe that there is correlation between the two options of question 14 (value over zero).

Results of question 15

In question number 15 the healthcare personnel who filled out the questionnaire have to indicate the number of COVID-19 positive patients reach the Emergency Room where they work in three different timing: the early stage of pandemic, the intermediate stage and the time of filling out the questionnaire (corresponding to the last stage of COVID-19 emergency).

Considering all the selected hospitals, the statistics calculated have been reported in table 4.22.

Table 4.22: *Statistics of the outputs of question 15 What was the average daily number of positive patients admitted to the ward where you work, during the following three phases: EARLY STAGE OF PANDEMIC, INTERMEDIATE STAGE OF PANDEMIC, THE CURRENT STAGE*

		15. What was the average daily number of positive patients admitted to the ward where you work, during the following three phases: EARLY STAGE OF PANDEMIC	15. What was the average daily number of positive patients admitted to the ward where you work, during the following three phases: INTERMEDIATE STAGE OF PANDEMIC	15. What was the average daily number of positive patients admitted to the ward where you work, during the following three phases: THE CURRENT STAGE
N	Valid	225	225	225
	Missed	0	0	0
Mean		13,78	12,80	4,16
Median		8,00	8,00	2,00
Minimum		1	1	1
Maximum		360	681	282

Many healthcare personnel filling out the questionnaire did not answer (80 people, or 35,6% of the total) and as it is possible to observe in table 4.22, someone indicated very big number, probably not considering the daily number but the whole period, or with a distorted perception of the real number of positive patients (maximum equal to 360; 681; 282 for the different period respectively). The minimum value is one for all the hospitals. It is possible to find the complete value of the outputs divided for the different periods in Appendix 5.

The results of each Emergency Room about question 15 are reported below with histograms. The different timings are differentiated by colours in the same histogram.

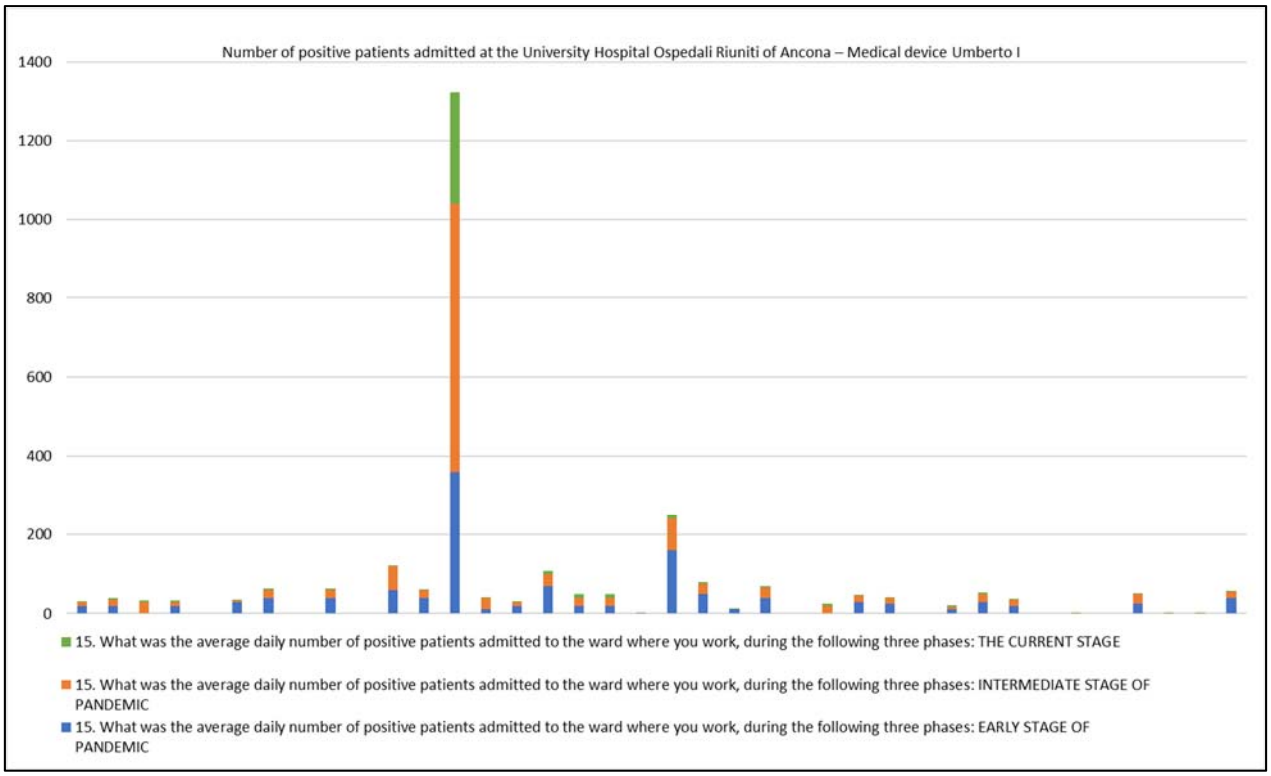


Figure 4.12: *Question 15 What was the average daily number of positive patients admitted to the ward where you work, during the following three phases: EARLY STAGE OF PANDEMIC, INTERMEDIATE STAGE OF PANDEMIC, THE CURRENT STAGE - Ospedali Riuniti of Ancona*

The 38 healthcare personnel of the Emergency Room of the Ospedali Riuniti of Ancona reported quite similar value answering to question 15 (figure 4.12). Exception for one person who wrote very high value for the number of COVID-19 positive cases treated, the other people indicated value with a mean of 29,52 positive cases in the early stage with a mode of 20 daily positive cases indicated (blue colour in the histogram); 18,73 positive cases during the intermediate stage and a mode of 20 (orange colour in the histogram); 3,63 positive cases at the current stage and a mode of 2 positive cases per day (green colour in the histogram). When there are no values, it means that healthcare personnel wrote zero as zero patients admitted or because they did not answer to question 15.

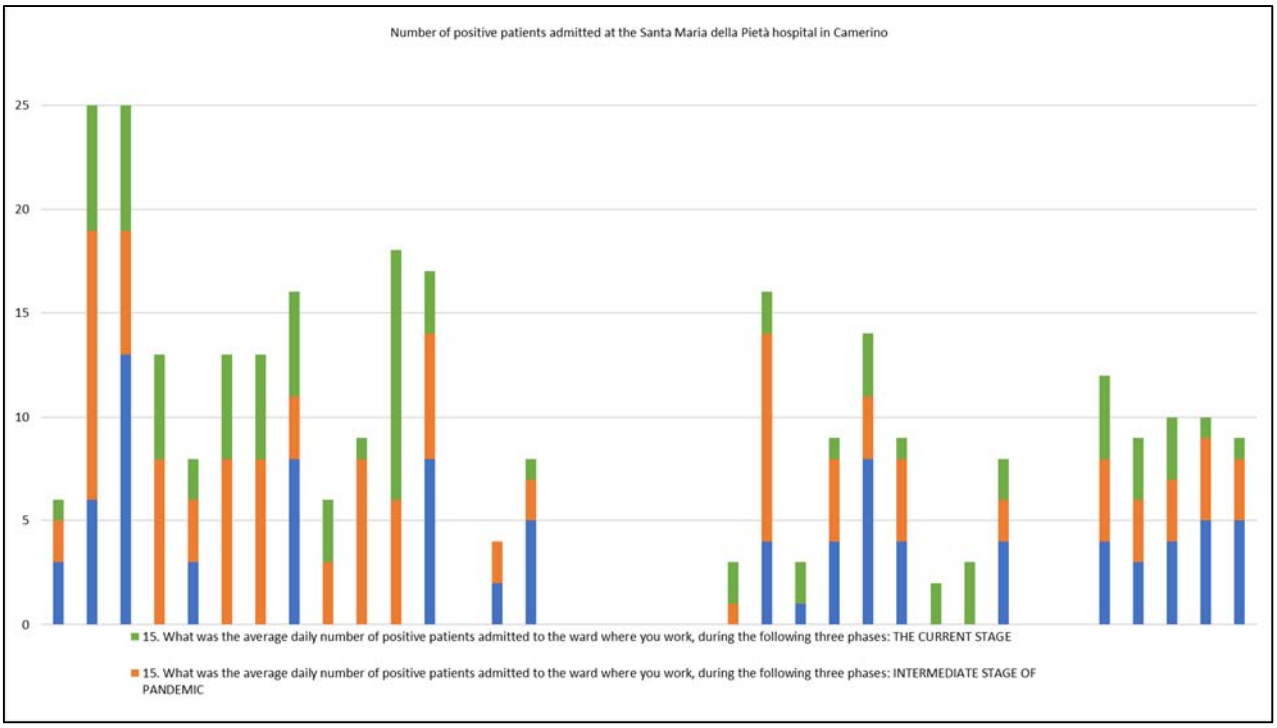


Figure 4.13: *Question 15 What was the average daily number of positive patients admitted to the ward where you work, during the following three phases: EARLY STAGE OF PANDEMIC, INTERMEDIATE STAGE OF PANDEMIC, THE CURRENT STAGE - Santa Maria della Pietà hospital in Camerino*

Data analysed for the hospital of Camerino include data from the hospitals of San Severino and Matelica, because during the COVID-19 pandemic healthcare personnel collaborated or worked in a hospital or another as these were a single hospital (figure 4.13). Anyway, the only COVID-19 hospital was Camerino. Most of healthcare works answered with very similar or equal value indicating the number of daily positive cases admitted to the ward of the Emergency Room where they work. Among 36 questionnaires filled out, there are only four higher values emerging from the others. That could be due to the perception of the respondents. In general, the mean of the number of patients treated at the hospital of Camerino is 3,36 in the early stages of pandemic with a mode of 0 (blue colour in the histogram); 4,25 during the intermediate stage with a mode of 3 daily positive cases (orange colour in the histogram); 3,04 at the current stage and a mode of 1 COVID-19 positive case per day (green colour in the histogram). The zero values verify when healthcare personnel wrote zero patients per day or when they did not answer.

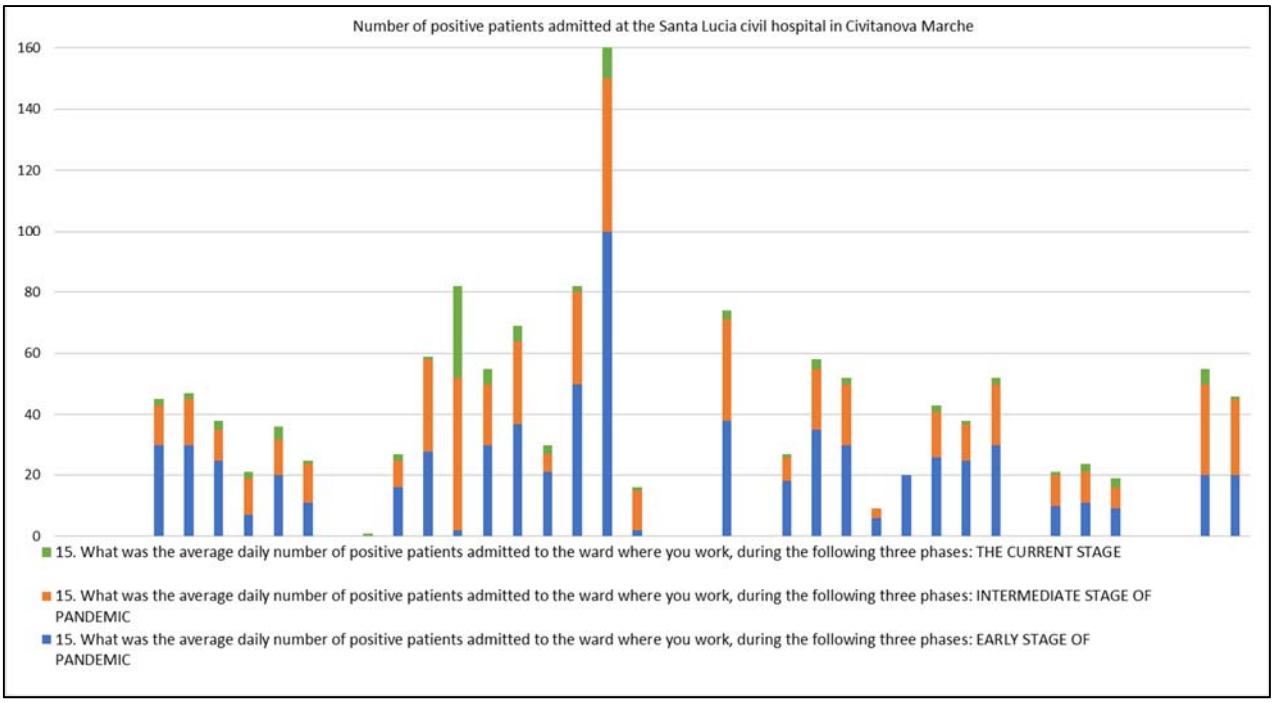


Figure 4.14: *Question 15 What was the average daily number of positive patients admitted to the ward where you work, during the following three phases: EARLY STAGE OF PANDEMIC, INTERMEDIATE STAGE OF PANDEMIC, THE CURRENT STAGE - Santa Lucia civil hospital in Civitanova Marche*

The number of patients daily admitted at the Santa Lucia civil hospital in Civitanova Marche is quite swinging among the answers to question number 15 filled out by 40 healthcare personnel. Healthcare personnel filling out the questionnaire, indicated a mean of 23,57 daily patients at the early stage of the pandemic and a mode of 30 patients (blue colour in the histogram); 17,43 during the intermediate stage and a mode of 20 patients (orange colour in the histogram); 3,37 at the current stage and a mode of 2 (green colour in the histogram). There are some zero value in the histogram in figure 4.14 because some healthcare personnel did not answer, or they indicated zero patients per day.

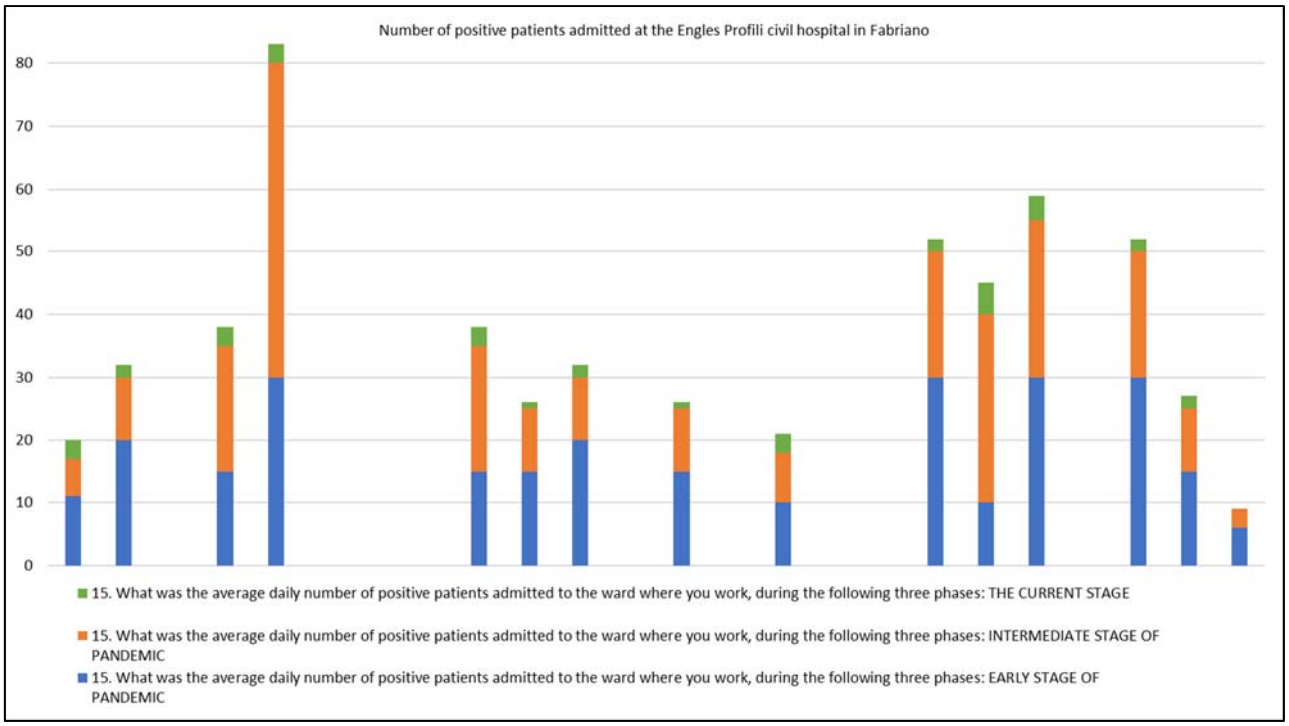


Figure 4.15: *Question 15 What was the average daily number of positive patients admitted to the ward where you work, during the following three phases: EARLY STAGE OF PANDEMIC, INTERMEDIATE STAGE OF PANDEMIC, THE CURRENT STAGE – Engles Profili civil hospital in Fabriano*

The histogram above (figure 4.15) represents the number of positive cases daily admitter at the Engles Profili civil hospital in Fabriano. The values are quite similar among the different periods. The healthcare personnel of the hospital of Fabriano filled out question 15 indicating a mean value of 18,13 daily patients admitted to the hospital in the early stage with a mode of 15 (blue colour in the histogram); a mean of 16,8 and a mode of 10 for the intermediate stage (orange colour in the histogram); 2,4 patients per day and a mode of 3 at the current stage (green colour in the histogram). Only one person among 24 respondents indicated the value 50 referring to the daily patients during the intermediate stage of COVID-19 pandemic.

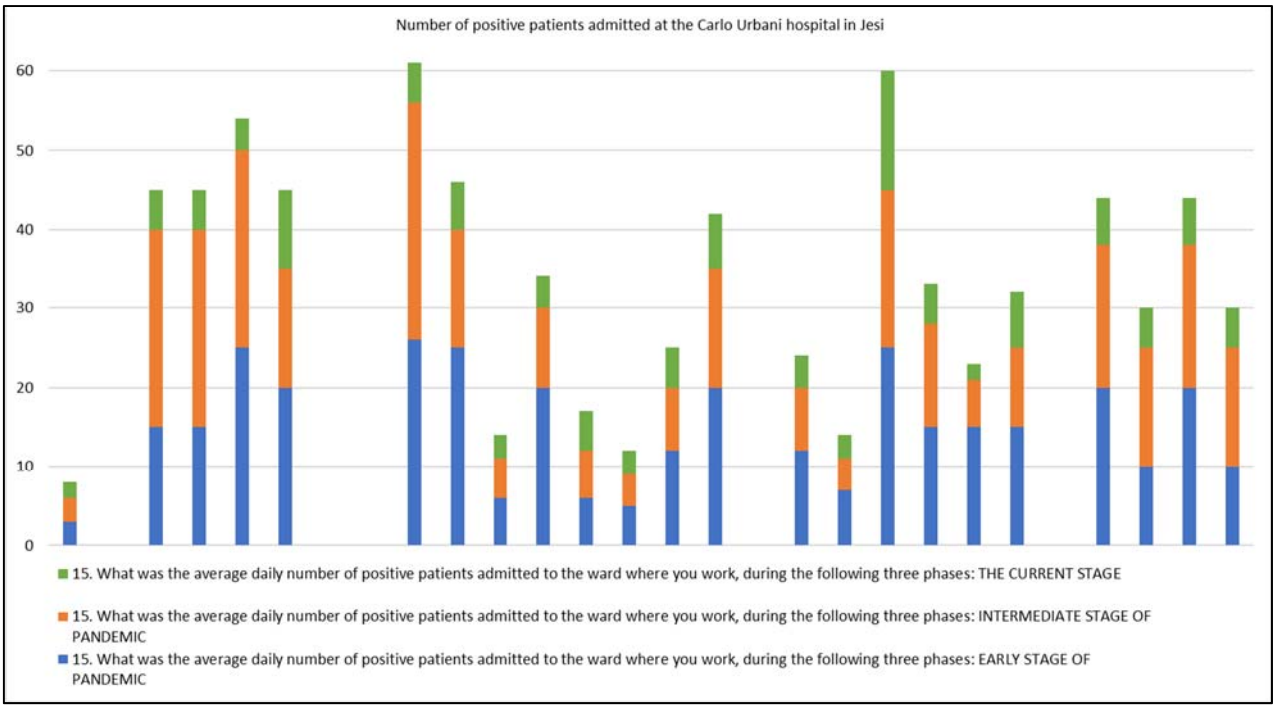


Figure 4.16: *Question 15 What was the average daily number of positive patients admitted to the ward where you work, during the following three phases: EARLY STAGE OF PANDEMIC, INTERMEDIATE STAGE OF PANDEMIC, THE CURRENT STAGE – Carlo Urbani hospital in Jesi*

The number patients positive to COVID-19 admitted at the Carlo Urbani hospital in Jesi presents high numbers for the early stage and the intermediate stage (respectively colour blue and orange in figure 4.16) and lower numbers at the current stage (green column). More precisely, the mean of daily admitted positive patients in the early stage was 15,09 and the mode indicated by healthcare personnel is 15; in the intermediate stage the mean was 13,61 and the mode 15; at the current stage the mean corresponds to 5,30 and the mode to 5.

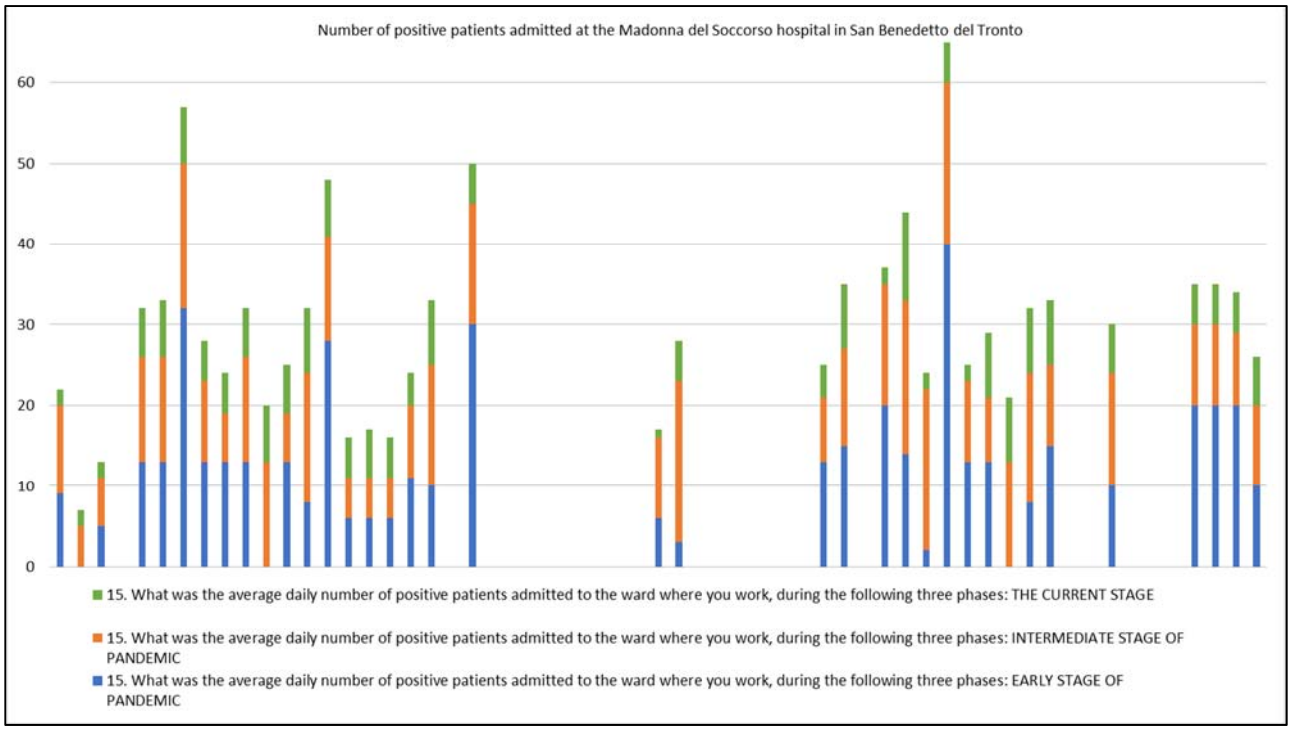


Figure 4.17: *Question 15 What was the average daily number of positive patients admitted to the ward where you work, during the following three phases: EARLY STAGE OF PANDEMIC, INTERMEDIATE STAGE OF PANDEMIC, THE CURRENT STAGE – Madonna del Soccorso hospital in San Benedetto del Tronto*

The results of question 15 for the hospital of San Benedetto del Tronto are shown in figure 4.17. The answers are very similar differentiating only for the period of analysis. The 59 healthcare personnel filling out the questionnaire indicated a mean of 12,73 daily patients admitted at the Emergency Room at the early stage of COVID-19 pandemic, with a mode of 13 (blue colour in the histogram); a mean of 11,65 patients per day and a mode of 10 during the intermediate stage (orange colour in the histogram); a mean of 5,46 daily positive patients with a mode of 5 at the current stage (orange green in the histogram). The zero values indicate no patient in the period of analysis or that the healthcare personnel did not answer to question 15.

Observing and comparing the histograms of the selected hospitals it is possible to see that, in some cases, the Emergency Room managed a number of patients very different. The table below compares the mean values and the mode values of the different hospitals.

Table 4.23: *Mean values and mode values of the selected hospitals*

Hospital	Number of respondents	Early stage	Intermediate stage	Current stage	Population
Ospedali Riuniti of Ancona	38	29,52	18,73	3,63	99.077
Santa Maria della Pietà hospital in Camerino Enrico Mattei hospital in Matelica Bartolomeo Eustacchio hospital in San Severino Marche	36	3,36	4,25	3,04	6.692 9.538 12.304
Santa Lucia civil hospital in Civitanova Marche	40	23,57	17,43	3,37	42.167
Engles Profili civil hospital in Fabriano	24	18,13	16,8	2,4	30.328
Carlo Urbani hospital in Jesi	28	15,09	13,61	5,30	39.579
Madonna del Soccorso hospital in San Benedetto del Tronto	59	12,73	11,65	5,46	47.544

The Ospedali Riuniti of Ancona seems to have carried out most COVID-19 positive patients in the three periods of time, followed by Santa Lucia civil hospital in Civitanova Marche, then by the hospital of Fabriano and Jesi which has similar values. At the end there are the Madonna del Soccorso hospital in San Benedetto del Tronto followed by the Santa Maria della Pietà hospital in Camerino.

Results of questions from 16 to 20

In connection with the guidelines, in the questionnaire is asked if there was a hospital-wide pandemic plan in place and how well was known by healthcare personnel. The table below shows the outputs of question number 16: “Was there a hospital-wide pandemic management plan in place and how much was known to the staff in your ward? [Yes, No, Uncertain]; [Very, so and so, little]”.

Table 4.24: *Cross between questions 16. Was there a hospital-wide pandemic management plan in place and how much was known to the staff in your ward? [Yes, No, Uncertain] and 16. Was there a hospital-wide pandemic management plan in place and how much was known to the staff in your ward? [Very, so and so, little]*

		16. Was there a hospital-wide pandemic management plan in place and how much was known to the staff in your ward? [Very, so and so, little]				Total
		No answer	Very	So and so	Little	
16. Was there a hospital-wide pandemic management plan in place and how much was known to the staff in your ward? [Yes, No, Uncertain]	No answer	17	3	1	4	25
	Yes	0	21	29	21	71
	No	43	23	6	10	82
	Uncertain	4	12	16	15	47
Total		64	59	52	50	225

Symmetric measure

		Value	Sig. approx.
Nominal per nominal	Phi	0,640	0,000
	V of Cramer	0,370	0,000
	Contingency coefficient	0,539	0,000
N. of valid cases		225	

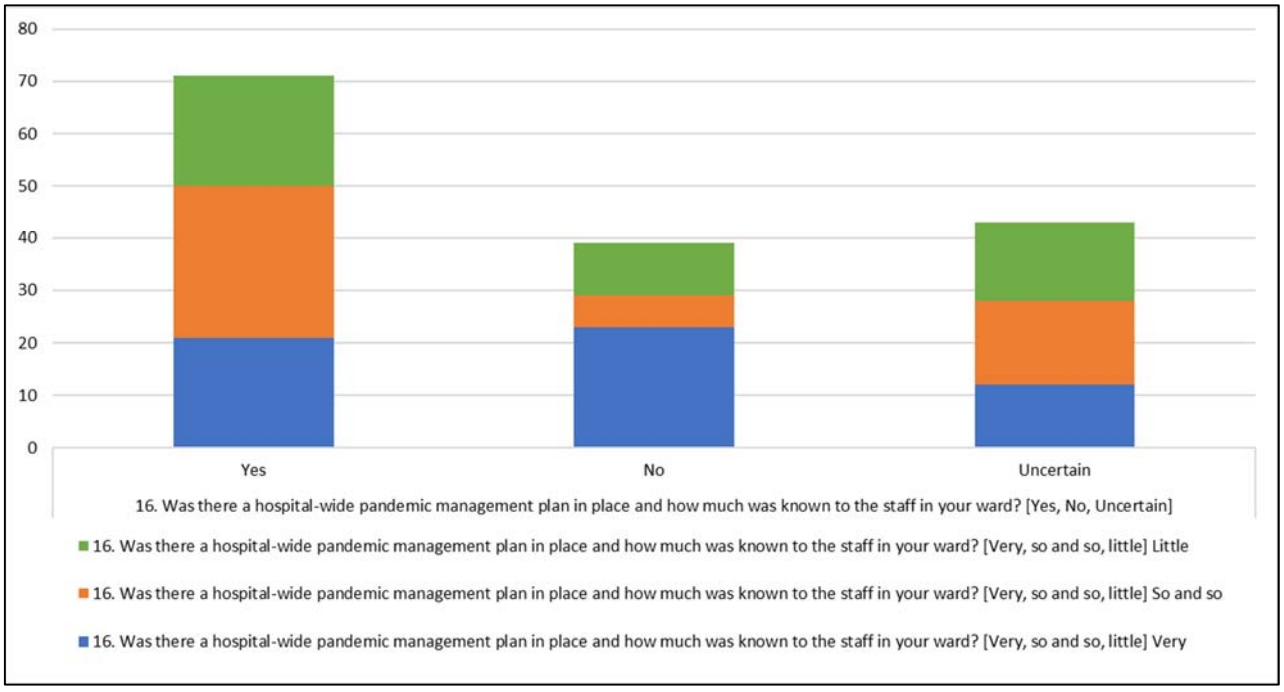
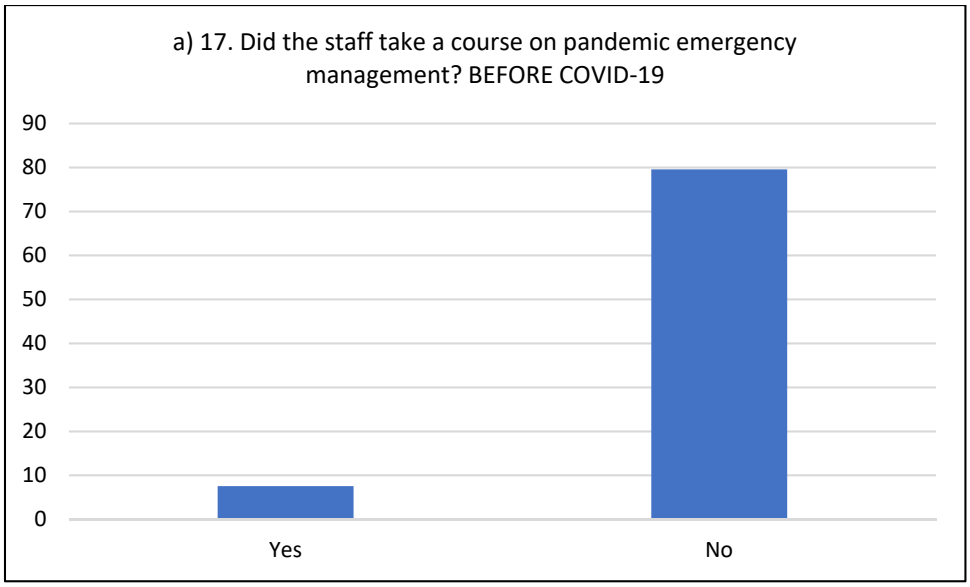


Figure 4.18: *Cross between questions 16. Was there a hospital-wide pandemic management plan in place and how much was known to the staff in your ward? [Yes, No, Uncertain] * 16. Was there a hospital-wide pandemic management plan in place and how much was known to the staff in your ward? [Very, so and so, little]*

Observing the data in the table 4.24. it is possible to see that at the time of COVID-19 pandemic most healthcare personnel knew a wide-hospital pandemic plan existed, but really, they knew it very little. 21 participants knew the existence of the plan and knew well what was written in it (blue colour in the histogram in figure 4.18– group of "Yes") as well of who knew the existence of the plan but did not read it (green colour in figure 4.18– group of "Yes"). 29 healthcare personnel knew the existence of the wide-hospital emergency plan but did not know it very well (orange colour in figure 4.18– group of "Yes"). Who did not know the wide-hospital plan, affirm to know it very well (23 participants (blue colour in the group of "No" in figure 4.18). Few healthcare personnel are uncertain about knowing the wide-hospital pandemic plan (last column in figure 4.18 in the group "Uncertain"). As shown in table 4.24, there is correlation among the two sub-question of question 16 (contingency coefficient 0,539).

At the time of the COVID-19 outbreak, the healthcare personnel working in the Emergency Room of the selected hospitals did not know very well the pandemic emergency plan, but they had the opportunity to take course on pandemic emergency management as shown in the tables and figure below.



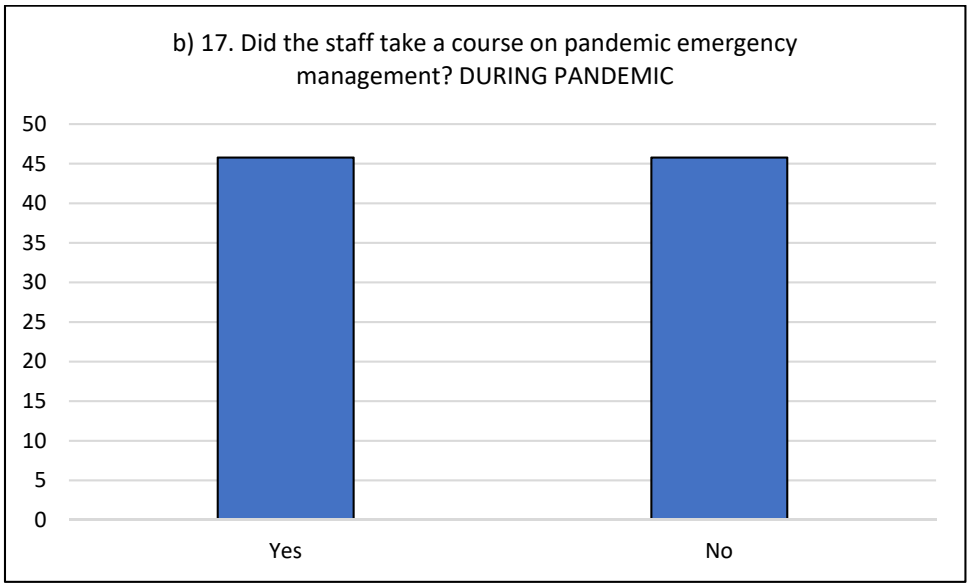


Figure 4.19: *a) Question 17 Did the staff take a course on pandemic emergency management? BEFORE COVID-19; b) Question 17. Did the staff take a course on pandemic emergency management? DURING PANDEMIC*

Table 4.25*: a) Question 17 Did the staff take a course on pandemic emergency management? BEFORE COVID-19; b) Question 17. Did the staff take a course on pandemic emergency management? DURING PANDEMIC*

a)		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	No answer	29	12,9	12,9	12,9
	Yes	17	7,6	7,6	20,4
	No	179	79,6	79,6	100,0
	Total	225	100,0	100,0	

b)		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	No answer	19	8,4	8,4	8,4
	Yes	103	45,8	45,8	54,2
	No	103	45,8	45,8	100,0
	Total	225	100,0	100,0	

Observing figure 4.19a and table 4.25a it emerges that before COVID-19 most of participants to the questionnaire did not take a course on pandemic management (179 among 225). Very few healthcare personnel took a course and others do not answer (17 and 29 participants respectively). Instead, during the COVID-19 pandemic (figure 4.19b and table 4.25b) the number of who took the course and who did not take the course was the same (103 participants).

***Table 4.26**: Cross between questions 17. Did the staff take a course on pandemic emergency management? BEFORE COVID-19 and 17. Did the staff take a course on pandemic emergency management? DURING PANDEMIC*

		17. Did the staff take a course on pandemic emergency management? DURING PANDEMIC			Total
		No answer	Yes	No	
17. Did the staff take a course on pandemic emergency management? BEFORE COVID-19	No answer	10	15	4	29
	Yes	3	7	7	17
	No	6	81	92	179
Total		19	103	103	225

Crossing the two sub-questions number 17 “Did the staff take a course on pandemic emergency management? BEFORE COVID-19” and “Did the staff take a course on pandemic emergency management? DURING PANDEMIC” (table 4.26), the outputs show that most participants did not take courses about pandemic management during the COVID-19 pandemic and did not take courses before COVID-19 (92 participants). Fewer participants took courses during the pandemic, but never took courses about pandemic management before COVID-19 (81 participants).

In a context of health emergency and impact of the whole Health System, in the questionnaire has been investigated the importance of the application of remote emergency support and the help received by local Institutions and voluntary organisations during the pandemic emergency.

With remote emergency support are included blogs where to consult scientific information, telemedicine to take care of patients unable to move or avoiding the risk of contagion, and remote medical consultation. The healthcare personnel evaluated the importance of remote emergency support with a five-level scale as shown in table 4.27 and figure 4.20.

***Table 4.27**: Question 18. Remote emergency support (e.g. blogs, telemedicine, remote medical consultations ...) was important in pandemic management.*

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	No answer	3	1,3	1,3	1,3
	Completely disagree	27	12,0	12,0	13,3
	Disagree	36	16,0	16,0	29,3
	Uncertain	66	29,3	29,3	58,7
	Agree	77	34,2	34,2	92,9
	Completely agree	16	7,1	7,1	100,0
	Total	225	100,0	100,0	

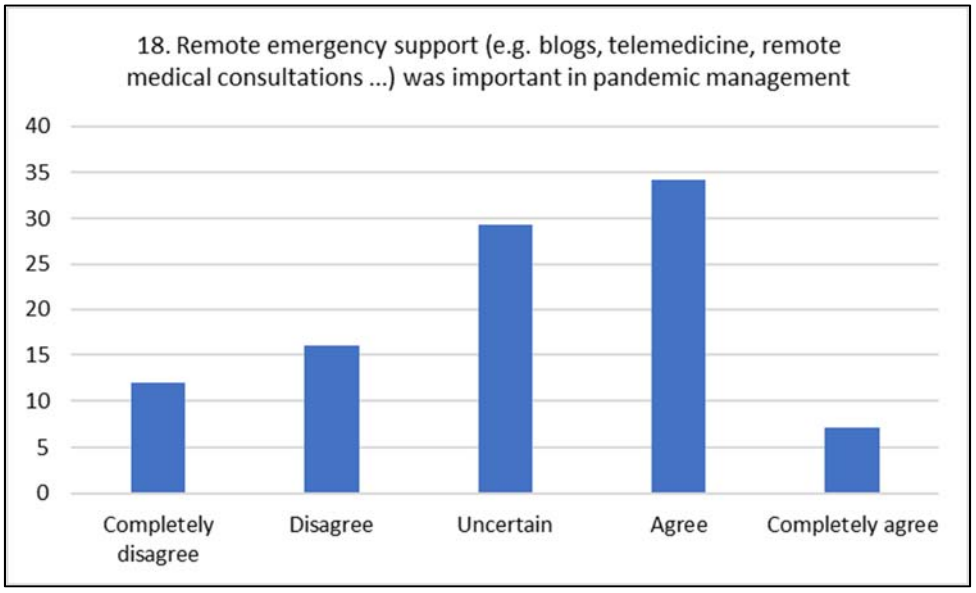


***Figure 4.20**: Question 18. Remote emergency support (e.g. blogs, telemedicine, remote medical consultations ...) was important in pandemic management*

Question 18 “Remote emergency support (e.g. blogs, telemedicine, remote medical consultations ...) was important in pandemic management” investigates the level of agreement of participants about the statement. Most of healthcare personnel filling out the questionnaire agree with the statement (77 participants among 225, or 34,2% of the total), or completely agree (16 participants, or 7,1%), supporting the importance of remote emergency support during the pandemic management. Many healthcare personnel are uncertain about the statement (66 participants, or 29,3%), but not few participants disagree or completely disagree about the importance of remote emergency support (36 and 27 participants respectively, or 16% and 12%).

The Italian Government made available the possibility of accessing funds and help from voluntary organisations by hospitals. The questionnaire investigates the level of importance of the support of Institutions and organisations with the question 19 “The support of local institutions and voluntary organisations in the area were fundamental in the pandemic management”.

***Table 4.28**: Question 19. The support of local institutions and voluntary organisations in the area were fundamental in the pandemic management*

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	No answer	5	2,2	2,2	2,2
	Completely disagree	15	6,7	6,7	8,9
	Disagree	33	14,7	14,7	23,6
	Uncertain	58	25,8	25,8	49,3
	Agree	83	36,9	36,9	86,2
	Completely agree	31	13,8	13,8	100,0
	Total	225	100,0	100,0	

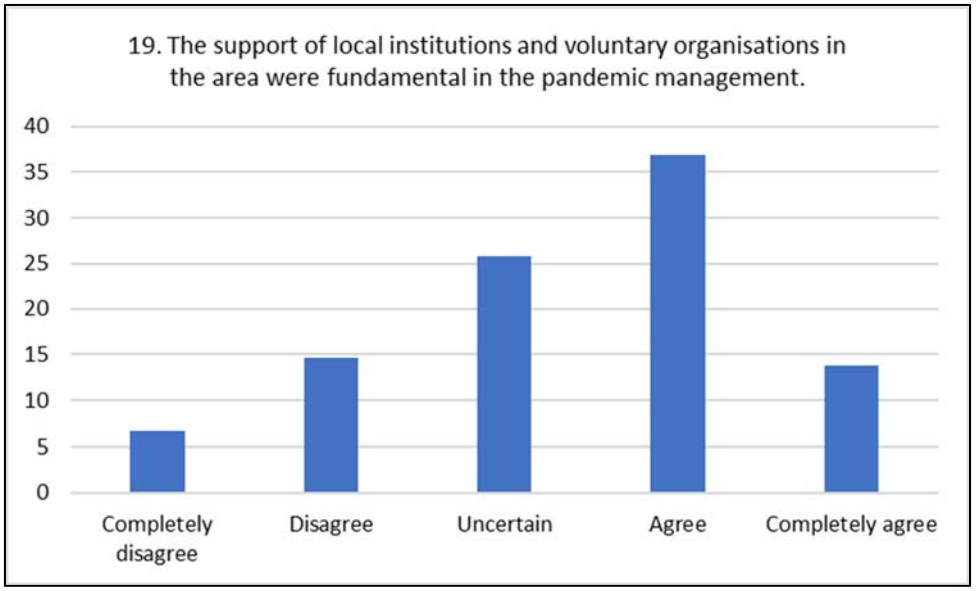


***Figure 4.21**: Question 19. The support of local institutions and voluntary organisations in the area were fundamental in the pandemic management*

Most healthcare personnel think that the support of local Institutions and voluntary organisations has been fundamental in the pandemic management (83 participants among the total 225, or 36,9% of the total). Not few healthcare personnel completely agree with the statement in question number 19 (31

participants, or 13,8%). Many participants are uncertain (58 participants, or 25,8%); and the others disagree or completely disagree (33 and 15 participants, or 14,7% and 6,7% respectively).

Some of the open answers to question 20 *"Emergency planning - report below your free considerations that you would like to share in order to improve future pandemic emergencies".*

In question 20 "*Emergency planning - report below your free considerations that you would like to share in order to improve future pandemic emergencies*", the healthcare personnel wrote about the implementation of specific pandemic plans, with flexible, understandable, and updated procedures, activities, guidelines, and specific division of roles. Someone suggested also international plans linked at global level, with the aim to collect common knowledge and coordinate the response to possible future pandemics. With the implementation of updated plans, the participants to the questionnaire suggest the involvement of all healthcare personnel and the implementation of courses (maybe mandatory) informing and training personnel of all different wards. Furthermore, many of them suggested the necessity of constant simulation and training about different type of emergency including epidemic and pandemic. They hope that with the implementation of new or updated pandemic emergency plans, concurrently the health structures will consequently be adequate in space, paths, device areas, resources, and technologies. Common requests of healthcare personnel filling out the questionnaire consist of the necessity to implement personnel at the Health System and the necessity to better define the role of territorial medicine which should support hospitals limit the flow of non-urgent patients. They focus on pandemic plans and training but pay attention also to the lack of help of territorial medicine.

Results of question 21 and 22

In question number 21 "*Lessons learned - more considerations, if there are, that you would like to share about pandemic management below*", the participants should write about the new skills learned during the last pandemic.

Most of participants report the acquisition of new knowledge about procedures or activities, and particularly the strength of collaboration toward a common objective. The collaboration among different professional figures was very appreciated by many healthcare personnel filling out the questionnaire. Among others, it emerges the necessity of courses about personal protective equipment (PPE), particularly the get dressed and the get undressed of PPE. Among the lesson learned explained, there are the constant and progressive implementation of knowledge during the everyday working activities; the importance of collaboration which is likely related to awareness of the role healthcare

personnel in a society during a health and biological emergency. The implementation of communication inside wards and between the managerial authorities and health workers has been fundamental as written by many participants to the questionnaire. Through the answers it emerges the importance of sharing information to accelerate a winning response. Healthcare personnel filling out the questionnaire highlight the importance of procedures and plans, but also of flexibility and capacity of adaptation that identify Emergency Room' personnel. Furthermore, politic should be sustained by science and not the substitute. Plan should indicate the direction; the administrations should guarantee the respect of procedures and rights; and emergency teams should save lives attended by their knowledge and the population support (who know what to do).

The last part of the questionnaire is dedicated to personal data of participants. The personal feelings are investigated with question 22 "*Difficulty - on a personal level what were the main problems you had to face during the pandemic*?".

The participants suffer most the lack of tools and materials, the shortage of personnel, the long shifts with personal protective equipment for many hours, the helplessness toward patients often isolated and dying alone, and the management of relations with their relatives which did not accept restrictions or procedures. They wrote about the constant fear triggered by stress and burnout, which could block them with the consequent limitation of services offered and the overload of activities for colleagues.

Results of question 23

The last question for healthcare personnel of the selected hospitals dealt with demographic information: age, gender, job, travel to get to work, marital status, children. Hereafter the frequency table with the outputs of each sub-question.

The first table among the demographic ones investigates the age of healthcare personnel with a division in classes of age: minor to 20 years old, between 20 and 30 years old, between 31 and 40 years old, between 41 and 50 years old, between 51 and 60 years old and over 60 years old. The classes include possible working ages.

***Table 4.29**: Question 23. DEMOGRAPHIC FRAMEWORK - How old are you? [<20, 20-30, 31-40, 41-50, 51-60, >60]*

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	No answer	26	11,6	11,6	11,6
	<20	1	0,4	0,4	12,0
	20-30	28	12,4	12,4	24,4
	31-40	53	23,6	23,6	48,0
	41-50	55	24,4	24,4	72,4
	51-60	55	24,4	24,4	96,9
	>60	7	3,1	3,1	100,0
	Total	225	100,0	100,0	

In table 4.29 it is possible to observe that participants to the questionnaire are aged between 20- and 60-years old exception for the 26 participants who did not answer. Indeed, that range reflects the possible age at which you can work in a hospital after the studies. Only one respondent or the 0,4% is aged less than 20 years old and few participants between 20 and 30 years old (28 participants or 12,4%). Most healthcare personnel are aged between 41 and 50 years old and 51 and 60 years old with 55 representatives each (or the 24,4% of the total 225). 53 participants or the 23,6% of healthcare personnel are aged between 31 and 40 years old. Very few healthcare personnel are aged over 60 years old (3,1%).

The table 4.30 represents the division in gender of healthcare personnel filling out the questionnaire. The division include three options: feminine (F), male (M), and fluid.

***Table 4.30**: Question 23. DEMOGRAPHIC FRAMEWORK - Gender [F, M, Fluid]*

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	No answer	111	49,3	49,3	49,3
	F	62	27,6	27,6	76,9
	M	52	23,1	23,1	100,0
	Total	225	100,0	100,0	

Most healthcare personnel preferred to not answer to this information (111 or 49,3% of the total). The other part of participants was divided similarly among female and male gender (62 female or 27,6% and 52 male or 23,1%).

One of the sub-questions of question 23 is about the expertise of healthcare personnel: medical specialist, physician, nurse, social health operator, other.

***Table 4.31**: Question 23. DEMOGRAPHIC FRAMEWORK - What is your job? [Medical specialist, Physician, Nurse, Social Health Operator]*

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	No answer	30	13,3	13,3	13,3
	Medical specialist	13	5,8	5,8	19,1
	Physician	41	18,2	18,2	37,3
	Nurse	113	50,2	50,2	87,6
	Social Health Operator	22	9,8	9,8	97,3
	Other	6	2,7	2,7	100,0
	Total	225	100,0	100,0	

The table 4.31 shows the outputs about the expertise of participants. Someone preferred not answering (33 among 225). Most participants are nurses (113 or 50,2% of the total). Many others are physicians (41 or 18,2%) and the rest are social health operators (22 or 9,8%) and medical specialists (13 or 8,8%). Those who answered "other" are mainly operators of 118. 30 participants decided to not answer to this question.

Observing table 4.32 it is possible to study the distance that the healthcare personnel have to travel to get to work. The options of the distance refer to the kilometres: from 0 to 5 km, from 5 to 15 km, from 15 to 50 km, over 50 km.

***Table 4.32**: Question 23. DEMOGRAPHIC FRAMEWORK - Do you have to travel a lot to get to work? [from 0 to 5, from 5 to 15, from 15 to 50, over 50]*

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	No answer	34	15,1	15,1	15,1
	from 0 to 5 km	66	29,3	29,3	44,4
	from 5 to 15 km	43	19,1	19,1	63,6
	from 15 to 50 km	72	32,0	32,0	95,6
	over 50 km	10	4,4	4,4	100,0
	Total	225	100,0	100,0	

Most participants live quite far from the hospital where they work (72 people or 32% live within 15 to 50 km from the hospital). Many healthcare personnel filling out the questionnaire live near the hospital where they work (66 or 29,3% live within 0 to 5 km from the hospital). 43 participants live not very near to the hospital (43 people or 19,1% live within 5 to 15 km from the hospital) and very few of them live far from the hospital (10 or 4,4% live more than 50 km from the hospital).

The frequency table 4.33 shows the outputs of the sub-question about the marital status of healthcare personnel filling out the questionnaire: married, cohabitant, fiancé, divorced, single.

***Table 4.33**: Question 23. DEMOGRAPHIC FRAMEWORK - Marital status [married, cohabitant, fiancé, divorced, single]*

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	No answer	30	13,3	13,3	13,3
	Married	90	40,0	40,0	53,3
	Cohabitant	39	17,3	17,3	70,7
	Fiancé	25	11,1	11,1	81,8
	Divorced	13	5,8	5,8	87,6
	Single	28	12,4	12,4	100,0
	Total	225	100,0	100,0	

Looking the results in the table above, it emerges that most of participants are married (90 participants among 225, or 40%). Many healthcare personnel cohabit with their partners and families (39 or 17,3%). Few participants are single (28 or 12,4%), few others are fiancé (25 or 11,1%) and very few participants are divorced (13 or 5,8%). 30 healthcare personnel prefer not to answer.

At the end of the questionnaire is investigate if healthcare personnel have children: no, yes 0 -6, yes 7 – 17, yes of age.

***Table 4.34**: Question 23. DEMOGRAPHIC FRAMEWORK - Do you have children? [no, yes 0 -6, yes 7 – 17, yes of age]*

		Frequency	Percentage
Valid	No	79	35,1
	Yes 0 - 6	28	12,4
	Yes 7 - 17	50	22,2
	Yes of age	54	24,0
	Rather not answer	27	12,0
	Total	225	100,0

The table 4.34 shows if participants have children and their ages. 27 healthcare personnel filling out the questionnaire prefer not to answer (12%). Most of them do not have children (79 or 35,1%). Some of participants have children between 7 and 17 years old (50 or 22,2%) and/or children of age (54 or 24%). Few participants have children between 0 and 6 years old (28 or 12,4%). Someone has more than one child and of different ages.

To characterise better the healthcare personnel participating to the questionnaires, some tables have been studied crossing the sub-question in question number 23.

Studying the sample of participants, the first investigation refers to cross ages and gender as shown in table 4.35.

***Table 4.35**: Cross between questions 23. DEMOGRAPHIC FRAMEWORK - How old are you? [<20, 20-30, 31-40, 41-50, 51-60, >60] and 23. DEMOGRAPHIC FRAMEWORK - Gender [F, M, Fluid]*

		23. DEMOGRAPHIC FRAMEWORK - Gender [F, M, Fluid]			Total
		No answer	F	M	
23. DEMOGRAPHIC FRAMEWORK - How old are you? [<20, 20-30, 31-40, 41-50, 51-60, >60]	No answer	25	0	1	26
	<20	0	0	1	1
	20-30	10	13	5	28
	31-40	17	19	17	53
	41-50	30	15	10	55
	51-60	25	14	16	55
	>60	4	1	2	7
Total		111	62	52	225

Among participants answering to the two sub-questions, it is possible to observe that the younger (20-30 years old) healthcare personnel are female (13 healthcare personnel female and 5 male). In the other age classes, the difference between female and male is not very strong. Generally, there are more female than male exception for the classes 51-60 and the older than 60 years old (14 females and 16 males in the class of 51-60 years old and 1 female and 2 males in the class older than 60 years old).

Cross-sectional analysis of gender and job (table 4.36).

***Table 4.36**: Cross between questions 23. DEMOGRAPHIC FRAMEWORK - What is your job? [Medical specialist, Physician, Nurse, Social Health Operator] and 23. DEMOGRAPHIC FRAMEWORK - Gender [F, M, Fluid]*

		23. DEMOGRAPHIC FRAMEWORK - Gender [F, M, Fluid]			Total
		No answer	F	M	
23. DEMOGRAPHIC FRAMEWORK - What is your job? [Medical specialist, Physician, Nurse, Social Health Operator]	No answer	22	4	4	30
	Medical specialist	6	2	5	13
	Physician	16	11	14	41
	Nurse	48	40	25	113
	Social Health Operator	15	5	2	22
	Other	4	0	2	6
Total		111	62	52	225

In table n. it is possible to observe that medical specialists and physicians are mainly men (2 female medical specialists and 5 males; 11 female physicians and 14 males). Most nurses are female (40 females and 25 male). Social health operators are female (5 females and 2 male).

Cross-sectional analysis of age and job (table 4.37).

***Table 4.37**: Cross between questions 23. DEMOGRAPHIC FRAMEWORK - How old are you? [<20, 20-30, 31-40, 41-50, 51-60, >60] and 23. DEMOGRAPHIC FRAMEWORK - What is your job? [Medical specialist, Physician, Nurse, Social Health Operator]*

		23. DEMOGRAPHIC FRAMEWORK - What is your job? [Medical specialist, Physician, Nurse, Social Health Operator]						Total
		No answer	Medical specialist	Physician	Nurse	Social Health Operator	Other	
23. DEMOGRAPHIC FRAMEWORK - How old are you? [<20, 20-30, 31-40, 41-50, 51-60, >60]	No answer	15	0	2	6	3	0	26
	<20	1	0	0	0	0	0	1
	20-30	1	0	4	22	1	0	28
	31-40	0	3	11	33	4	2	53
	41-50	7	2	9	30	6	1	55
	51-60	5	5	12	22	8	3	55
	>60	1	3	3	0	0	0	7
Total		30	13	41	113	22	6	225

Most of participants are nurses in the 31-40 class of age (33 nurses; 3 medical specialists; 11 physicians; 4 social health operators; 2 other job). Many nurses are also in the class of age 41-50 (30 nurses; 2 medical specialists; 9 physicians; 6 social health operators). Less nurses are between 51 and 60 years old (22 nurses; 3 medical specialists; 12 physicians; 8 social health operators). Only few medical specialists and physicians are older than 60 years old (3 each).

Cross-sectional analysis of job and marital status (table 4.38).

***Table 4.38**: Cross between questions 23. DEMOGRAPHIC FRAMEWORK - What is your job? [Medical specialist, Physician, Nurse, Social Health Operator] and 23. DEMOGRAPHIC FRAMEWORK - Marital status [married, cohabitant, fiancé, divorced, single]*

		23. DEMOGRAPHIC FRAMEWORK - Marital status [married, cohabitant, fiancé, divorced, single]						Total
		No answer	Married	Cohabitant	Fiancé	Divorced	Single	
23. DEMOGRAPHIC FRAMEWORK - What is your job? [Medical specialist, Physician, Nurse, Social Health Operator]	No answer	20	4	2	1	1	2	30
	Medical specialist	0	9	2	1	0	1	13
	Physician	2	20	5	5	0	9	41
	Nurse	4	46	29	17	7	10	113
	Social Health Operator	3	8	0	1	4	6	22
	Other	1	3	1	0	1	0	6
Total		30	90	39	25	13	28	225

Most medical specialists are married, and very few are cohabitant or fiancé or single (9 married; 2 cohabitants; 1 fiancé and single both). Most physicians are married; few physicians are single and very few physicians are cohabitant and fiancé (20 married; 9 singles; 5 cohabitant and fiancé both). Most of nurses are married, less nurses are cohabitant, more less of them are fiancé and few are single or divorced (46 married; 29 cohabitants; 17 fiancés; 10 singles; 7 divorced). Social health operators are mainly married or single, few of them are divorced and only one is fiancé (8 married; 6 singles; 4 divorced).

Cross-sectional analysis of marital status and the age of children (4.39).

***Table 4.39**: Cross between questions 23. DEMOGRAPHIC FRAMEWORK - Marital status [married, cohabitant, fiancé, divorced, single] and 23. DEMOGRAPHIC FRAMEWORK - Do you have children? a) No; b) Yes, 0-6; c) Yes, 7-17; d) Yes, of age*

a)		23. DEMOGRAPHIC FRAMEWORK - Do you have children? No		Total
		No answer	Yes	
23. DEMOGRAPHIC FRAMEWORK - Marital status [married, cohabitant, fiancé, divorced, single]	No answer	29	1	30
	Married	77	13	90
	Cohabitant	19	20	39
	Fiancé	3	22	25
	Divorced	13	0	13
	Single	5	23	28
Total		146	79	225

b)		23. DEMOGRAPHIC FRAMEWORK - Do you have children? Yes, 0-6		Total
		No answer	Yes	
23. DEMOGRAPHIC FRAMEWORK - Marital status [married, cohabitant, fiancé, divorced, single]	No answer	30	0	30
	Married	72	18	90
	Cohabitant	30	9	39
	Fiancé	24	1	25
	Divorced	13	0	13
	Single	28	0	28
Total		197	28	225

c)		23. DEMOGRAPHIC FRAMEWORK - Do you have children? Yes, 7-17		Total
		No answer	Yes	
23. DEMOGRAPHIC FRAMEWORK - Marital status [married, cohabitant, fiancé, divorced, single]	No answer	30	0	30
	Married	47	43	90
	Cohabitant	35	4	39
	Fiancé	25	0	25
	Divorced	10	3	13
	Single	28	0	28
Total		175	50	225

d)		23. DEMOGRAPHIC FRAMEWORK - Do you have children? Yes, of age		Total
		No answer	Yes	
23. DEMOGRAPHIC FRAMEWORK - Marital status [married, cohabitant, fiancé, divorced, single]	No answer	24	6	30
	Married	62	28	90
	Cohabitant	34	5	39
	Fiancé	24	1	25
	Divorced	3	10	13
	Single	24	4	28
Total		171	54	225

Most participants did not answer to the question about children, but among those who did, the majority of healthcare personnel who do not have children are cohabitant and engaged (table 4.39a). Married health workers mostly have children of all different ages (0-6 years old; 7-17 years old; of age) as shown in table 4.39b, c, d. Few cohabitants have children little, young or of age; whereas divorced participants mainly have children of age (table 4.39c).

4.3 PRISMA Statement for New Zealand

A preliminary selection of 190 articles was collected from the consulted databases all focussed on New Zealand's response to the pandemic. Subsequently, duplicated records (24) were eliminated during the initial screening phase, and after a detailed assessment of the abstracts, and another 15 were excluded as they fell outside the scope of the review. A more in-depth assessment was carried out during the complete reading of the articles. In total, 46 articles and documents were included in this PRISMA review, comprising 44 scientific articles and 2 reports. Three of these documents were directly related to the institutional management encompassing policies and healthcare regulations. The remaining 43 articles covered various aspects, including socio-cultural approaches, historical experiences and short- and long- term impacts, with each category covered roughly by a similar proportion of articles.

The primary source for articles mining was the AUT library, accounting for 80% of the articles. Additionally, 13% were sourced from NZ Research, 7% from New Zealand Government COVID-19 legislation. The articles retrieved from EBSCO were identical to those in the AUT library collection.

***Table 4.40**: Description of articles selected in different databases platforms searching for different keywords*

Database Key words	EBSCO	New Zealand Government COVID-19 legislation	NZ research	AUT library
COVID-19 New Zealand	74.084	102	155.756	47.215
Pandemic preparedness New Zealand	220	-	8	5.233
Pandemic strategies New Zealand	604	-	95	29.979
Pandemic response New Zealand	872	-	159	33.276
Total articles chosen	27	30	12	64
Total articles chosen without duplicate	0	3	4	39
Final total of articles chosen	46			

Studies were also searched through other platforms (Tab. n.). Six online repositories and one organisation were identified, and upon examination, a total of 1819 reports were found. However, only 22 reports were assessed for eligibility and related to the focus area of Institutional management (policy and healthcare) as well as geographic and demographic analysis. The primary sources for the identification of documents and data were the NZ "Unite Against COVID-19" governmental platform and the Ministry of Health repositories (approximately 32% both). The remaining sources were

grouped in the "other" category (approximately 23%) including the New Zealand Government Beehive (about 10%).

Only journal articles and official government documents and data were analysed. In cases where articles and documents were compared in multiple searches, they were considered only once.

***Table 4.41**: Description of documents available and selected in different platforms*

	New Zealand Government Unite Against COVID-19	New Zealand Government Beehive	Ministry of Health	Stats NZ	Other
Link or documents available	74	1715	16	6	14
Link or documents consulted	7	2	7	1	5
Total Link or documents consulted	22				

Data about articles, reports and documents collected from databases, registers and other methods were resumed in the PRISMA flow diagram following the statement's process.

The figure 4.23 illustrates the PRISMA flow diagram complete with data.

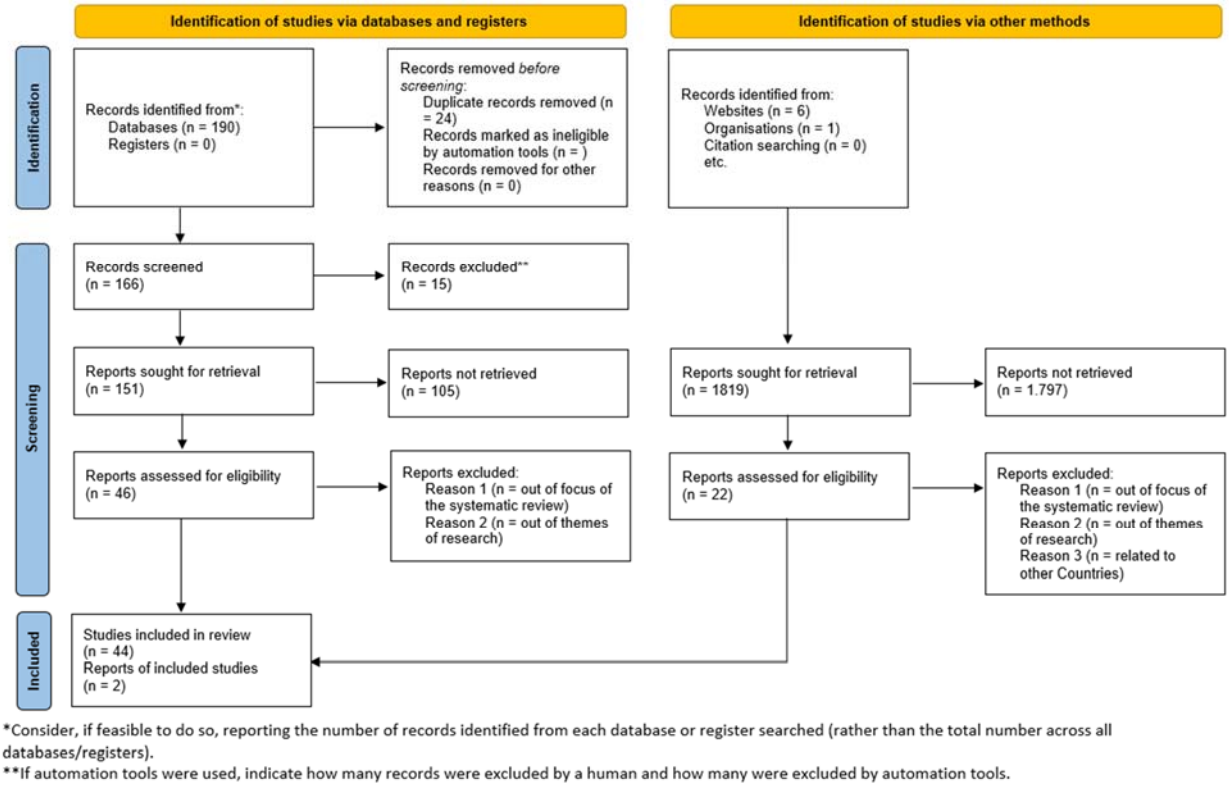


Figure 4.22*: PRISMA flow diagram of the research study*

Source: Modified from the PRISMA flow diagram of Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. For more information, visit: http://www.prisma-statement.org/

Scientific papers report: i) the preparedness of New Zealand Health System and the population supported by the strong memory of past epidemics and pandemics; ii) evolution of pandemic strategies; iii) healthcare workers' resilience due to their preparedness and number of employees; iv) minorities condition during pandemic events; v) socio-cultural importance in pandemic management. Documents and official website answer to the research questions of the PRISMA statement about: i) actions and measures implemented during the COVID-19 pandemic and the previous epidemics and pandemics; ii) guidelines implemented during the COVID-19 pandemic and the previous epidemics and pandemics; iii) socio-cultural approach of the Government in the implementation of measures.

4.4 Interviews in New Zealand

The results of the 5 open interviews (4 experts and 1 resident) carried out in New Zealand will be summarised below.

Expert 1 (in public health and international humanitarian assistance): Reflecting on my experience in public health and international humanitarian assistance, with the information broadcasted by the NZ Government and validated by the Ministry of Health, I felt a sense of security during the recent pandemic. Obviously, there was a certain level of apprehension due to the unknown nature of the virus, but we were all well-informed about what was needed to be done, both at home and at work.

One of the crucial aspects which needs to be highlighted is the lasting memory of the Spanish Flu epidemic in New Zealand in 1918. A significant number of people died due to the flu introduced by European colonisers, particularly affecting indigenous and Māori communities. This historical event has left a deep impression on both elderly and younger generations. They learned about it at school, and especially from their parents, who passed down not just facts but also emotion and insights. This historical context contributes to a lack of trust in individuals from European countries by some indigenous people. Europeans played a role in the dispersal or the partial elimination of indigenous communities. As a result, any further loss of lives within the entire New Zealand population is simply unacceptable.

The cultural approach plays a pivotal role in the management of epidemic and pandemic, influencing both governmental decisions and the response of the population. When administrative measures align with the culture of a country, the population is more likely to appreciate the significance of certain mandatory directives. Moreover, if the population has a cultural inclination towards preserving life, more individuals are aware of the best practices, resulting in a larger portion of the population in good health and more inclined to accept the information provided. This strong commitment to preserve one's own health and of the entire community, compels each incoming Government to prioritise health security and assistance during its tenure. Conversely, the population is prepared and educated to preserve its own health and that of others. It is common for many people to have family members living outside the country, necessitating self-sufficient and self-care. This condition impacts not only economic self-sufficiency but also health preservation: the sentiment being "if I get sick, there won't be anyone to look after me". The isolation nature of New Zealand shapes the character of its own population and Government administration.

The sense of protection of the Government and the self-protection of the population plays a vital role in preserving hospitals from being overwhelmed, especially when hospitals are consistently operating at full capacity and have to prioritise patients based on emergency criteria. Some less privileged individuals, such as Māori, at times feel anxious about the possibility of not receiving necessary treatments. The public health system operates as a closely integrated system, considering itself self-reliant. It intervenes in every type of event with a robust structure that spans from the local to the scientific, regional, national, and international levels. Communication within the public health structure is seamless, characterised by a "hand-to-hand" system. Collaboration with other units is essential and it may be beneficial to establish a collaborative and coordinated system with a shared glossary. What appears to be missing is inclusion of disaster and Union Civil Protection Mechanism training for healthcare personnel during their university studies.

During the COVID-19 pandemic, the Government implemented stringent restrictions such as the long-term closure of borders, which were well-received by the population due to the resulting sense of safety, despite the inconveniences faced by residents returning home. The real difference in the administration during this period may have been the relatively young age of those in leadership positions within the Government, enabling them to connect with people at all levels of the population and reducing the perceived distances between the leadership and the public. The New Zealand Government seems to prioritise a unified community over multicultural or multi-ethnic distinctions (of which New Zealand is constituted). Prime Minister Jacinda Arden's communication strategy, marked by simple language and clear explanations of the Government decisions, contributed to the success. Additionally, the scientific support provided to the Government's management of the COVID-19 pandemic played a crucial role in validating government actions. Furthermore, while local-level emergency management is important, there are instances where national-level management is more effective and necessary to ensure a coordinated and organised response. National support typically has access to the latest tools and innovations, making collaboration with exclusive management a priority.

Obviously, it will take time for the experience of the COVID-19 pandemic to become part of the collective memory and personal experience of the people. At present, there is a high level of discontent among the public, compounded by difficulties associated with the ongoing pandemic.

While there may not be a perfect pandemic plan, the biological hazard posed by epidemics and pandemics should be accorded the same importance as other hazards in the field of disaster geography. A one-size-fits-all plan for the world is not feasible because plans must be adapted to the

geographic nature and cultural context of a region. What is most critical to consider is the potential for saving lives. When an event occurs, especially when its origin and identity are unknown, the decisions of the Government may need to evolve rapidly. Such changes can impact public trust, but it is crucial to adjust guidelines based on new discoveries. People should not seek information from unofficial sources, and Institutions should provide information and guidelines honestly and transparently.

Expert 2 (on Disaster Studies): For what that concerns the Government' strategies, I think that probably they did not consider the long-term effects. This includes economic impact, societal effects such as psychological well-being, consequences for education, domestic violence, and impacts on relationships. At first, the population accepted the restrictions imposed by the Government, possibly believing they would be short-term measures. At the first stage of the pandemic, it was challenging to critically evaluate the new regulations for COVID-19 management, as people had significant trust in the Institutions. However, it appears that this trust may be evolving.

Analysing the strategies implemented, it would be very interesting to make a timely comparison between the strategies implemented by Italy and New Zealand during the recent pandemic. The effectiveness of so-called "winning actions" as defined by the WHO depends on the chosen criteria and the observed impacts. Reducing or controlling the number of positive cases and preventing overwhelming hospital admissions are some positive criteria. However, it is essential to consider the long-term impacts, including economic and social effects, loss of trust in the Government, impacts on vulnerable populations such as minorities or the elderly, children, and immunosuppressed individuals, which may be considered negative criteria for the analysis.

For example, a famous deejay was allowed to enter New Zealand by crossing the borders because he was a resident, while some mothers or pregnant women were not allowed reuniting with their families in New Zealand because they did not have residency.

Furthermore, at the first stage of COVID-19 pandemic, the Government and social media conveyed a sense of the outside world being in complete turmoil, while New Zealand was seen as a safe island closed off from the chaos. Notwithstanding the difficulties and despite the travel restrictions the virus entered the country. It is also interesting to observe how different countries on opposite sides of the world adopted similar strategies to face the pandemic.

Viruses should be recognised as biological hazards associated with epidemic and pandemic, promoting the need for pandemic management. Following this recognition, it becomes necessary to study what kind of actions should be taken before an emergency occurs. The mitigation and preparation phases should include increasing hospital capacity for patients' management and

recovery, expanding the healthcare workforce, paying attention to vulnerable people, improving population preparedness, and enhancing overall population health. Coordination among Public Health, disaster experts and scientific experts is crucial.

The COVID-19 pandemic let to emerge the deficiencies and lack of preparedness for pandemics in many developed countries in the northern-west hemisphere, contrasting with the experiences of less developed countries in the eastern hemisphere, that are more familiar with epidemics.

During the pandemic, it seemed as if there was only one type of hazard: the SARS-CoV-2 virus. However, it may be more beneficial to adopt a multi-hazard approach to avoid losing sight of other hazards, especially those typically present in a specific area.

In the history of New Zealand, the Government has issued the highest-level alert only three times: during the earthquake of Christchurch, the COVID-19 pandemic, and the cyclone Gabrielle. It raises questions about whether the activation criteria for these alerts have been consistent.

The anti-COVID-19 vaccine was portrayed as the ultimate solution to the pandemic, but this may not be entirely accurate. Better information and more precise communication are needed to address vaccine hesitancy. Many people are refusing not only anti-COVID-19 vaccine, because of the loss of trust in Institutions.

Expert 3 (on Public Health): Several questions arise when considering the pandemic emergency, with a focus on vaccine, minorities, and immigrants:

- Are the cultural needs and requirements of minority groups genuinely considered in the regulations implemented for COVID-19 pandemic?
- What can be done to ensure the inclusion of the entire population, including the minority groups?
- Is it clear how to reserve vaccines?
- Where can one find information about vaccines and which categories are included?
- What should individuals with temporary visas do? Do they have access to vaccines, or do they exit as part of the response?
- Are the information materials translated into different languages?
- How can people's knowledge be enhanced to make compliance with regulations such as vaccine uptake more voluntary than mandatory?
- How can the population be actively engaged in emergency response and adequately prepared?

It is desirable to have a community that knows what to do and responds to the preservation of common good, without a sense of compulsion or coercion.

The response of New Zealand to COVID-19 pandemic has been highly effective, with the Government performing admirably. However, there are some aspects which may go unnoticed. For example, my research focussed on the implementation of the vaccine strategy and how minority groups have been included.

Some general observations about vaccines can be made parents are more willing to vaccinate their children if they are willing to get vaccinated themselves, unlike some individuals who may have questions and be less prepared for vaccination. The readiness to receive the vaccine often depends on the impact of the General Practitioner on their patients or their knowledge about the vaccine.

It is very important to include epidemic and pandemic in the studies of disaster risk reduction.

Expert 4 (on Geography): There are conflicting opinions on the management of COVID-19 in New Zealand, but overall, the population takes pride in what has been accomplished. New Zealand's strategies have particularly become a source of pride when compared to many other countries. New Zealanders are accustomed to make comparisons as they seek recognition and acknowledgement on the global stage.

New Zealand is not frequently mentioned in worldwide reports, as it recognises its relatively modest global significance. However, following the COVID-19 pandemic, New Zealand did receive attention in global reports due to Cyclone Gabrielle compared, in contrast to earthquakes in Turkey and Syria. The pandemic management model has been compared to the success of countries like South Korea. However, New Zealand's approach stands out because it has a liberal Government unlike Korea which has a more authoritarian/communist Government.

Minorities groups, including Māori and others are protected and depicted at the Parliament, so their claims of lack of respect for their situation and needs are not always justified.

The Health System in New Zealand is divided into districts, but it is managed at the national level.

The relatively short period of border closure is not universally acknowledged as a protective measure. Some people fail to recognise that this approach saved money, and provided reimbursement for work limitations, along with optimal services for online school and university lessons, particularly when compared to the experiences in other countries. It is worth noting that those criticising border closure are often the same individuals who are concerned about the entry of people into New Zealand due to the risk of increased contagion or virus transmission. While not many people previously included pandemic management in disaster risk reduction studies, there is a growing recognition of the need to do so following the COVID-19 pandemic.

Local Resident: The fear of the pandemic played a pivotal role in driving the population's compliance with the restriction imposed by the Government. The support of the scientific and health teams that

advised the Government was crucial in instilling trust and acceptance of these restrictions. The fear was associated with the unknown virus, which was perceived as a potential cause of certain death upon infection. The primary instinct was protecting oneself from others, before embracing a sense of communal responsibility to protect others as well. This perception coupled with the encouragement of remote work during the pandemic has led to ongoing challenges. For example, it is possible to identify four types of problems: socio-psychological, economic, health, and political.

From a socio-psychological perspective, cases of depression, phobias, and isolation symptoms have emerged. Many individuals prefer working from home for comfort and to avoid contact with others. People are less inclined to go out and travel compared to before COVID-19 pandemic event. The memory of the epidemic is always vivid in the minds of New Zealanders, and it is pivotal in health preservation, self-regulation, adaptability, and response to events.

Economically, companies have had to adjust and adapt their working activities. Public activities such as restaurants, coffee shops, hairdressers have suffered due to reduced patronage. The long-term effects of the restriction are yet to fully materialise. Furthermore, the pandemic has had uneven economic impacts, with some becoming wealthier due to increased rents and material costs, while others have fallen into extreme poverty.

It is widely understood that hospitals cannot adequately manage a surge of patients during a pandemic. Public Health measures have supported patient management, but many healthcare personnel, particularly nurses, were infected due to inadequate information. Spaces designated for patient care were often insufficient, leading to recommendation self-management at home, which was not always successful. Contact tracing helped control patient clusters but concerns about privacy invasion were raised. Restriction on visits and patient activities in rest homes or rehabilitation centres, have to led patient regression.

The decision to make COVID-19 vaccination mandatory is common in New Zealand for public employees, and business owners, but not everyone has accepted this requirement. The Māori culture, for instance, has historically been cautious about chemical drugs, leading to strategies aimed at involving Māori healthcare personnel in vaccination campaigns. Similar strategies have been implemented for Pacific communities.

Considering the political activities and strategies, the Government provided updates on the pandemic, implemented decisions, and shared guidelines three times a day. The Prime Minister personally announced official laws especially if they applied to a specific area, instilling trust, and fostering a sense of self-responsibility among the population. Awareness about the new virus, its impacts, and the need for preparedness increased through information about the pandemic's evolution in other

countries. The information and guidelines from the WHO complemented the strategies implemented by the New Zealand Government.
In conclusion, the implemented strategies engendered a sense of protection among the population, with most adhering to guidelines. Minorities were among few who protested. The only concern raised is the long-term impact of the restrictions, on tourism, agriculture, small and medium-sized enterprises, and the socio-psychological well-being of the population.

I live in the biggest city of New Zealand and in one of the most impacted cities by the last pandemic, but it is important to recognise the safety of the country compared to the ones where I lived during my childhood like Africa and South America. The advantages of living on an island with protection and multi-ethnic reality are clear, but the risks also exist. Some of these downsides include the need for self-sufficiency, even though it has not been fully achieved, and a strong economic reliance on tourism and international students, particularly from Asian countries like China, Korea, and Japan.

I shared these opinions and observations with my clients and many of them have shared similar perceptions.

4.5 Parallels between Italy and New Zealand

Italy and New Zealand adopted a different approach to the management of COVID-19 pandemic. Italy adopted a mitigation strategy characterised by numerous Ordinances, Decrees and Laws by the Government. New Zealand favoured the elimination strategy with long-lasting measures. The table below summarised some of the principal measured adopted by the two countries.

***Table 4.42**: Italian and New Zealand measures adopted during the COVID-19 pandemic management*

Italy		**New Zealand**	
MITIGATION STRATEGY		ELIMINATION STRATEGY	
24.01.2020	Operational indications for monitoring the health status of passengers on flights originating from China	14.03.2020	The Government announces anyone entering New Zealand must self-isolate for 14 days, except those arriving from the Pacific.
30.01.2020	First two COVID-19 positive cases	28.02.2020	First COVID-19 positive case
Hospitals manage COVID-19 patients in separate departments with a consequent limitation on cure and health services.		Public Health Institute manage COVID-19 patients in order to avoid hospitals overcrowding.	
31.01.2020	Declaration of the state of emergency in the whole Country as a consequence of the health risk associated with the onset of pathologies deriving from transmissible viral agents.	25.03.2020	New Zealand moves to Alert Level 4 and the entire nation goes into self-isolation. A State of National Emergency is declared.
25.02.2020	Suspension throughout the regional territory of public events, educational services of all levels, museums, places of culture and libraries, public competitions (except for health professions); activation of Gores functions.	19.03.2020	All indoor gatherings of more than 100 people are to be cancelled.
09.03.2020	On the national territory: avoiding incoming and outgoing movements, suspension of sporting events, promoting ordinary leave and holidays, closed ski resorts, suspended events, suspended educational services, closed museums, suspended bankruptcy procedures, bar and restaurant activities.		Borders closure to all exception for New Zealand citizens and permanent residents. Self-isolation and tests for 14 days.

11.03.2020	Throughout the national territory, suspension of commercial activities except for the sale of primary goods, catering, personal services. Closure of all levels of education. National lockdown.		
17.03.2020	14 days of self-isolation for returns from abroad.	14.03.2020	Anyone entering New Zealand must self-isolate for 14 days, except those arriving from the Pacific.
Positive patients isolated in the same hospitals department.		09.04.2020	Introduction of MIQ Managed Isolation Quarantine.
18.03.2020	Guidelines of good practices.	Guidelines broadcasted at the start of Alert Level 4 (25.03.2020).	
22.03.2020	Closures of all activities.	08.06.2020	New Zealand moves to Alert Level 1.
16.05.2020	Free travels and movements inside the region of residence.		
17.05.2020	Partial reopening of activities and events. Not for schools and universities.		
30.06.2020	Partial reopening of borders.		
24.10.2020	Employment of 1500 health workers on the territory.		
27.12.2020	Start vaccination of healthcare workers.	20.02.2021	Start vaccination.
02.01.2021	Adoption of the National Strategic Vaccine Plan for the prevention of SARS-CoV2 infections.		
31.03.2022	End of the state of national emergency.	02.12.2021	End of COVID-19 Alert System.
		12.09.2022	End of COVID-19 Protection Framework (traffic lights).

Italian Government issued numerous Ordinances, Decrees and Laws during the COVID-19 pandemic from the first COVID-19 transmission outside China in 2020 to March 2022. The Italian measures were adapted to the evolution of pandemic inside the Country. The New Zealand government, on the other hand, favoured measures with long-term effects, but fewer updates to the measures implemented.

4.6 Field Exercise MODEX

In relation to the indicators selected in the research project, what emerges from the simulation reflects the attention to some points highlighted in the indicators as shown in table 4.43.

***Table 4.43**: Results of the indicators analysed during the MODEX Arcevia 2023*

INDICATOR FOR HEALTH & SAFETY MACROAREA	**Description**	**What to observe?**	**What in the simulation?**
Number of hospitals	Number of hospitals in the studied areas.	How many field structures intervene?	3 EMT – the first day the PMA of Ancona was also involved.
Number of residential services	Number of residential services for elderly people in the studied areas.	How many residential services are in the area?	1 Casa della Salute.
Emergency network	Organisation of the emergency network among hospitals, public administrations, population and all the different stakeholders involved in the emergency.	How is organised the emergency chain (field hospitals, public administration, fireman, civil protection, voluntaries)?	The EMTs had some difficulties in the reception of information from the Excon. The emergency number 112 was the filter among different actors of operations.
Information quality	Quality of the information received by the hospital's emergency room from public administrations and stakeholders involved in the emergency.	Clear information.	Excon was main responsible of the information forecast.
Coordination	Coordination among hospitals, public administrations and stakeholders involved in the emergency.	How do the field hospitals coordinate with other stakeholders?	Excon was main responsible of the coordination. The EMTs depends on Excon and received support from local associations and local hospitals.
Medical specialist	Number of medical specialists working in the emergency room of the selected hospitals.	How many medical specialists per patient?	It was not possible to register this data, but in each field hospitals there were about 30 individuals among healthcare workers, technicians, chefs.
Physician	Number of non-specialist physicians working in the	How many physicians per patient?	It was not possible to register this data, but in each field hospitals

	emergency room of the selected hospitals.		there were about 30 individuals among healthcare workers, technicians, chefs.
Nurse	Number of nurses working in the emergency room of the selected hospitals.	How many nurses per patient?	It was not possible to register this data, but in each field hospitals there were about 30 individuals among healthcare workers, technicians, chefs.
Social worker in public health service	Number of social workers in public health service working in the emergency room of the selected hospitals.	How many social workers in public health service per patient?	It was not possible to register this data, but in each field hospitals there were about 30 individuals among healthcare workers, technicians, chefs.
Interdisciplinarity	Level of interdisciplinary skills requested in the emergency room of the selected hospitals.	Which kind of preparation characterised the healthcare personnel?	Healthcare personnel specialised in emergencies.
Drug/patient	Ratio between available specific drugs and patients in the emergency room of the selected hospitals.	Are in the field structure the availability of drugs per patient?	All the EMTs had a pharmacy locked with a variety of drugs. Furthermore, if the stockpiles finished, they could contact the other EMTs in the area or the nearest local pharmacy (not damaged).
Triage tag	Adequacy of triage procedures in the emergency room of the selected hospitals.	Are the triage procedures adequate to the European instructions?	PMA had Italian procedures not EU. The EMTs applied the EU procedure, except for the Germany field hospital that was requested from examiners to update some procedures.
Temporary tent structures	Availability of temporary tent structures used by the emergency room of the selected hospitals (used as waiting/isolating rooms for patients needing care).	How are the tents organised?	Tent constituted the hospital structures and the logistic offices.

Number of vehicles	Adequate number of emergency vehicles to deal with many emergency calls.	How many vehicles per field hospital?	Austria: 2 own ambulances Germany: no ambulance Romania: 2 own ambulances Despite that, field hospitals faced difficulties in finding ambulances on time for the transfer of all patients.
Helipad availability	Availability of helipads near the hospitals.	There is a helipad in the area?	The stadium of the Municipality became an emergency helipad space.
Hospital accessibility	Easiness to both enter and exit the hospital area.	Yes, experts decided the areas' position.	The teams studied the flow direction.
Emergency room layout	Flexibility in rearranging the layout of the emergency room of the selected hospitals.	Flexibility in rearranging when the first suspected cases appear.	The EMTs rearranged the hospitals after the meningo-encephalitis cases. But one EMT (Austria) did not recognise any cases.
INDICATOR FOR POLITICAL & ECONOMIC MACROAREA	**Description**	**What observe?**	**What in the simulation?**
Partnership/ international/ interregional cooperation	Activation of the subsidiarity principles.	Which kind of cooperation is predicted?	EU support and teams' cooperation.
Governance (strength and stability)	Citizens' trust in the government.	How much does the population trust in the Government?	Not available, because Modulistan is not a real Country. But the actual Mayor of Arcevia has been elected with 80% of votes.
Human rights	Respect of human rights in the emergency directives.	Are human rights respected during the emergency?	Aome injects requested police intervention.
Giving and accepting aid	Aptitude of Government in receiving or giving support during the emergency.	Has the Government asked for help?	Modulistan Administration asked for international support.
Aid continuity	Aptitude of Government in giving continuity to aid during the emergency.	Has the Government given aid?	Ministry of Health guaranteed support and provision of vaccines for example.

Multi-stakeholders' engagement	Involvement of many stakeholders to deal with the emergency.	Which kind of stakeholders were involved?	Modulistan Administration, civil protection and volunteers, field hospital from other Countries.
INDICATOR FOR SOCIO-PSYCHOLOGICAL MACROAREA	**Description**	**What observe?**	**What in the simulation?**
Availability of green areas	Presence of green areas near the emergency room accessible by healthcare personnel.	Are there green areas?	EMTs were arranged in open air areas.
Common area with sufficient physical distance	Presence of lounges with adequate physical distancing accessible by healthcare personnel.	Are the spaces adequate for physical distancing?	Tent had quite adequate spaces for physical distance.
Sport/relaxing spaces	Presence of sport/relaxing spaces accessible by healthcare personnel.	Are there sports/relaxing areas?	All the EMTs had an area to relax inside tents where to have coffee/tea/food or to take a break.
Psychological support	Provision of psychological support dedicated to healthcare personnel	Are in the field hospitals psychologists to support healthcare personnel?	It was not possible to collect this data.
Psychological training	Exercise programs for the management of psychological stress specifically designed for emergency room healthcare personnel.	Emergency healthcare personnel should be prepared for psychological management in emergency situations.	It was not possible to collect this data.
Ethical principles	Decision making during emergencies driven by ethical principles.	Are the ethical principles respected during the emergency activities?	Some injects requested police intervention to solve a case of violation. The attention for different cultures was fundamental to interact with the local population.
Social organisation in the area	Presence of voluntary organisations supporting the emergency rooms of the selected hospitals.	Which social organisation participated?	ARES, CRIMEDIM and Civil Protection volunteers.
INDICATOR FOR DEMOGRAPHIC MACROAREA	**Description**	**What observe?**	**What in the simulation?**
Average age	Average age of the population living in the	Average age of the population of Arcevia.	46,2

	areas served by the studied hospitals.		
Male	Number of male individuals in the areas served by the studied hospitals.	Male individuals in the population of Arcevia.	2096 (49,06%)
Female	Number of female individuals in the areas served by the studied hospitals.	Female individuals in the population of Arcevia.	2176 (50,93%)
Resident	Number of inhabitants in the areas served by the studied hospitals.	Number of residents in Arcevia	4.272 inhabitants
Population density	Population density in the areas served by the studied hospitals.	Population density of the population of Arcevia.	33,85 (4.272 inhabitants/ 126,2 km²)
INDICATOR FOR PANDEMIC MACROAREA	**Description**	**What observe?**	**What in the simulation?**
COVID-19 positive cases (per province)	Number of individuals positive to COVID-19 in the areas served by the studied hospitals.	Number of patients with suspected meningoencephalitis per field hospital or in Modulistan.	About 7
Updated pandemic national plan	Updating status of the pandemic national plan.	Is there a pandemic national plan updated?	Updated
Updated pandemic regional plan	Updating status of the pandemic regional plan.	Is there a pandemic regional plan updated?	Updated
Updated hospital emergency plan	Updating status of the hospital emergency plan.	Is there a pandemic hospital plan updated?	Updated
Maximum hospital capacity	Maximum beds capacity of the selected hospitals.	Number of beds in the field hospitals	Austria: 7 beds, 2 severe cases, 1 pregnant woman and her baby.
COVID-19 ward	Presence of a COVID-19 ward in the emergency room of the studied hospitals.	Is there a meningoencephalitis ward?	All the EMTs had a tent to isolate patients which were separated from the other areas/tent.
Bed assigned to COVID-19 patients	Number of beds that can be dedicated to “COVID-19 patients” in the studied hospitals.	Number of beds dedicated to meningoencephalitis suspected patients.	It was not possible to collect this data.
Contingency staff	Possibility to temporarily increase the emergency personnel during pandemics.	Are there dedicated healthcare personnel for meningoencephalitis?	It was not possible to collect this data.
Overtime working hours	Possibility to ask for overtime working hours during the pandemic.	Do the healthcare personnel work longer than their shift.	Healthcare workers worked non-stop, but trying to respect shifts.

Personal protective equipment	Availability of protective gears in the emergency room of the studied hospitals.	Have all the stakeholders the PPE?	Personal protective equipment was available in adequate number.
Pandemic emergency training	Pandemic training and drill designed for healthcare personnel.	Has the healthcare personnel done emergency training?	All emergency medical technicians followed emergency training.
Previous experience	Healthcare personnel previous experience with pandemic emergencies (before the COVID-19 emergency).	Has the healthcare personnel previous experiences?	All experts dealt with COVID-19 pandemic.
Different paths for COVID-19 and non-COVID-19 patients	Availability of different paths specially designed for COVID-19 patients in the emergency room of the studied hospitals.	Are in the field hospitals different paths dedicated to meningoencephalitis suspected patients?	All the EMTs separated patients before entering the tent.
Dedicated supply chain of medicines and medical supplies	Availability of specially designed pandemic procurement plans for medicines and medical supplies.	Is In the field hospitals availability of medicine for meningoencephalitis?	Adequate for a first treatment.
Contact tracing	Availability of a plan to identify and notify people who have been exposed to someone with an infectious disease.	What kind of contact tracing method is implemented?	Data not requested and registered by field hospitals.
Vaccination	Availability of vaccination plan.	Are vaccines available?	The EMTs could request vaccines to the Ministry of Health.
Communication	Adequacy of the emergency communication among hospitals, public administrations, population, and stakeholder involved in the emergency.	Are technical or common terms used during emergency communication?	Communication flow controlled from TAST (technical team), who coordinated all the EMTs and EUCPTs.
Funds (per healthcare personnel or tools)	Extra-funds, per healthcare personnel or gears, provided to the emergency room of the studied hospitals.	Are funds available?	The Ministry of Health of Modulistan provided funds for vaccines.
Flexibility of health care workers	Capacity of health care workers to adapt their skills/activities to the specific needs created by the pandemic emergency.	Observation of how to change the activities when the suspected meningoencephalitis overcomes.	Most healthcare workers recognised meningo-encephalitis symptoms and asked for recovery to the nearest not damaged local hospital.

Timeliness	Readiness of the emergency room of the selected hospitals.	Speed of activities during the emergency.	A little bit slow.
Remote medical support	Availability of remote medical support.	Has the remote medical service participated?	They asked support to the nearest not damaged hospitals directly.
Emergency number	Efficiency of emergency number response.	Has the emergency number worked well?	The Modulistan Operation Centre, as the 112 emergency number, managed the emergency calls.

The first three columns have been already described in the "methodology" section, including indicators, their description and what is observed during the simulation. The fourth column of the table refers to the data collected in the MODEX Arcevia 2023. The missed information depends on not planned activities related to specific indicators or to the impossibility to collect that kind of data.

Emergency Medical Teams participating to the Arcevia MODEX 2023 training applied European guidelines and knowledges acquired during the COVID-19 pandemic. Most indicators selected were applicable during MODEX: the general organisation was well defined with the Excon coordinating the activities, the TAST supervising the EMTs actions, EMTs managing patients and the Modulistan Administration and volunteers supporting the activities. Each field hospital (EMTs) was self-sufficient to carry out the emergency activities and managing unexpected events.

The involvement of the population of Arcevia make the MODEX a collective training for emergencies.

5. DISCUSSION AND INTERPRETATION

5.1 Multi-Criteria Decision Analysis for the Marche Region

5.1.1 TOPSIS analysis

The similarity in the results of the TOPSIS analysis can be attributed to various factors. The consistency in the ranking across different waves suggest that the selected hospitals maintained a consistent approach throughout the waves, and the most resilient hospitals effectively managed COVID-19 patients. Another possibility should be that since the first wave of COVID-19 pandemic represented the most challenging scenario due to the uncertainty surrounding the virus' origin and effects, the selected hospitals may have been better prepared for subsequent waves, even as the virus mutated and evolved (World Health Organization, 2020a). Regarding less positive factors, the similarity in the results may depend on other two factors: the large number of indicators selected and the collective lack of preparedness among hospitals and lack of knowledge about pandemic management. The first factor could cause the neutralisation of differentiation among the results of the indicators analysis (Ishizaka & Nemery, 2013). The second aspects resulted in the loss of human lives and a high number of infections lasting across the waves. In association with this possibility, there is a notable lack of resilience within the health system concerning pandemics.

The results do not change significantly when excluding indicators with the same values, suggesting that all selected indicators influence the outcomes, and that equal values do not substantially impact the results.

The only exception is in the second and third waves when indicators with distinct values are considered, possibly due to the extended analysis period, which benefits from a well-balanced set of indicators (Ishizaka & Nemery, 2013).

Observing the results, the hospital that consistently ranks the top, indicating the highest resilience, is the A.S.T. – Territorial Health Agency in Pesaro. It is worth noting that the province of Pesaro and Urbino was the first area in the Marche Region to be affected by the COVID-19 pandemic, followed by the province of Ancona. In this province, two hospitals were selected: the Ospedali Riuniti of Ancona and the Carlo Urbani hospital in Jesi, which present different levels of resilience, with Jesi Hospital demonstrating a better level. The hospital of Ancona is the biggest in the Marche Region and serves as the primary regional hospital. The relatively low level of resilience is likely attributed to the substantial influx of patients from across the region and inadequate staffing, despite the increase

in personnel during the COVID-19 pandemic. It appears that the issue stemmed not only from understaffing, but also the unpreparedness of the healthcare workers in dealing with the new biological hazard. Considering the performance of the Pesaro and the Jesi Hospitals over the different waves, it becomes evident that these hospitals likely handled the pandemic more effectively. On the contrary, the hospitals of Fabriano and Camerino, being somewhat smaller than the other hospitals, may have struggled to maintain an appropriate balance among indicators such as personnel, or available convertible beds, or preparedness, even after the complete transformation of Camerino Hospital into a COVID-19-hospital. The lower levels of resilience could be due to the unpreparedness of the structures, the flux of patients and the availability of spaces. Moreover, healthcare personnel at Camerino Hospital were distributed among Camerino, Matelica and San Severino Marche hospitals, resulting in a consistent reduction in workforce. Especially during the first wave of the COVID-19 pandemic, the absence of clear information at the national level or ambiguous guidance compelled hospitals to independently organise and coordinate among themselves to address the pandemic. This aspect could be further explored through the analysis of questionnaires in the 5.2 paragraph.

However, an exception arises when there are multiple positive cases. This suggests that uncommon indicators carry greater significance than common ones. This can be correlated with the observation that Pesaro Hospital, which consistently ranks first and thus exhibits greater resilience, does not maintain this position in the second or third wave when common indicators are excluded. It could be inferred that Pesaro Hospital handled the situation less effectively during the second wave. This may be attributed to its initial impact and ongoing recovery phase, whereas Civitanova Hospital was better prepared due to having more time to organise itself, given that infections in the province of Macerata occurred later. The Civitanova hospital represent the example of the case which a minimum of preparation and the right timing in the management of biological hazard make the difference in the effectiveness of the response in a risk event.

The overall lack of pandemic resilience in the selected hospitals is reflected in the values of the relative closeness coefficient (Pi) or performance score, which falls within a range around 0,600. This range is above the average, but not very high, rather close to the value of the ideal resilience equal to one.

5.1.2 AHP analysis

Within the frame of the Analytical Hierarchical Process of this research project, the comparison among the results coming from the weighting process completed by the six experts filling the pairwise forms, produced a low correspondence. The AHP should help the TOPSIS analysis in identifying the key indicators for pandemic response and resilience (Ortiz-Barrios et al., 2021). The experts' insights should distinguish among macro areas and indicators of varying priority, based on their experience and knowledge (Saaty, 1987). Weights have been assigned with very different choices expressed from the experts, and probably, this is due to various causes: i) experts' personal experience; ii) experts' role in society or professional role; iii) a rather large number of indicators to be compared; iv) a relatively low number of experts completing the AHP. These causes could be deemed very significant thus explaining the null results of the AHP analysis, namely not highlighting one indicator as more important than the other. Yet, the null results of the AHP analysis could be seen as the demonstration that the various indicators considered are all important, thus emphasising the importance of multi-stakeholder approach in pandemic management. A third explanation could be that each expert paid more attention to the indicators of the macro area they feel comfortable with (considering the broad scope of the five indicators macro areas) and felt possibly less comfortable in assigning weights to the indicators of the other macro areas. Yet, it is the very nature of disaster risk reduction and emergency management that requires the interaction of various expertise, quite often very different from one another. Thus, an overarching model of interpretation and coordination of the various dimensions of risk and emergency is necessary. This observation suggests that the fragmentation and differences of public health policies across the regional government bodies of Italy should be transformed into a collaborative approach between different experts and stakeholders starting from the national to the local level passing through the regional level with the aim to plan an effective pandemic emergency response.

5.2 Perception analysis in the Marche Region

The Multi-Criteria Decision Analysis is supported by questionnaires administered to healthcare workers of the Emergency Room of the selected hospitals. These questionnaires investigated healthcare workers' perceptions of pandemic emergencies and provided their viewpoint on the indicators and macro areas.

More than half of the contacted healthcare personnel participated in the study answering the questionnaire, showing interest in the subject. Furthermore, some of those who did not participate in the study explained that they were not working in the hospital during the COVID-19 pandemic. Overall, the collaboration to the study signalled interest from these professionals in finding ways to enhance epidemic and pandemic management. In the following pages the results of the collected questionnaires will be discussed trying to find connection with the different facets and indicators of pandemic resilience discussed so far.

The results obtained with the first two questions confirm what emerged in the literature review, namely that most representatives of the Italian Health System did not deal with serious epidemics and particularly pandemic before COVID-19. The results are related with the indicator "Previous experience" analysed in this research project, highlighting the importance of living other experiences to acquire knowledge and become confident with procedures and reactions. Furthermore, the healthcare personnel recognise the unpreparedness of the national and local Health System and the consequent lack of clear procedure and guidelines about pandemic response and management.

Analysing the results of question number 3, many indicators (particularly of the pandemic macro area) could be associated with the answers of healthcare personnel: "Updated pandemic national plan", "Updated pandemic regional plan", "Updated hospital emergency plan"; "Pandemic emergency training"; "Communication"; "Emergency network", "Information quality"; "Flexibility", "Flexibility in the use of facilities", "Interdisciplinarity". The indicator of "Timeliness" was clearly important when healthcare personnel wrote about the importance of recognising the virus better to understand how to properly react. The cited indicators should be carefully considered when updating pandemic emergency plans. Despite all the difficulties that emerged during the COVID-19 pandemic, the interviewed healthcare personnel highlighted how important it was working as a team thus corroborated the importance of indicators such as "Coordination" and "Previous experience" as suggested in the Progress Report of the WHO of February 2020 (World Health Organization, 2020b).

In regard to the level of preparation of the population for a pandemic like COVID-19, investigated with question 5, the healthcare personnel share the idea that the local population they served, and probably the whole Italian population, was not prepared or sufficiently knowledgeable for such an event as also reported in the study of Sanfelici, 2020. The consequences could be the massive flux of patients to the Emergency Room, or the lack of proper behaviour to protect themselves from the virus which overloaded the Health System. Yet, if the healthcare personnel felt unprepared to manage the pandemic (as emerged in the first two questions), it is somewhat unreasonable to expect the population better prepared (Sirleaf & Clark, 2021). It is very likely that the population living in the areas near the selected hospitals had never faced any epidemic or pandemic in their life (certainly not of this magnitude), and consequently, had no experience with this type of hazard. This finding indicates that more effort is needed to increase the population's education and preparedness; after all the good health of a population often depends on knowledge and self-prevention and -control as it is provided in the updated Pandemic National Plan (Piano Strategico-Operativo Nazionale di Preparazione e Risposta a una Pandemia Influenzale (PanFlu) 2021-2023, 2021). Furthermore, it could be expected that when the population is well informed about pandemic, they are more likely to be willing to accept the directives of the Government or the Health System, even if the requests limit some freedoms as occurred in New Zealand (Ministry of Health, 2017; Summers et al., 2020).

Communication during an emergency is another pivotal topic which requires dedicated analysis. The results obtained with questions from 6, 7 and 8 show that the healthcare personnel think that communication was not very well organised and functional inside the hospitals and between the hospitals and the administrative level. The role of social media in clarifying information and helping knowledge exchange is still debated and unclear; results are a confused population and confused healthcare personnel who gather information through social media when no answers came from official channels. Probably, this is one of the reasons why the Italian Government update the National Communication Plan for Pandemic (Piano Nazionale di Comunicazione del Rischio Pandemico - Quadro Strategico, Strutturale e Procedurale 2023-2028 ad Interim, 2023).

Observing all the outputs about communication, it is possible to assert that in general communication was not adequate during the COVID-19 pandemic. healthcare personnel consider three aspects, which also appear among the underperforming selected indicators ("Communication," "Emergency Network," and "Information"), namely there should be rules on the role that everyone should play, including those who must disseminate the information. Furthermore, healthcare workers express the necessity of an effective communication with well-defined procedures of interaction and shared terms (among hospitals, departments and between hospitals and stakeholders). Inside hospitals, events of

lack of understanding or non-collaboration among wards may turn into bad management of patients and resources. In the social environment, events of misinformation or overload of information or infodemic may impact the perception and the response of the population components (Barua et al., 2020). The resulting state of chaos and confusion could only highlight the difficulties in dealing with an unknown hazard, in managing the emergency and in limiting the damages. The language barrier did not emerge from the responses of healthcare workers. This could indicate that most patients were Italian, or that those from other countries spoke Italian or found ways to stay informed about what was happening and what they needed to do to protect themselves. It could be beneficial if information and communication were broadcasted in multiple languages to ensure that everyone is updated with the events and feel included in the emergency response.

Generally, considering the situation of healthcare personnel of each expertise (medical specialists, physicians, nurses, social health operators) before and during the COVID-19 pandemic it is possible to observe that the health personnel was inadequate in the management of patients in both timing (Ruiu, 2020; Sadeghi et al., 2021). Probably it is due to the lack of personnel compared to the request of patients and necessities, due also to certain expenditure cuts at the health level, or the massive flux of patients during emergencies. Physicians and nurses seem to be the categories more limited and necessary. The worsening conditions during emergencies imply the exponential increase of difficulties in the management of patients and the evidence of the shortage of the Health System. In other words, interpreting the answers to the questionnaires, it is possible to observe that the situation before COVID-19 pandemic was already critical. The COVID-19 pandemic is not the only cause of the health crisis, but probably one of the events that contributed to the decline of the Health System for a defined time or for the next future. Rebalancing the personnel and the resources of the Health System is necessary and is urgent to guarantee good health and save lives. These results support the presence of indicators like “Medical specialist”, “Physician”, “Nurse”, “Social worker in public health”, “Contingency staff (% increase)”, “Funds (per healthcare personnel or tools)”. During the COVID-19 pandemic, additional personnel were enlisted, providing a significant boost to the Health System. However, it was possible that some newly hired individuals lacked extensive expertise or fell ill themselves, further complicating the situation. It is strongly recommended that the workforce is familiar with the hospital where they are employed, adequately trained for emergencies and present in sufficient numbers.

The balance is barely moved to those who disagree with the oversize of medical devices (PPE, helmets, ventilators, CPAP, etc.) available, or rather to those who think that at the time of filling out the questionnaire, when the emergency was less urgent, the medical devices available were

inadequate to deal with a pandemic. This could be due to the different mindset between who think that a consistent stock of medical device could save more lives; and who think that it is not necessary a huge quantity of medical devices because they have an expiry date and need to be replaced. The selected indicators "Medicine/patient", "Personal protective equipment", and "Supply chain of medicines and medical supplies (diversified)" correspond to the necessity to pay attention to how to manage medical devices without wastefulness. Furthermore, it is essential that medical device have legal guarantees and are suitable for combating specific virus or bacteria. Simultaneously, healthcare workers must be well-informed about the proper use of these devices.

The results about the economic costs could suggest the necessity of investment in public health materials, structures, and personnel as emphasised in the second sub-hypothesis regarding small financing for pandemic preparedness. This is related to the selection of indicators as "Aid support", "Aid continuity", "Funds (per healthcare personnel or tools)".

The results of questions 11 and 12 highlight the importance of functional investments, with an impact on the long term and not only on the short term, also considering the indicator "Partnership/international/interregional cooperation" and "Multi-stakeholders' engagement". Assessing the quality and quantity of material to be stocked, considering the needs and, for example, the expiration date, or considering which healthcare facilities needs investments, or avoiding waste of health materials, or investing in preparedness and planning are some of the main economic points functional to improve the quality of health and safety. Such measures could enhance the update of pandemic emergency plans to face potential future pandemics.

Interpreting the results of question 13, it could be claimed that notwithstanding the emergency and the presence of an unknown situation for most healthcare personnel, the Hippocratic Oath and above all the ethical principles driving everyday actions prevailed over the difficulties. It is the person who takes decisions, not only the worker in his role. When the rules or the guidelines are not defined, the ethical principles determine the right choice. The driving thinking is always protecting and saving yourself and others. The selected indicator "Ethical principles" should focus on these aspects. Moreover, when updating pandemic plans, ethic and culture should be drivers of measures and actions implemented as suggested in the guidelines of the Centers for Disease Control and Prevention (Ethical Guidelines in Pandemic Influenza - Recommendations of the Ethics Subcommittee of the Advisory Committee to the Director, Centers for Disease Control and Prevention, 2007). This approach facilitates decision-making for healthcare workers, coordination among rescuers and the acceptance of regulation by the population.

The disagreement about the sense of protection related to responsibilities, probably is due to the lack of guidelines about pandemic, so that the healthcare personnel could feel insecure about what to do and have to do it fast during the emergency. There is also the possibility that they could be not totally protected for some actions because the insurance policy of the hospital or the personal one was not provided, considering the pandemic something not very well known or possibly considered and the SARS-CoV-2 virus completely unknown. Indeed, few participants felt more protected after the high emergency period, on the contrary of the early stage of the pandemic. Starting from the second wave of COVID-19 pandemic, a sort of guidelines or normative have been updated, so that the healthcare personnel could follow more specific information. The indicators about the update of plans refers to avoid these problems. Updating national, regional plans and implementing pandemic emergency hospital plans, procedures and measures should be organised and clear in the event of a pandemic emergency.

The different number of patients managed by the Emergency Room of the selected hospitals could be due to the hospital capacity, or the number of positive patients going to the Emergency Room of a specific place, or to the possibility that some hospitals were the only one active for COVID-19 cases in a big area. Furthermore, it is necessary to highlight that these are numbers indicated by healthcare personnel filling out the questionnaire and not ascertained values. For this reason, it is possible to suppose that healthcare workers may perceive a greater or lesser number of COVID-19 positive patients depending on their stress levels or feelings about the pandemic.

The value for each hospital seems to be related to the population of the cities where the hospitals are located. Furthermore, the hospital of Ancona is the Regional Hospital, and it might be possible that some people from the whole Province or coming from other Provinces of the Marche Region preferred to go there. Ancona was the second province in timing and number of positive cases to be impacted by the COVID-19 pandemic (the first was the Province of Pesaro e Urbino, for which questionnaires are not available). The Civil Hospital Santa Lucia of Civitanova Marche accepted positive patients coming from Abruzzo (the region south of the border with Marche Region) and probably this is the reason why it managed more patient than the hospital of San Benedetto del Tronto with a bigger population. Fabriano and Jesi have similar populations and supported the Province of Ancona in the management of COVID-19 patients. The hospital of Camerino was activated as COVID-19 hospital compared to the other selected hospitals and it managed patients of a small area in the inland of Marche Region.

Analysing the results of question 16, it is possible to observe that those who affirm to not know the wide-hospital plan but at the same time to know it very well are not coherent. This situation makes the result invalid. This incoherence could be due to a mistake in the interpretation of the question/poor composition of the question.

The uncertainty and the opposite answer about the existence and the knowledge of the hospital emergency plan could be due to the real not existence of a pandemic plan inside the hospital but only of an emergency plan, the lack of information about wide-hospital plans, or the different approach of different hospitals or different wards inside hospitals. Anyway, also participants positively answering about the existence of the pandemic plan inside the hospital did not know it perfectly. Maybe these data suggest the main necessity of an updated pandemic plan inside hospitals, and then the fundamental need to inform healthcare personnel about wide-hospital plans as suggested in the European user manual of the WHO (World Health Organization, 2012). Not only the directors should know what to do in different types of emergencies, but the whole personnel. Furthermore, specific plan for pandemic implemented to Internal Emergency Plans Massive Influx of Injured (Piano Emergenza Interno Massiccio Afflusso di Feriti – PEIMAF), constant update of plans and informing the personnel about activities and procedure should be a possible option to implement the emergency response. What just mentioned it is supported by the selection of the indicators “Information quality” and “Updated hospital emergency plan”.

The results of question 17 seem to suggest that probably before COVID-19 there was not a big interest in taking courses about pandemic, or the healthcare personnel did not experience any event needing the implementation of knowledge about pandemic and the priority of courses was devolved to other topics. On the contrary, during the emergency the healthcare personnel probably adopted a strategy dividing between who took course and who not, or it is a casualty. The first option is interesting because it could be supposed that who took the course reported the information and the new learnt knowledge to those who did not take the course. The aim should be sharing information and at the same time optimising the number of formed people and the number of who have to work hard in the condition of shortage of personnel. The indicator “Pandemic emergency training” should be probably added to the other courses the healthcare personnel have to attend. This could assist healthcare personnel before a pandemic event occurs, rather than during or after it occurs as suggested in the updated Italian national pandemic plan (Piano Strategico-Operativo Nazionale di Preparazione e Risposta a una Pandemia Influenzale (PanFlu) 2021-2023, 2021).

The agreement of healthcare personnel about remote emergency support could be due to different reasons (question 18). Primary, the capacity to optimise time and personnel taking care of a large number of patients leaving beyond the problem of distance and the stress caused by the fear of contagion. Telemedicine and remote medical consultation were not always possible because of the presence of Wi-Fi connection and usually the presence of a third person who can help the physician in presence near the patient (if the patient was not able to move). Anyway, these are two options to preserve vulnerable patients or protect physicians from possible contagion. Secondly, avoiding patients at the Emergency Room asking for information and explanation about the new virus with official, public, and online blogs could quickly answer the number of questions coming from scared people, or people trying to understand what to do. This question is related to the indicator "Remote medical support" that could be something which needs to be deepened, implemented, and specialised for emergency events.

The amount of healthcare personnel uncertain could be due to the indecision about the effective support received by local Institutions and organisations during the COVID-19 pandemic about funds, information, and support (question 19). The level of agreement reflects the necessity of support, without which it could be difficult to manage an emergency because of the lack of personnel, material, and supplies. Probably, the large cut of economic resources in the health sector influenced the high request of support from hospitals. Furthermore, the emergency events frequently request the involvement of more material and human resources. Including "Aid support", "Aid continuity", "Multi-stakeholders' engagement", and "Social organisation in the territory" among the selected indicators should suggest the involvement of the whole community in planning and preparing for next pandemic events.

The necessity of updated national, regional and hospital pandemic plans emerge interpreting the results of question 16, and the answer to open question 20. This reflects the principal hypothesis and the second sub-hypothesis. Furthermore, question 20 seems to highlight the cut of economic resources in Italy at health level as in question 17. The Cross-sectional analysis of questions 20 and 19, highlights that people working inside hospitals felt the responsibility of doing something and working hard to manage the COVID-19 pandemic, and on the contrary the territorial medicine seemed it had the chance of refusing or limiting its own activities relieving responsibilities. Generally, question 20 highlights the problematic related to the previous questions and the healthcare personnel' suggestion to implement a more prepared, organised, and effective Health System. A coordinated response is essential to organise activities in response to a pandemic event involving hospitals, support structures, or strategies to enhance the effectiveness of emergency response.

The COVID-19 pandemic carried out many problems, difficulties, and consequences already visible, but at the same time the pandemic brought about a change and taught thinking about different risks and prepared them both in the Health System environment and the whole population (Sanfelici, 2020).

Analysing the results of question 21 and considering the necessity about courses explaining the use of personal protective equipment (PPE), particularly wearing and removing PPE, it could seem quite unexpected because maybe it should be the basis of the training of healthcare personnel. About communication, a good emergency communication could make the difference in the response and timing during the management of disasters, so that probably healthcare personnel suggest the implementation of guidelines for it. The necessity of updated pandemic plans is probably correlated with the awareness that it is impossible to be totally prepared for every type of emergency and the capacity of going beyond fear and stress are often essential. Question 21 seems to summarise many indicators in the health and safety macro area as the indicators in the pandemic macro area. Furthermore, this question seems to highlight many points which should be considered during the pandemic emergency planning. Among the answers, it emerges the real needs and functional skills adopted by healthcare personnel dealing with the pandemic and to consider at the moment of the update of plans.

The results of question 22 highlights personal fears, it is possible to understand the lack in preparation and management by healthcare personnel (as supposed in the principal hypothesis). During the higher waves of COVID-19 pandemic, the healthcare personnel must wear PPE for the entire duration of the shift, enduring limited air availability and visibility, hot conditions, and limitation on movement. It is important to remember that in many cases the PPE were limited and to save resources to avoid contagion, many healthcare personnel must see their physical needs inside the coverall of the personal protective equipment. To the pandemic emergency frightening all people, it added to the embarrassment, the discomfort, and the feeling of concern at the physical and psychological level (as supposed in the third sub-hypothesis).

The other persistent problems were the fear of the unknown and the changes in the relationship with families. For many healthcare personnel, understanding what to do or taking fast decisions has been difficult and improves the sense of unpreparedness and inadequacy because of the different and conflicting information. All these situations usually develop in the event of burnout or psychological impacts.

Surely, the worry about the unknown and the change in the work timetable and the family routine are all very difficult elements. Furthermore, the psychological impact of COVID-19 pandemic has long

term effects and is worse than the physical ones. It takes time to return to the routine before the pandemic or comprehend and embrace new measures and activities. Better preparation and preparedness should be the starting point for a better response to the problem. The focus should be on indicators selected in the socio-psychological macro area to mentally define procedures and activities supporting healthcare personnel or that help them conduct their working activities. The objective should be not only to assist healthcare workers in managing the pandemic, but also to prevent psychological conditions such as depression. "Overtime working hours" should be regulated and not improvised, but particularly it should be fundamental to the implementation of provided "Contingency staff (% increase)".

The demographic information of healthcare personnel participating in the questionnaire, showed that most of the responders hold a degree in medical professions with years of experience working in hospitals, having faced different types of patients and problems during their career, including SARS of 2002 or HIV. Such a heterogeneous body of professionals in the different hospitals could be a winning characteristic mixing experience with new knowledge or method, or self-confidence in various situations with openness in difficult situations.

The division among healthcare personnel' genders is quite balanced, providing different strength, sensitivity, and adapting capacity very useful during emergency (Kadir, 2021; Rana et al., 2021).

The results of question 23 highlighted that few healthcare professionals live near the hospital where they work. The reasons for this could be different, including a rational choice to limit interactions with their patients outside of the work environment, thus distinguishing the work from home (Oecd, 2019; Okan et al., 2019; Pauer et al., 2016). For what it concerns the cross of information among the different sub-questions of question 23, it is possible to observe that, some medical specialties are mostly preferred by women and others mostly by men. Besides the choice of a specific career, the age could help in reaching the desirable level, because for example the nursery course in Italy requires 3 years, whereas the various medical specialties require 6 years of Medical School and 3 further years of specialised courses and practice. Moreover, the timing to reach a permanent position in a public hospital could require years of precarious contracts.

5.3 PRISMA Statement for New Zealand

The short time spent in New Zealand did not allow this researcher to get the necessary training and authorization to conduct questionnaires or interviews in New Zealand. Yet, considering the wealth of information on epidemic and pandemic management literature available on New Zealand a PRISMA Statement was a viable alternative for this research project to analyse New Zealand's approach to pandemic management. By examining the most recent COVID-19 pandemic and working backwards, it was possible to delve into the origins and principles of New Zealand's pandemic management strategies.

New Zealand was not spared from the spread of COVID-19 and recorded its first confirmed case on 28th February 2020[55]. The affected individual was in his 60s and had recently returned from a trip to Iran[56]. Due to its geographical isolation in the South Pacific Ocean and its status as a non-major international travel hub, New Zealand gained a slight time advantage compared to many other countries before COVID-19 entered its borders (Gilray, 2021; Henrickson, 2020; McDougall, 2021; Menzies & Raskovic, 2020a; Sharma et al., 2021). As the time of this review in March 2023, New Zealand had reported 2.228.291 positive cases over three years of COVID-19 pandemic, mostly concentrated during the second wave of COVID-19 that impacted the country[57]. In comparison with many other countries, especially in Europe and the United States, the extent of COVID-19 contagion in New Zealand could be considered limited[58]. One of the advantages New Zealand had in facing the pandemic within its borders is its low population density (Cumming, 2022; Gilray, 2021; Henrickson, 2020; Summers et al., 2020; Williamson, 2020). The population of New Zealand consists of about 5 million people living in an area of less than 270 thousand square kilometre[59]. New Zealand's isolation and low population density, exception for its major cities, can be considered key parameter not only for limiting the virus' entry into the country and facilitating physical distancing but also for enabling the adoption of effective pandemic response strategies (McDougall, 2021; Menzies & Raskovic, 2020; Vasilaki et al., 2022). However, the Government's response to COVID-19 played a pivotal role. New Zealand's approach to COVID-19 received commendation from various sources, including the World Health Organization (WHO) (Beattie & Priestley, 2021; Blair et al., 2022; Craig, 2021;

[55] New Zealand Government, Official Government website dedicated to COVID-19 updates, https://covid19.govt.nz/.
[56] Ministry of Health, Single Case of COVID-19 Confirmed in New Zealand, https://www.health.govt.nz/news-media/media-releases, accessed 07th March 2023.
[57] Ministry of Health, COVID-19: Current cases, update 06 March 2023 https://www.health.govt.nz/covid-19-novel-coronavirus/covid-19-data-and-statistics/covid-19-current-cases, accessed 07th March 2023.
[58] World Health Organization, Coronavirus (COVID-19) Dashboard, https://covid19.who.int/table, accessed 07th March 2023.
[59] Stats NZ, Tatauranga Aotearoa, Population, https://www.stats.govt.nz/topics/population

Gray et al., 2020; Nhamo et al., 2020; Stanley & Bradley, 2021; Te Aho, 2021; Williamson, 2020). Initially, like many other countries, New Zealand was unprepared to deal with an infectious disease like COVID-19 (Kvalsvig & Baker, 2021). Furthermore, the New Zealand Influenza Pandemic Plan was last updated in 2017, following WHO recommendation to develop pandemic influenza plans after the experience with SARS, influenza A (H5N1) and influenza A (H1N1) in the 21st century (Ministry of Health, 2017). However, it did not adequately consider the possibility of a non-influenza pandemic (Kvalsvig & Baker, 2021). The 2017 national plan was based on a mitigation strategy (Baker et al., 2020), assumed that vaccines were supposed to be available within six months (Ministry of Health, 2017) and reported unclear border measures to restrict entry for citizens and permanent residents (Nhamo et al., 2020). Consequently, the 2017 plan served as a starting point to respond to the new Coronavirus pandemic, along with lessons learned from the past epidemics and pandemics such as the 1918 Spanish influenza, the A(H1N1) of 2009, the Severe Acute Respiratory Syndrome (SARS), the Middle East Respiratory Syndrome (MERS) and Ebola of 2000s (Nhamo et al., 2020). Additionally, New Zealand's extensive experience with natural disasters like earthquakes and floods contributed to increase its preparedness for emergencies (Menzies & Raskovic, 2020a). In support to these foundational elements, several key existing legislation documents underpin New Zealand's preparedness and response, including the Health Act 1956, Epidemic Preparedness Act 2006, Civil Defence and Emergency Management Act 2002[60].

New Zealand response to COVID-19 pandemic is outlined below, aiming to address the research questions posed by the first and second sub-hypothesis of this research project regarding the role of public and private healthcare facilities, the contributions of institutions and local organisations/stakeholders, and the impact of the current political structure and the existing economic model:

Upon learning of the spread of a novel virus of unknown aetiology from China to the rest of the world, on 3rd February 2020, the New Zealand Government immediately started its response to the pandemic. The Government promptly imposed temporary entry restrictions into New Zealand on all foreign nationals travelling from or transiting through mainland China[61]. Even before the virus had reached New Zealand, the Government was already planning and preparing the response Gauld, 2022). On 28th February, after the first reported case of COVID-19 in the country, the Government adopted a

[60] New Zealand Government, Legislation and key documents, About our COVID-19 response, Unite against COVID-19, https://covid19.govt.nz/about-our-covid-19-response/legislation-and-key-documents/, accessed 10th March 2023.
[61] New Zealand Government, Beehive.govt.nz, The official website of the New Zealand Government, New Zealand to restrict travel from China to protect against coronavirus, https://www.beehive.govt.nz/release/new-zealand-restrict-travel-china-protect-against-coronavirus

so-called “go hard and go early strategy” or “elimination strategy” (Cumming, 2022; Beattie & Priestley, 2021). The principal aims were to prevent the entrance of COVID-19 into the country and to completely and immediately eliminate the virus’ spread and transmission within New Zealand. The elimination strategy consists of the implementation of immediate and robust measures designed to prevent the introduction and local transmission of an exotic pathogen such as COVID-19 (Baker et al., 2020). This strategy could be summarised as including extensive testing and contact tracing, isolating confirmed cases, quarantining individuals exposed to the virus, effective border management, rigorous outbreak control measures, and a vaccination campaign (Oliu-Barton et al., 2022). On 5th March 2020 the first case of local transmission was recorded in Auckland (Cumming, 2022). Subsequently, on 14th March, the Government announced that individuals entering New Zealand were required to self-isolate for 14 days, with an exception for those arriving from the Pacific[62]. On 19th March 2020, an ordinance of border closure to all individuals except New Zealand citizens and permanent residents was issued. On 25th March New Zealand moved to Alert Level 4, the highest level within the four-tiered Alert Level system established to combat COVID-19, leading to nationwide self-isolation. A State of National Emergency was declared[63], and the complete border closure remained in effect until the end of 2021 (from 2022 there was partial free entrance). Unfortunately, the first COVID-19-related death occurred on 29th March 2020[13]. On 9th April 2020, the Managed Isolation Quarantine (MIQ) order was introduced for all people entering in the country, involving 14 days of isolation in designated facilities[64]. The elimination strategy, as implemented by the Government in accordance with the Ministry of Health, was initially expected for a few months. However, despite early success, a second wave of COVID-19 cases emerged in the country between 1st July to 15th October 2020 (Vasilaki et al., 2022). At the start of the second wave, all cases recorded had entered from overseas (Cumming, 2022). The transition to a mitigation strategy only occurred in October 2021 (Blair et al., 2022), also helped by the high vaccine coverage (Vattiato et al., 2023). The mitigation strategy, which has been adopted by many other countries, particularly in the western world, involve a range of measures that increase as the pandemic progresses, including the closure of schools and non-essential activities, with the goal of “flattening the curve” of pandemic mitigation (Baker et al., 2020). The figure 5.1 provides a summary of the timeline of the key events and policy

[62] New Zealand Government, Timeline of key events, About our COVID-19 response, History of the COVID-19 Alert System, Unite against COVID-19, https://covid19.govt.nz/about-our-covid-19-response/

[63] New Zealand Government, Beehive.govt.nz, The official website of the New Zealand Government, New Zealand to restrict travel from China to protect against coronavirus, https://www.beehive.govt.nz/release/new-zealand-restrict-travel-china-protect-against-coronavirus

[64] Ministry of Business, Innovation & Employment, Immigration and tourism, Isolation and quarantine, Managed Isolation and Quarantine, About MIQ, MIQ timeline, https://www.mbie.govt.nz/immigration-and-tourism/isolation-and-quarantine/managed-isolation-and-quarantine/about-miq/miq-timeline/

decisions taken by the Government through the entire duration of COVID-19 pandemic in New Zealand.

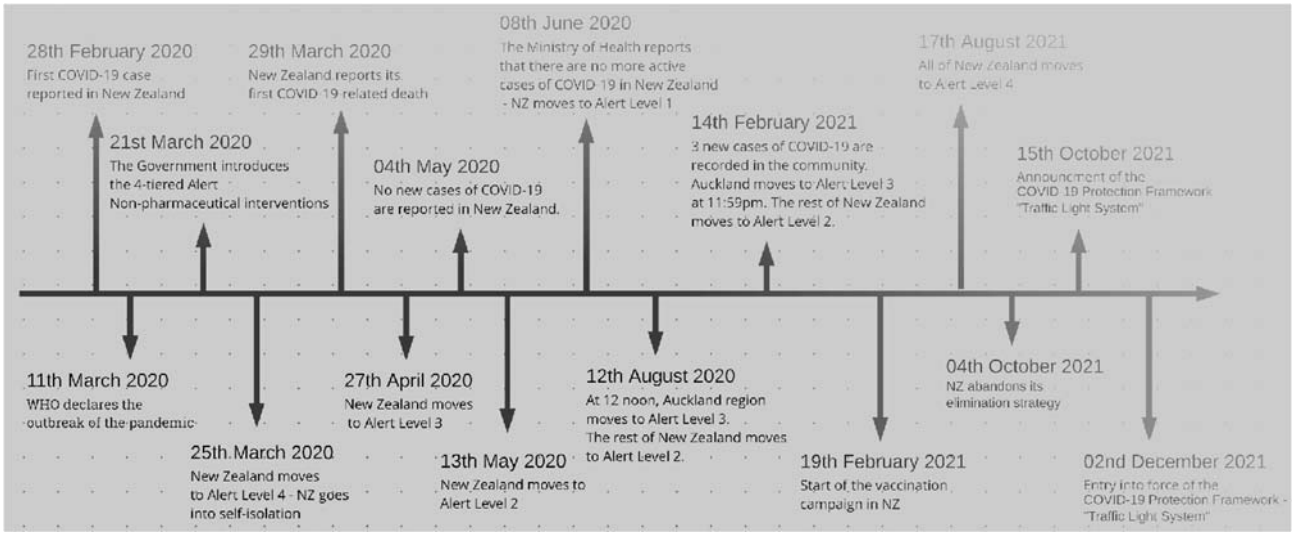


***Figure 5.1**: Timeline with dates of key events and policy decisions*

Source: New Zealand Government (Blair et al., 2022)

The implementation of an elimination strategy by the New Zealand Government was made possible through three primary elements: unanimous approval by the parliamentary representatives; centralisation of decision-making with the absence of regional or local level government involvement in health matters; and strong support from the Ministry of Health and the Ministry of Finance in the decision-making process.

Over the years the New Zealand Health System has put in place stringent biosecurity measures (Menzies & Raskovic, 2020a) managed at national level, involving the Government, the Health Ministry and the Ministry of Finance. This results in a limited political argument around government decisions (Gauld, 2022). At regional level, the responsibility for providing or funding health services according to national orders lies with the 20 District Health Boards (DHB). The COVID-19 Public Health Response Act 2020 (the COVID-19 Act) established a legal framework for responding to COVID-19, allowing the Minister for COVID-19 Response to issue immediate public health orders[65] (COVID-19 Public Health Response Act 2020, 2022). This empowered the Ministry of Health to take swift actions to preserve public health, potentially overriding government decisions if required. General acceptance was facilitated by the institution of the Ministry of Health's COVID-19 Technical Advisory Group (TAG), which provided scientific support for the decision-making process

[65] Ministry of Health, Manatū Hauora, COVID-19: Legislation and Orders, https://www.health.govt.nz/covid-19-novel-coronavirus/covid-19-response-planning/covid-19-legislation-and-orders#epidemic.

(Baddock, 2020; Blair et al., 2022; Manning, 2021). The Ministry of Finance provided funding to meet various needs, such as supporting the health system' capacity, purchasing emergency supplies like medicines and personal protective equipment; financial assistance for people affected, and funding for Māori healthcare personnel to administer the vaccine and for the tourism sector, highly impacted by border's restrictions (Blair et al., 2022; Manning, 2021). New Zealand made significant investments in health promotion to prevent and prepare for disasters and new pandemics, with the goal of reducing mortality (Cumming, 2022; Lovell et al., 2015). Thanks to these efforts and the involvement of the population, New Zealand achieved a Global Health Security (GHS) Index score of 62,5, ranking 13th globally. In a 2019 report on pandemic preparedness, New Zealand GHS Index score was 51,9)[66]. The GHS Index is "the first comprehensive assessment and benchmarking of health security and related capabilities across the 195 countries that make up the States Parties to the International Health Regulations (IHR [2005])" [67]. It was developed through a collaboration between the Nuclear Threat Initiative (NTI) and the Johns Hopkins Center for Health Security. Despite progress in strengthening New Zealand's response capacities for infectious diseases (Charania & Turner, 2018), the GHS Index identified several weaknesses, including understaffed epidemiology workforce, insufficient commitment to share and report surveillance data, and a lack of regular exercises to test the response to emerging biological risk (Blair et al., 2022).

The key figures leading the national response to COVID-19 in New Zealand are the Prime Minister Jacinda Arden and the Director-General of Health Ashley Bloomfield. Globally, the Prime Minister has been recognised as an exceptional crisis leader (Beattie & Priestley, 2021; Gilray, 2021), with strong support from her team. Her communication through the pandemic was characterised by honesty, transparency, motivational language, and expression of care (Beattie & Priestley, 2021; Blair et al., 2022; Henrickson, 2020). The hegemonic "us" (Gilray, 2021) gave reason to an emergent nationalism, using analogies or metaphors like "a nationwide wall defence", or "team of five million", or "our battle", or "unite against COVID-19". This approach emphasised social support (Gilray, 2021; Menzies & Raskovic, 2020). The message focussed on taking personal care and looking after others. Sports and military metaphors underscored the importance of team working in achieving the objective or prevailing in a battle. The use of Kiwi vernacular and the te reo Māori (the Māori language), and the encouragement to stay within family "bubbles", or to support each other highlighted the principles of Kiwi and particularly the Māori's importance of family units (Beattie & Priestley, 2021). Prime Minister Arden demonstrated empathy and inclusiveness in her speeches, sharing stories and

[66] New Zealand Government, Te Kāwanatanga o Aotearoa**,** How government works, https://www.govt.nz/browse/engaging-with-government/government-in-new-zealand/.
[67] GHS Index – Global Health Security Index https://www.ghsindex.org/about/

expressing empathy for various individuals, including households, families, businesses (Beattie & Priestley, 2021; Craig, 2021; Morgan et al., 2022). She promoted a rhetoric of kindness.

Daily speeches by the Prime Minister and the Director-General of Health emphasised the Government's commitment to being present for the community, providing information, explaining implemented decisions, and addressing questions. Furthermore, the principal instructions for dealing with the pandemic and the orders were translated into different languages, reflecting New Zealand's growing multiculturalism and increasing appreciation of Māori culture (Gilray, 2021; Menzies & Raskovic, 2020).

The clear approach and the support of scientists and public health officials bolstered the public's trust in Government's decisions (Menzies & Raskovic, 2020; Vasilaki et al., 2022). It can be affirmed that the success of the response to COVID-19 pandemic in New Zealand was a result of the coping, transformative and adaptive capacities in addressing the profound impact (Menzies & Raskovic, 2020) by the whole community with the Government and the Health Institutions. The robust response of Institutions, combined with a community that possessed knowledge, awareness, and experience with epidemic and pandemic, created an effective partnership in managing the COVID-19 pandemic. The population preparedness and aptitude to face a pandemic and follow government directives may be attributed to consistent health information, and health programs. However, it is also likely influenced by collective memory of previous epidemics, especially the devastating Spanish Influenza of 2018. The Spanish influenza pandemic of 1918-1919 was described as "the world's worst recorded pandemic since the Black Death of the fourteenth century" (Rice, 2020). It led to a significant loss of life among New Zealanders, with Indigenous Māori communities experiencing particularly catastrophic consequences (Charania & Turner, 2018; Rice, 2020). These historical events left a lasting imprint on the collective memory of many New Zealanders, transcending cultural boundaries and becoming an integral part of New Zealand's culture and history. The response to a new pandemic is typically accompanied by fear, especially when the nature of the threat is not well understood. However, New Zealanders have demonstrated their capacity to respond and their sense of individual responsibility in protecting themselves, others, and the entire community, working together to overcome the challenges posed by such crises.

The flip side of the coin and responses:

New Zealand's geographical position played a significant role in protecting it from the spread of COVID-19. However, it's essential to note that New Zealand's population has a long tradition of mobility (Gauld, 2022), making the entry of the virus into the islands almost inevitable. Furthermore,

New Zealand is an important destination for tourism and business (Gauld, 2022). The pandemic led to border restrictions, which, while necessary for public health, had inevitable economic consequences. For example, many university students and seasonal agricultural workers in New Zealand typically come from overseas, and their absence had a substantial impact on the country's economy (Henrickson, 2020; Menzies & Raskovic, 2020).

Notwithstanding, the preparedness of New Zealand in managing emergencies and the high level of preparedness in its health system, the COVID-19 pandemic highlights some factors that could be improved.

The health system in New Zealand is public funded and is highly computerised (Huang et al., 2014). The New Zealand Healthcare (HC) System, now known as the New Zealand Health and Disability System, has evolved over the time with various items of legislation. Additionally, New Zealand can pride itself on having a high number of healthcare personnel compared to other countries of the Organisation for Economic Cooperation and Development (OECD). For instance, the number of physicians scores 3,6 (with 1,6 being the OECD average); and the number of nurses and midwives is 11,8 (compared to the OECD's 4.0) [68]. However, the OECD average reveals a shortage of hospital beds in the country. During the COVID-19 pandemic, several challenges emerged. Healthcare personnel sometimes returned to their home countries (the Government invest in making New Zealand one of the easiest places in the world for health workers to go to even before COVID-19 pandemic[69]), or tested positive to COVID-19, or took a new employment in the MIQ facilities or in Public Health, leading to a shortage of personnel in the health system. It was also challenging for new healthcare personnel arriving from overseas, as they faced financial constraints in affording MIQ facilities, as noted by Blair and colleagues (2022). The pandemic significantly impacted the daily work activities of healthcare personnel, particularly nurses, midwives, and personal care assistants. They were on the front-line in the "battle" against COVID-19, and their responsibilities extended beyond their formal roles. They had to reorganise procedures, ensure ethical and effective care, "go the extra miles", and manage their own fears of getting sick (Holroyd et al., 2022). Dealing with this wide range of responsibilities contributed to psychological stress and may have affected triage activities, which were already under pressure. The Emergency Department' triage in New Zealand is based on the Australasian Triage Scale, which "prioritises limited resources in a timely, equitable and efficient manner to do the greatest good for the greatest number" (Lockett, 2020). The difficulty in

[68] The World Bank – Open data, https://data.worldbank.org/indicator/SH.MED.BEDS.ZS?name_desc=true
[69] New Zealand Government, The official website of the New Zealand Government, Government plan to boost health workers, https://www.beehive.govt.nz/release/government-plan-boost-health-workers

proceeding with these procedures was exacerbated by wrong decisions and significant issues, leading to overcrowding and access block in hospitals (term used to describe the delay in the admission of patients from Emergency Departments to inpatient areas within a hospital (Lockett, 2020)). In addition, at the beginning of the COVID-19 pandemic, healthcare personnel were overwhelmed by much and contrasting information, making it hard to discern priorities and best practices (Cook et al., 2021). Despite these challenges, teamwork and leadership played a crucial role in managing the emergency effectively.

Particular attention should be given to the role of nurses and paramedics who staff Healthline's COVID-19 support number. People can call this number for health advice and information at any time, 24 hours a day, seven days a week[70]. It is different from the emergency number 111 for Police, Fire or Ambulance, which individuals should theoretically call for COVID-19-related reason only if they experience severe symptoms such as shortness of breath, severe chest pain, fainting, or unconsciousness[71]. Healthline staff provided assistance to 170.000 Kiwis in just the month of March 2020 (Leahy, 2020). Inevitably, callers often faced long wait times. This problem was partially resolved through more detailed information on the Ministry of Health's and the Government's COVID-19 dedicated websites. These websites explain what to do if someone get in contact with COVID-19, when to call the Healthline's COVID-19 support line number and when call the national emergency number[21,22,72, 73, 74].

From a social and psychological perspective, criticisms of the legality of Government mandates emerged during the COVID-19 pandemic (Gilray, 2021). Supporters of mitigation were concerned about the long-term public health repercussions of the economic damage caused by strict lockdowns and border closures (N. J. Long et al., 2022). Supporters of elimination argued that achieving the Zero-COVID-19 status minimises COVID-19 fatalities, supports economic recovery, and entails fewer overall restrictions on civil liberties (Long et al., 2022).

The strict border closure was a point of contention, with some viewing it as a violation of human rights. Initially, border closures were accepted, but as time passed, people with families abroad, or those who need to return to New Zealand for work grew increasingly disappointed. However, as

[70] Ministry of Health, More about Healthline, https://www.health.govt.nz/your-health/services-and-support/health-care-services/healthline/more-about-healthline

[71] New Zealand Government, Unite Against COVID-19, When call for help, https://covid19.govt.nz/prepare-and-stay-safe/when-to-call-for-help/

[72] New Zealand Government, Free health advice, Who to contact in an emergency, or for advice about COVID-19 symptoms and other health advice, https://www.govt.nz/browse/health/public-health-services/free-health-advice/

[73] Ministry of Health, Contact us, https://www.health.govt.nz/about-ministry/contact-us

[74] Ministry of Health, More about Healthline, https://www.health.govt.nz/your-health/services-and-support/health-care-services/healthline/more-about-healthline

Henrickson (2020) wrote, using a Māori proverb, just walls or borders can keep danger out. This implies that protecting through border control is essential to limit external harm and preserve stability inside. Manning (2021) argued that "the end justifies the means". Indeed, during the lockdown, the "fear of others" intensified for many people, as they believed that individuals from abroad could introduce new viruses into the country, or people outside their homes could transmit the virus (Baddock, 2020; Dutta et al., 2020). Some individuals still prefer smart working instead of coming back to the office, finding it more comfortable and appreciating the time spent with families and the increased free time (Radka et al., 2022).

The COVID-19 pandemic restriction had a significant impact on mental health, resulting in increased psychological distress and anxiety within communities (Nedthongsavanh, 2021; Pavlova et al., 2022; Takefuji, 2022). This was attributed to factors such as isolation, fear of the virus, apprehension about others, loneliness, or pre-existing moderate or severe mental health conditions. Despite that, the New Zealand Government and the Ministry of Health made substantial efforts to support the population, trying to mitigate the impact on mental health. The "Unite Against COVID-19" webpage, dedicated to COVID-19 information, provided information on where to find support and relevant telephone numbers80F[75,] 81F[76]. The services were available in different languages including English, Māori, and other Asian languages. Unfortunately, mental health issues are sometimes linked to suicide, a serious concern for New Zealand's communities (Bandyopadhyay & Meltzer, 2020). the Ministry of Health dedicate an online page where people could seek support and help to prevent extreme episodes82F[77]. The New Zealand Government launched a dedicated campaign called "Getting through together" aimed at sharing ways to help Kiwis to cope with the stress of COVID-1983F[78]. Furthermore, many sport or health associations updated their support services to address mental health issues related to the pandemic's impacts.

Other problems resulting from border closures or lockdown period was, and still is, of an economic nature: the loss of income related to the tourism stop (L. Taylor, 2020). New Zealand's economy is highly dependent on tourism (Henrickson, 2020), but tourism was impossible during the first 18 months of the pandemic (Blair et al., 2022). The impact of the income loss at national level will be felt in both the short- and in the long- term. In the short-term many people lost their jobs or experienced reduced income, leading to an increase in poverty across the country. This adversely

[75] New Zealand Government, Unite Against COVID-19, Looking after your mental wellbeing, https://covid19.govt.nz/prepare-and-stay-safe/looking-after-your-mental-wellbeing/

[76] New Zealand Government, Unite Against COVID-19, Mental Health Hub, COVID-19: Your mental health and wellbeing, https://covid19.health.nz/advice/mental-health

[77] Ministry of Health, Your Health, Mental health and wellbeing – where to get help, https://www.health.govt.nz/your-health/services-and-support/health-care-services/mental-health-services/mental-health-and-wellbeing-where-get-help

[78] New Zealand Government, Beehive.govt.nz, The official website of the New Zealand Government, COVID-19 mental health support begins (2020), https://www.beehive.govt.nz/release/covid-19-mental-health-support-begins

affected vulnerable people and exacerbated the situation of new ones (Oliu-Barton et al., 2022). Poverty conditions, coupled with vulnerable health conditions, particularly affected Māori communities in New Zealand (Bandyopadhyay & Meltzer, 2020). In the COVID-19 Response Action Plan implemented by the Government and the Ministry of Health, attention was given to these situations (Ministry of Health, 2020). However, this was insufficient for Indigenous communities, who had to contend with health-related inequalities. Many Māori could not access MIQs facilities due to an inability to pay for them. Vaccine access for elderly Māori during the first campaign did not account for their mean age or higher prevalence of risk factors compared to the European-New Zealand population. Furthermore, there were disproportionately higher rates of infection and mortality from COVID-19 among Māori. Additionally, online health information and the Healthline service did not consider the lack of Internet or phone services in Indigenous communities (McMeeking & Savage, 2020; Gurney et al., 2021). On the other hand, the cohesive Māori community responded to challenges posed by COVID-19 pandemic through mobilisation and self-responsibility (McMeeking & Savage, 2020). They established information channels and distribution network systems sharing information through word of mouth and sharing telephones and Internet access. Younger or healthier people took care of elderly, and those who contracted COVID-19 by distributing food (Gurney et al., 2021; McMeeking & Savage, 2020). Who received economic support from the Government shared income with the whole community.

This systematic review highlights the principal successful points of New Zealand's response to the COVID-19 pandemic.

From a broad perspective, it is evident that the strength of New Zealand's response lies in the implementation of the elimination strategy. Prioritising the containment of contagion and saving lives took precedence over potential long-term economic consequences. A multidisciplinary approach has been adopted, engaging the Government, Ministry of Health, Ministry of Finance, scientific committee, and the population. Scientific, cultural, and ethical principles were diligently applied, recognising the importance of scientific foundation in decision-making. In the multicultural nature of New Zealand's population, the respect for diversity and the application of ethical principles at all levels were crucial. The historical development and implementation of new guidelines following various past disaster events helped New Zealand in the response to the COVID-19 pandemic, but the real powerful point was the vivid memory of previous events. Memory can teach what to learn from experiences and how to prepare for new risks. Considering past or possible traumatic events impacting the country of New Zealand, such as earthquakes, the Christchurch terrorist attack of 2019, the White Island volcano eruption at the end of 2019, the police shooting protests from 2000 to 2022, the threat of tsunami and floods, the COVID-19 pandemic highlighted the importance of a multi-

hazard approach in the disaster's response. Another effective strategy adopted by New Zealand's COVID-19 response team was the focus on coordination. A cohesive approach involving all levels, including Government, Health System and population characterised the activities implemented. The interdependency among institutional management, social and cultural characteristics and memory of prior experiences seems to provide a solid foundation for pandemic guidelines.

While progress has been made, there is likely an ongoing need for increased healthcare resources (healthcare personnel and infrastructure). Health education has to be constantly updated alongside efforts to catalyse substantial improvements in population welfare.

Several limitations should be noted in the methods used for this systematic review. Firstly, the large volume of results obtained from different open-source platforms presented challenges in terms of filtering, and it is possible that relevant literature was unintentionally excluded. The review was conducted by a single reviewer, which means there was no multiple checking of results. Finally, the scope of this review was limited to specific research focus areas, potentially excluding other important studies.

It is conceivable that the articles cited in this systematic review may have been referenced in other reviews of pandemic response. Additionally, several articles addressed more than one research theme and could have been categorised differently.

This systematic review may serve as a valuable resource for government administrators at all levels, researchers and pandemic managers interested in the principles and fundamental aspects of effective pandemic preparedness and response planning.

Analysing the interviews carried out in New Zealand, it emerges that despite the different backgrounds of the interviewees, a common set of themes emerged. Most of them emphasised the profound influence of cultural and historical memory related to past pandemics, the commendable management of the COVID-19 pandemic by the Government, and the negative effects of the restriction implemented. All the experts and individuals interviewed consider the geographical isolation of New Zealand as a protective advantage against external viruses, agents, and hazards. This perception extends to the country's multicultural nature, characterised by a young populace that coexists harmoniously, shares knowledge from diverse backgrounds, and supports one another for the common good. The general sense of vulnerability associated with these two factors seems to be quite mild. A paradox arises in the dichotomy between those who moved to New Zealand in search of opportunities or a new life and those who suffer due to their inability to reunite with their families and relatives because of the restrictions. As underscored by the second expert, the concept of family is an intrinsic human need. Although discontent regarding long-term restrictions is prevalent among all interviewees, the second expert and the representative of the community seem to be more

concerned about the enduring impacts of these measures compared to others. The prevailing sentiment among those who are most supportive of the government's strategies appears to be that prioritising saving lives is the primary rationale behind the pandemic management's success.

The experts argue that the study of pandemics should be integrated into geography and disaster risk reduction studies, adopting a multi-sectoral approach. It seems that pandemics have been somewhat of a novel discovery for countries in the northern and west hemisphere, while they represent a more familiar and troublesome reality for eastern nations. Often, pandemic events have been associated with health and medical research rather than being recognised as hazards requiring proactive planning and preparedness.

One striking observation is the profound sense of belonging to New Zealand shared by interviewees, even though many of them come from other countries or have ancestral ties outside New Zealand.

This strong connection to the country, shaped by New Zealand's culture and the ancient Māori principles of community and environmental respect, serves as a guiding force motivating both the Government and the wider population in responding to past and present pandemics. Undoubtedly, the friendly, straightforward, and scientifically grounded approach adopted by the Government has been fundamental for the COVID-19 management, contributing to the re-election of the Administration.

5.4 Parallels between Italy and New Zealand

The study of specific topics of Italy and New Zealand including i) geographic position, ii) political administration, iii) population distribution and composition, iv) socio-cultural characteristics, and v) health system and historical experiences of epidemic and pandemic events; aims to identify the similarities and differences of the two countries. These key characteristics may significantly impact the planning, management, and response to a pandemic. Below, similarities and differences are outlined in an attempt to investigate the aspects highlighted in the research questions of the sub-hypotheses.

The geographic position of the two countries under analysis provides insight into their global connection. Italy's strategic position in the south of Europe, in the centre of the Mediterranean Sea, has historically driven the Italian position among European countries. Geographically, politically, and economically, Italy represents a significant intersection connecting the Indian and Pacific Ocean to the Atlantic Ocean. Its position in the Mediterranean Sea gave Italy control over maritime traffic and established it as a hub for the distribution of goods from Africa and Asia to central and northern Europe (Deandreis et al., 2022; Farnesina - Ministry of Foreign Affairs and International Cooperation, 2017). Despite the historical significance, in recent years, Italy has experienced a decline in centrality, and it has seen a reduction in economic and political importance due to the emergence of other countries in the global commercial network (Simoni, 2020). Considering the globalisation phenomenon, the movements of goods, necessities, people, and economic activities, including tourism, jobs, and immigration, can easily traverse administrative borders (Mena et al., 2022).

New Zealand is geographically isolated in the Pacific Ocean, but politically connected with the United Kingdom of which it is dependent as an historic colony. New Zealand holds the unique position of being one of the two potential access points to the South Pole, alongside South America and stands as the largest island in Oceania. The interest of other countries in New Zealand dates back to ancient time, driven both by its location at the edges of the land surface and its hospitable nature. Initially, colonisation plans were made to exploit New Zealand's territory, but it later became a chosen location for settlement due to its abundant resources, favourable climate, and opportunities it presented. Nowadays, New Zealand has garnered international interest due to the beauty of its landscape, employment opportunities, and the innovation characteristics of a young country (Rowan. Taylor et al., 1997).

Examining these factors that describe Italy and New Zealand, it is possible to observe that the geographic position of the two countries is a key determinant shaping their socio-political and

economic characteristics. Both countries have to consistently assert their positions in the global economy and politics. While Italy contends with historical prejudices, New Zealand seeks to capture the interest of other countries and establish itself as distinct. Within the nations, the government appears to be more familiar in New Zealand than in Italy, where the distance between the population and the members of the Government is considerable. Probably, with the approach of the New Zealand Government, it may be easier for the population to accept new regulations and requests (Okan et al., 2019). The Government is perceived as a helpful and supportive authority that takes care of the interest of each member of the community. The sense of community is less frequent in Italy than in New Zealand, which is likely influenced by the communal approach of many Asian nations. That factor influences the social approach where individuals are accustomed to take care of themselves preserving the health of other people, rather than to consider preserving themselves only. The New Zealand community seems to function as a unified entity, despite the multicultural characteristics of the population. Probably, in Italy, an individualistic approach more typical of the western countries is more common, and it is possible that the sense of patriotism has been lost.

Associating that factor with the ease of crossing borders in Italy for goods and people may be considered as a condition favouring the spread of epidemics and pandemics inside the country and the low level of health consciousness of the population (Gioia et al., 2022). The minority of immigrants in Italy drives them to be informed about what to do in order to comply with national and local regulations and avoid the fear of penalties. In New Zealand the preservation of cultural customs sometimes conflicts with the respect for national rules (Okan et al., 2019; Sun et al., 2021).

The strict controls at New Zealand's borders reflect the sense of preservation and respect for nature and people living on the islands: non-indigenous species can have a negative impact on the ecosystem, including viruses and bacteria introduced from outside the country. This approach makes it easier to limit contagion and the introduction of hazardous elements.

Italy and New Zealand have a similar territorial extension, but the population density is higher in Italy and lower in New Zealand (the New Zealand residents are a tenth of Italians)[42,63]. When considering the introduction of viruses or bacteria, contagion may occur more rapidly in Italy due to the proximity of contacts among people. The median age is acknowledged as a vulnerability factor for biological hazards, and the elderly population in Italy could be more vulnerable than the inhabitants of New Zealand (Rivieccio et al., 2020; D. S. K. Thomas et al., 2020). The high incidence of serious diseases among the population minorities in New Zealand could be a significant factor when comparing the elderly population of Italy (Manning, 2021; Morgan et al., 2022; Velotti et al., 2022).

Related to the impact of biological hazards and examining the Health System structure of the two countries under analysis, it is possible to observe that while the Italian Health System seems to be more widespread across the entire territory, the New Zealand Health System appears to be less encumbered by bureaucracy. In the first case, the adaptation of regulations and strategies to the area of jurisdiction suggests a thorough evaluation of resources and needs; in the second case, there emerges an easier acceptance of new regulations and a streamlined administration of the health sector throughout the territory.

The reduction experienced by the Italian Health System began in 2010 (Cartabellotta et al., 2019), affecting human, material, and financial resources. This situation has led to a critical condition for Italian hospitals and health emergency structures, diminishing the effectiveness of health administration at the local level. The bad management of the Italian health system and the lack of previous experiences by healthcare personnel and population appear to predict serious difficulties in facing the COVID-19 pandemic. On the contrary, in New Zealand resources are well distributed, and there is a tendency not to overwhelm hospitals even during emergencies such as pandemics. The experience of other epidemics and pandemics increases the preparedness of both the health system and the population. Furthermore, New Zealand had a little more time to prepare for COVID-19 pandemic compared to other countries, particularly Italy.

In summary, critical points have emerged both for Italy and New Zealand, highlighting that all analysed factors i) geographic position, ii) political administration, iii) population distribution and composition, iv) socio-cultural characteristics and v) health system and historical experiences of epidemic and pandemic events are fundamental for being prepared in facing a pandemic emergency.

5.5 Field Exercise MODEX

The MODEX was an opportunity to assess the key aspects emphasised in the research study. The effectiveness of indicators, the response and performance of healthcare workers, and the efficacy of implemented measures were assessed during the training exercise. Field hospitals were compared with traditional hospitals and healthcare facilities. By observing the activities of the MODEX exercise, it was possible to examine whether healthcare workers accustomed to emergencies adjusted their approach and learned how to handle epidemic situations following the COVID-19 pandemic.

First, probably, it is necessary to highlight that during any simulation, many actions are already planned and obviously it is not a real emergency. In the MODEX training the actors are previously informed about the different activities, but not in detail, and they are monitored to verify their actions and attitudes. They have to be performant, and in Arcevia the three EMTs should obtain the International Certification, so that it was quite similar to a part of an exam necessary to reach the certification letting them to be employed in disaster events outside their Countries.

Some general positive aspects emerge during the MODEX of Arcevia. The EMTs were completely self-sufficient, starting from the principal activities for the first treatment of patients, to beds and kitchen to daily activities of healthcare personnel.

Generally, the field hospitals included all the indicators of the health and safety macro area of the PhD research. They were well organised, and the tents work in connection among them, but well separated like real wards. The flux of patients has one direction from the entry to the exit, as the ambulances arrive and depart. The physical distance between healthcare personnel and patients is quite adequate also in case of infection outbreak. Obviously, the separated tent for suspected patients is better for isolation and physical distancing than the other areas.

The staff was composed of about thirty people with different expertise such as physicians, nurses, logistic responsible, one or two chefs, technicians, and ambulance drivers. They were organised in shifts and can cover day and night emergencies. Furthermore, the personnel were qualified and specialised in emergency management: they are trained to work fast and with a massive arrival of patients. Two field hospitals among three can also treat simple chirurgical injury, and transfer patients with their ambulances to the nearest hospital. All field hospitals had a locked pharmacy which can be useful for different injured cases.

The political and economic macro area of indicators selected in this research was completely included because MODEX is a simulation with international support, with a regional involvement, in a specific

municipality. The indicators of psychological and social macro areas were included too, with field hospitals completely exposed to green and relaxing areas; application of ethical principles respecting different cultures between healthcare personnel and patients or administrations; involvement of different voluntary organisations.

The demographic macro area is compiled with a Country that does not exist, Modulistan.

The indicators of the pandemic macro area have been included in most activities by the EMTs. They had some difficulties in identifying meningoencephalitis, and one field hospital recorded no cases, but generally they adopt all the necessary precautions.

The EMTs updated internal plans for the infection cases, had personal protective equipment for healthcare personnel and for patients. Moreover, the EMTs received the support of the Ministry of Health in the management of the situation and provision of drugs or equipment.

Considering the whole dimension of indicators, it is interesting to observe how the emergency actors worked as a single machine, or a chain where each single link is fundamental. If a link is disconnected, all the emergency actors could be affected by errors or defections, impacting on the emergency management. The coordination is fundamental not only inside the field hospital, but also with other hospitals, emergency numbers and particularly with the principal coordinators of Excon.

The principal problems observed during the MODEX Arcevia 2023 involve different ambits; first, communication, then information, coordination, logistic, and transports.

The emergency chain exhibits a dual structure, combining both top-down and bottom-up approach. In this configuration, the EUCPT assumed the role of coordinating actions from the top, while the EMTs are responsible for reporting critical information and needs from the bottom.

The communication from EMTs to the Modulistan Operation Centre – 112 found many difficulties starting from equipping EMTs of a phone line working in Modulistan and the malfunctioning of the telephones of the Modulistan Operation Centre. The correct use of a common language (English) gave some limits, particularly if the line was not clear between whose mother language is not English. This means that very specialised experts with correct use of language should always be employed, especially during an emergency. The fast and clear communication could save life, or however be fundamental in the development of activities. Other types of communication problems were in the patients' treatments. People injured come from Modulistan, instead of healthcare personnel who come from other European Countries so that the languages are different. In this case, gestures, and

healthcare personnel' experience in identifying the problem of the injury surely can help in solving the problem or taking decisions quickly. Anyway, the flow of communication was controlled from TAST (technical team) supporting the EMTs' logistics.

The information coming from the EUCPT, or the Ministry of Health was not always quickly received or implemented by the EMTs. For instance, EMTs encountered challenges, including a field hospital that failed to complete the list of materials left for the subsequent team on time. Additionally, during a rescuing exercise, another group of healthcare workers deviated from the indicated coordinates and stopped in a different position. The situation highlights the complexities faced by emergency responders in coordinating and executing critical tasks during challenging circumstances. Probably, they were busy taking care of patients, or they missed to complete some indications. The objective was to implement some standardised actions but not always the EMTs have been able to do it. This situation is not very useful during an emergency when everything needs to be coordinated in order to manage resources and limit damages fast. Moreover, a report from EMTs is fundamental for EUCPT or for the Ministry of Health to organise day-to-day activities and assistance's distribution.

The logistics have to guarantee support to the field hospital they refer to in any cases, if the power goes down, or if the Wi-Fi doesn't work. The contacts among EMTs, or with the coordinators or the ambulances have to be always available. Increasing the difficulties, the ambulances to transfer patients were limited, even if some field hospitals have their own ambulance. Furthermore, the EMTs have to identify the priority of transporting patients, explaining well what injured them, how many patients need to transfer and if one healthcare provider has to be with the patient for undelayable reasons. The severity of a patient's injury limits the number of patients inside the ambulances.

These kinds of problems conditioned the coordination of all activities, resources, and patients' treatment.

The lack of coordination inside the field hospital, or negligence of healthcare personnel results in the loss of two lives in one of the EMTs.

Some minor observations could be highlighted regarding the general overview of MODEX Arcevia simulation. The first problems arose at the arrival of the field hospitals in the dedicated area: in one case, a truck transporting toilets and big containers was too big, and it cannot arrive at destination because of the small street and difficult bend; in another area, the personnel cannot put up one of the tent over some stockage material because the tent was too small compared with the concrete on the floor. The stocked material was outside tents and not covered assuming the risk of rain or bad weather.

This could not be a problem for the material stocked inside metallic containers, but it is advised against the materials stocked inside wood containers. Furthermore, the adequacy of the material in every kind of situation and place may be recommended for a field hospital. In this scenario, it is advisable for field hospitals to reassess their design and materials to ensure preparedness for various soil types, and all-weather condition. Such considerations are crucial for optimising the functionality and resilience of these critical healthcare facilities.

In relation to the indicator "Different paths for COVID-19 and non-COVID-19 patients" the EMTs were well organised, but in one of the three field hospitals, the tent dedicated to the infectious patients is part of the triage tent and not very well isolated from the others. They set up the tents in that position for space-reason, but they figured out that it was not a good decision because the infection could reach the other patients and the healthcare personnel in the connected tents. The proliferation of potential virus or bacterial infection inside the field hospital could only amplify the emergency problems.

Sometimes, during the night, some field hospitals asked for limiting the patients' arrival because they need to rest, or they already have had too many patients. Probably, during a real emergency it is unlikely that such a request would be feasible due to the uncontrolled influx of incoming patients. However, hospitals could strategically redirect patients to ensure proper attention and treatments.

During the MODEX activities, the three field hospitals have to use the European model for triaging. Otherwise in one hospital, the healthcare personnel use their old document. It was not very different to the other two triage structures, but it is quite less schematic. Furthermore, the other two were facilitated by colour indications. Symbols instead of many written words and the use of a common language and a common scheme of triaging should help healthcare personnel of different hospitals to immediately understand the patient's problem. In this way every kind of second treatment (i.e., transfer in another hospital, reallocation of the patient) should be clear, faster and should limit worsening situations. A symbol is more direct and understandable compared to written descriptions.

In relation to the indicator "Timeliness", during the MODEX Arcevia 2023 training it had been possible to observe that some of the planned activities had been managed a little bit slowly. Some examples are the updating of the needed ambulance for patients, or the preparation of the final report for the end over by each team leader of the field hospitals. During emergency situations, timeliness is essential to save lives, dispose of patients and limit damages.

In conclusion, the European exercise MODEX in Arcevia had been an opportunity to test the importance of training activities, the definition of skills to be prepared and the accuracy of the

response to health emergencies. Modulistan should be compared to the Italian Nationality and Arcevia, the area where the hospital should take place. Indeed, the principal actors of the MODEX Arcevia 2023 were the field hospitals. In this research project it is possible to compare the field hospital with the emergency room of a hospital in order to observe if, in a quite real emergency scenario, the indicators selected in the doctoral project have been important. It is a test for an emergency event including biological emergency after the global event of COVID-19 pandemic. Healthcare personnel has to recognise symptoms of an infectious virus, manage the related patients and consider treating all other types of patients. The possibility is a massive influx of injured or positive patients and the probability of contagion inside tents. The attention of cultural respect and the diligence in establishing a shared and comprehensive language are critical components in fostering the acceptance of foreign rescuers and streamlining emergency activities.

In both cases, hospitals and field hospitals have to save patients, avoid complications and deaths and manage the emergencies among health guidelines coming from the World Health Organisation, the European Commission, the National and the internal guidelines when available. In a scenario where multiple risks arise; the rescue force may exhibit effective coordination and organisation. The role must be previously defined, outlining likely actions and measures for specific emergency events, thereby limiting accidents, and ensuring that rescuers are adequately prepared.

Obviously, real events differ from simulations; disasters are always different, accidents could happen, emotions could change the expert's attitude or reaction. Anyway, the emergency simulations represent an opportunity to test the experience of experts, to verify their competences, and to implement the preparedness for specific emergencies. Emergency trainings can assist in assessing the efficacy and effectiveness of planned measures or identifying the need of corrections. It is not possible to wait for emergencies to happen to become more prepared. Some kind of emergency could never happen until a disaster comes. The COVID-19 pandemic is an example of a very less known emergency in some areas of the world. For these reasons, planning and preparing for disaster is necessary. Planning activities should encompass all type of hazards and risks, not only the most frequent events, but also the potential ones. The scope of simulations should be the preparedness for a good response to the emergency. Rescuers, Administrators, and the entire population play crucial roles in this coordinated and well-prepared emergency chain, as they assist each other.

5.7 Guidelines for pandemic preparedness and planning

The findings of this research were harmonised in the following proposed guidelines for pandemic preparedness and planning. The broad macro areas that needs consideration and pondering reflects the multi-sectoral approach that planners should follow during the implementation of a pandemic plan. Experts in disaster management, political, economic, health, socio-psychological aspects, demography, and pandemics.

Base points:

- Emergency networks should be established with a defined coordination among hospitals and at every administrational level: national, regional, and local. Improvisation is not permitted.
- Only one spokesperson, preferably the Government representative, should provide information to avoid misinformation and an infodemic.
- A multi-stakeholder approach to pandemic planning and response must be adopted due to the potential multiple impacts this risk could have. This approach should also ensure aid support and continuity.
- Ensuring effective and functional emergency communication, characterised by a combination of top-down and bottom-up approaches.
- Human rights, culture and ethical principles must always be respected. In this way, the population's trust in the Government and Health System should be assured.

Observation for the awareness of the area:

Demographic characteristics influence the evolution of disasters including vulnerable and exposed individuals and elements.

- A register of the elderly, immunosuppressed individuals, and children should assist in assessing the percentage of people at major risk. At times, epidemics and pandemics affect one gender more than another, hence it is crucial to monitor that aspect of the virus. Specific indications and directives should be adopted to protect them (e.g., priority of vaccination, promotion of free health checks).

- The distribution across the territory, the population density, and commuting serve as potential vectors of transmission. Restricting movements appear to be the only solution to halt the spread of the virus.
- The health status of the population enhances resilience if it is maintained.

For health structure:

- Health experts should take into account the distribution of hospitals and healthcare facilities, along with residential services and public health infrastructure, concerning the population. The aim is to evaluate the capacity to accommodate potential patients and the practicality of segregating facilities between those for pandemic patients and those for regular patients. With this separation, it should be possible to avoid overcrowding during emergency situations.
- In the health structures, the number of medical specialists, physicians, nurses, and social workers in public health services should be proportional to the potential number of patients, preferably exceeding the proportion. In emergencies, the available personnel should be sufficient to manage a large influx of incoming patients.
- Healthcare workers should be prepared with interdisciplinary skills regardless of their departmental assignments. During emergencies, additional workers may need to compensate for any shortages of specialists.
- A stock of drugs effective against various virus families should be continuously monitored for availability and updated with new discoveries.
- Flexibility in the use of facilities is recommended, but hospitals should also have the capability to expand available space, if necessary, perhaps using tents.
- The availability of green areas, sport and relaxing spaces, psychological support and training should improve working conditions, particularly during emergencies.
- Emergency vehicles should be proportioned to the maximum capacity of the health structures, maybe with the help of volunteers. It is recommended that separate routes for entry and exit are designated. The helipad space is an exclusive property.
- Triage tag should be adequate to the European indication in order to be fast, shared and effective.

Specific indication related to pandemic emergency:

- Constant update pandemic emergency plan (national, regional, and for hospital).
- At the onset of the pandemic, implementing an elimination strategy; subsequently, adopting a mitigation strategy. This approach should restrict the virus from entering an area and reduce transmission among individuals.
- Assigning resources to discover the nature of the virus to quickly understand what actions to take, how to manage the virus, and how to protect against it (e.g., physical distancing, personal protective equipment, lockdown). Timeliness of interventions is fundamental.
- Implementing a shared database that includes successful strategies, positive cases, deaths, and causes of virus transmission (through contact tracing) to monitor the situation's evolution and contain contagion.
- Hospitals should be provided with isolated departments designated to manage positive patients, including the availability of convertible beds.
- The development and implementation of specialised remote medical support such as telemedicine should be promoted to mitigate the risk of virus transmission or to facilitate care for individuals at home.
- Simulation and training for healthcare workers, as well as stakeholders, are crucial for pandemic emergency preparedness and for testing planned strategies.

These guidelines should be functional for the implementation of pandemic emergency plans.

6. CONCLUSION

Risks emerge when natural elements interact with the human sphere, such as when viruses bump into human society. Therefore, mitigating risks entails a detailed process of planning and preparation. The objective of this research study is to investigate the critical aspects of pandemic emergency planning and provide a set of guidelines to assess local and national Health Systems Resilience to biological hazards such as a Coronavirus. Indeed, during pandemic emergencies, the Health System is the primary impacted sector and the foremost in initiating and managing response, the activation and management of response. Identifying activities essential to emergency management, the purpose is to implement the resilience of the system, but also of the whole political and social level with the resilience of the system as well as that of the entire political and social framework. The main study areas are Italy and the Marche Region. Additionally, New Zealand, recognised as one of the most successful Countries in dealing with COVID-19 pandemic, has been selected for a comparison.

The methodology involved a six steps process aimed at highlighting the essential factors influencing pandemic planning and resilience as described in the figure below.

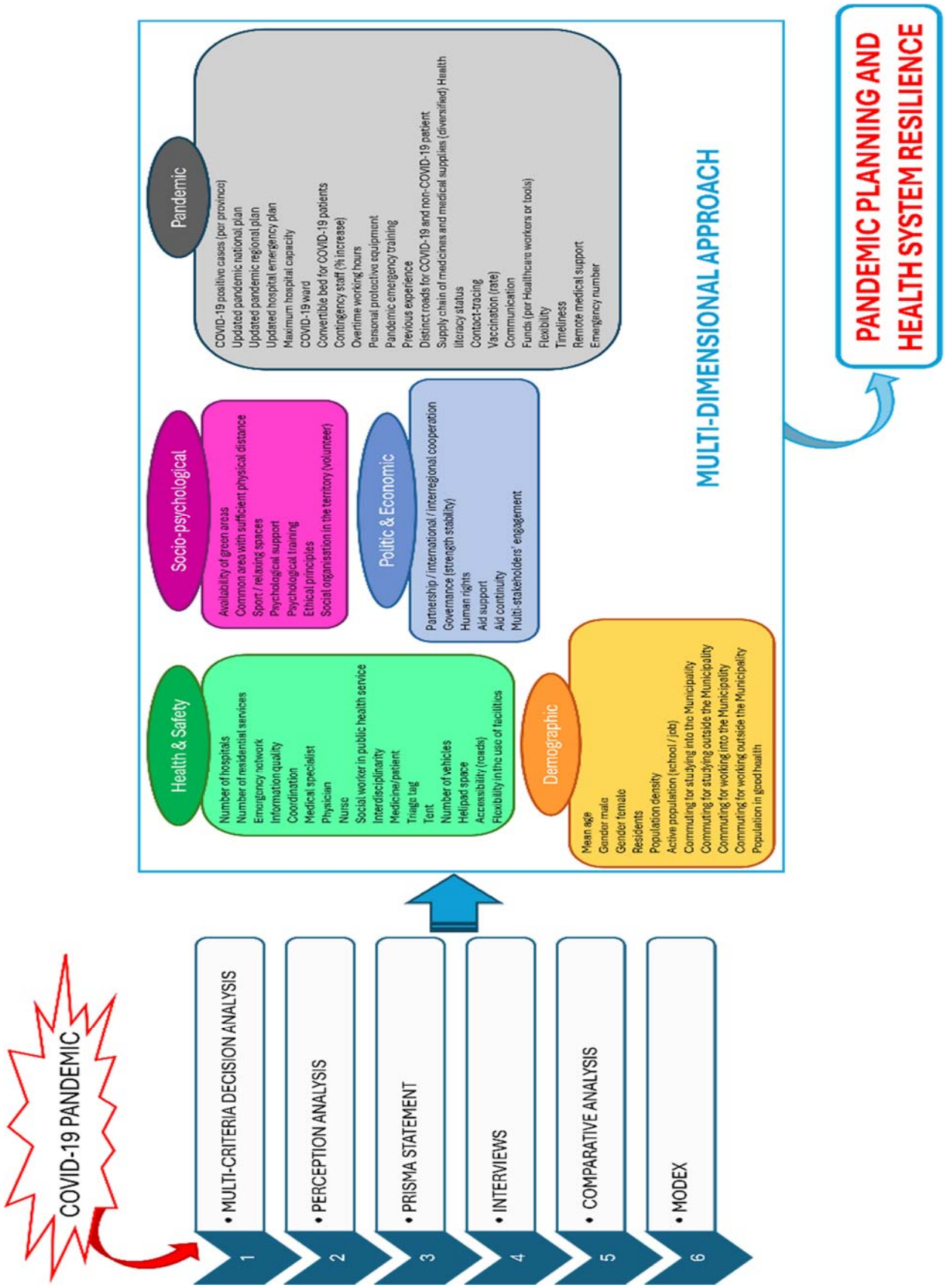


Figure 6.1*: Description of the six steps process implemented to establish guidelines for pandemic planning and health system resilience involves adopting a multi-dimensional approach which evaluates selected macro areas and includes relevant indicators*

The bibliographic review was conducted for the selection of indicators. These indicators were functional for the Multi-Criteria Decision Analysis, which enables the study of the most resilient hospital among those selected in the Marche Region and identifies the potential equal importance of indicators. The perception analysis examined the healthcare workers' perception of pandemic emergencies, their preparedness and psychological status. The PRISMA statement aimed to identify the most successful factors of New Zealand's management of COVID-19. The comparative analysis focussing on similarities and differences between Italy and New Zealand. At the conclusion, the EU MODEX involves field training to assess the chosen indicators and verify their real-world effectiveness in enhancing pandemic preparedness.

From a broad perspective, it can be asserted that COVID-19 pandemic impacted the Health System of every country in the world, including Italy. During the spread of COVID-19, the Italian Health System was not adequately prepared to handle pandemics. The number of positive cases and deaths reflects a symptom of limitation in the battle against the new virus. Therefore, an updated pandemic emergency plan, educational training for healthcare workers and pandemic formation for the population should be implemented. Responsibilities are shared during emergencies.

The **first phase** of this research focuses on the study of the state-of-the-art on global pandemic planning and preparedness through a comprehensive bibliographic review of scientific literature and official documents. With this phase, the response to the principal hypothesis and research questions commences, in conjunction with other phases. The bibliographic review outlines the worldwide coordination by the World Health Organization and the implementation of guidelines that Countries should follow to update their pandemic emergency plans. Indeed, nations directly affected by epidemics and pandemics regularly revise their plans as new knowledge emerges. However, Countries less frequently exposed to such events appear to neglect updating their pandemic emergency plans. Therefore, the Health System Resilience is not homogeneous among different Countries. Asian and African Countries appear to be better prepared for pandemic emergencies, possessing updated plans, build experience, and an educated population, in contrast to European and American Countries. Israel, New Zealand, Singapore, South Korea boast a high level of health resilience gathered with past experiences and in dealing with the COVID-19 pandemic. In the specific case of Italy, the focus on planning is directed towards other risks rather than epidemics and pandemics. The pandemic emergency plan in place at the time of the COVID-19 outbreak was dated back to 2006, and generally, Italy lacked extensive experience with this type of risk since Spanish Influenza or the previous plague. The focus on the Marche Region let to observe the Health System

organisation in Italy and inside regions and the fragmented pandemic management from national to local level, including the lack of resources and tools.

The outputs resulting from the first phase enabled the collection of a set of indicators corresponding to specific factors outlined in the scientific paper and official documents addressing pandemic emergencies, planning, and preparedness. Studying the local level, a selection of hospitals dealing with the COVID-19 pandemic patients was carried out for the Marche Region.

Indicators and hospitals have been useful for the second phase of this research project.

The **second phase** of the doctoral project focuses on the COVID-19 pandemic in the Marche Region. It involves studying the importance of indicators and evaluating hospital resilience through Multi-Criteria Decision Analysis. Two types of analyses were conducted: Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) and Analytic Hierarchy Process (AHP). This phase tries to support the principal hypothesis, the first and the second sub-hypothesis.

TOPSIS was used to assess the health resilience of selected hospitals in the Marche Region with indicators serving as criteria for ranking hospitals' resilience. The results of the analysis indicate that the hospital of Pesaro is most resilient, followed in descending order by the hospitals of Jesi, San Benedetto del Tronto, Civitanova Marche, Ancona, Fabriano, Camerino. This ranking reflects the progression of the COVID-19 pandemic across the different provinces including the timing of the virus' arrival in each province, number of positive cases, and the demographic composition of the population (density, age, and geographical distribution). Moreover, Pesaro's hospital was the first to manage COVID-19 patients and had time to adapt through the duration of the pandemic. Ancona's hospital received patients from across the region, while Camerino's hospital treated patients from other parts of the region despite Camerino did not have any positive case in the first phase of pandemic. Jesi's hospital effectively supported the hospital in Ancona by covering a significant portion of patients in the province. The situation of the rank does not change, analysing the different waves of COVID-19 pandemic.

In an effort to assess whether certain indicators hold more significance than others, the AHP was conducted. However, the consultation with experts did not yield a definitive ranking of preferences for indicators. Instead, it appears that each expert favours indicators associated with their own area of expertise. The outcomes of both the previous TOPSIS analysis and the AHP results indicate that the selected indicators can be evaluated as essential for assessing the resilience and preparedness of

hospitals. As a consequence, pandemic planning could be founded upon these selected indicators, incorporating a multi-stakeholder approach.

The **third phase** of the research aims to explore the healthcare workers' perception about pandemic. Even in this phase, the analysis focuses on the COVID-19 pandemic. The healthcare workers who participated in the questionnaire were employed in the selected hospitals of the Marche Region. By investigating the perception, the socio-psychological aspect is studied addressing the second and the third sub-hypothesis and related research questions. Despite working in different hospitals, the responses of healthcare workers were similar. This suggests common needs and deficiencies in the Health System of the Marche Region, which aligns with the finding from the bibliographic review on the Italian Health System. Pandemic emergency plans need to be enacted at the local level. The emergency communication and information strategy should be well-defined, effective, and functional. In order to provide for the lack of direct experiences, emergency training should be conducted for the entire community, along with specialised courses for healthcare workers, including facilities adaptation. Roles and responsibilities should be established prior to the occurrence of an emergency, and psychological support should be provided to both workers and individuals involved in the pandemic emergency.

In the **fourth phase**, all the information gathered for Italy was gathered for New Zealand through the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA statement). This systematic review aims to identify the key factors which enabled New Zealand to be one of the best-performing Countries in managing the COVID-19 pandemic. The fourth phase also includes interviews with experts in different disciplines and local inhabitants in order to investigate the perception of locals about the COVID-19 pandemic.

The New Zealand population has a long history of dealing with epidemics and pandemics, with Spanish Influenza holding a prominent place in the collective memory of its people. The first New Zealand inhabitants such as Māori were devastated by the Spanish Influenza and preserved the memory until the present days. On the other hand, the big communities of Chinese, Korean, and Japan's individuals are used to accept and follow Government directives without opposing them. The population's experience and the Government's implementation of an elimination strategy have been the key factors for success. The familiar approach of the Prime Minister, serving as the sole source of information and directives, supported by the Ministry of Health and a scientific team facilitated the shared goal of limiting contagion and eliminating the virus. Furthermore, the Health System

boasts an adequate number of healthcare workers and differentiated structures for the management of common patients and those affected by pandemics.

The **fifth phase** of the research project involves comparing the approaches of Italy and New Zealand to pandemic risk. In this phase, all the information gathered in the preceding phases is juxtaposed between the two countries, serving as a summary of the entire project. The results illustrate the contrasting situation in two Countries on opposite sides of the world, despite their similar geographical extents. New Zealand, as an island, is completely isolated in the South Pacific, whereas Italy is connected to the rest of Europe in the North and serves as a central hub in the Mediterranean Sea, facilitating trade and movements. Hence, in case of virus spread, the border closure is simpler for New Zealand compared to Italy. In terms of population, the lower density in New Zealand makes physical distancing easier, and the depth of experience regarding pandemic is bolstered by the vivid memory of past events, notably the Spanish Influenza, which resulted in significant casualties. The fear of such a devastating virus and the principle of community preservation compelled the population to heed Government guidance and adopt protective measures. Furthermore, New Zealand has a multi-ethnic population; consequently, the Government uses to broadcast information in various languages and implements strategies that respect the culture of minorities. With a prepared population, the Health System can prevent overcrowding and manage patients across various health facilities. Italy lacks extensive experience with pandemics, and the population lacks a collective memory of previous experiences. In Italy, most of the information broadcasted by the Government is in the national language, which can be challenging for tourists and foreigners to understand without spending additional time.

One significant difference between Italy and New Zealand is the general approach, likely correlated with culture. Italy has a predominant individualistic approach, where each individual thinks about themselves, their freedom, their health, their well-being. Despite having a multi-ethnic population and the Parliamentary Monarchy, New Zealand adopts a collectivistic approach, where everyone preserves others to preserve themselves.

The **sixth phase** analyses the methodology and the quantitative and qualitative data by field testing, such as the EU MODEX, the European exercise for stakeholders training. The Arcevia MODEX of June 2023 simulated both an earthquake and a subsequent epidemic. This provided an opportunity to test some of the selected indicators. Participation in MODEX highlighted several commonalities with the doctoral research outputs, such as the importance of clear, shared, and effective communication among hospitals, emergency services, healthcare workers, and patients. Another fundamental aspect

highlighted by the European exercise is the importance of having an adequate number of personnel and availability of tools, especially when dealing with multiple hazards. Timeliness is fundamental in field hospitals, especially in the event of a massive influx of patients, to swiftly save lives and, for example, limit the spread of viruses within the hospital. This could be achieved through specific guidelines, which represent the primary successful strategy, and by defining procedures that must be known by each employee.

The **final observations** encompass a sort of guidelines that could prove useful for pandemic management at the local level and are applicable to higher levels of administration. The analysis underscores the critical need for updated pandemic emergency plans. These plans should incorporate several key aspects to enhance preparedness for and management of pandemic events during emergencies. National, regional, and local leaders should limit the fragmentation of procedures and adopt a familiar approach in order to mobilise people's cooperation in emergency situations. Viruses go across political borders, hence, there is a necessity to make fluent procedures. The figure below shows the results of the analyses and the key points highlighted.

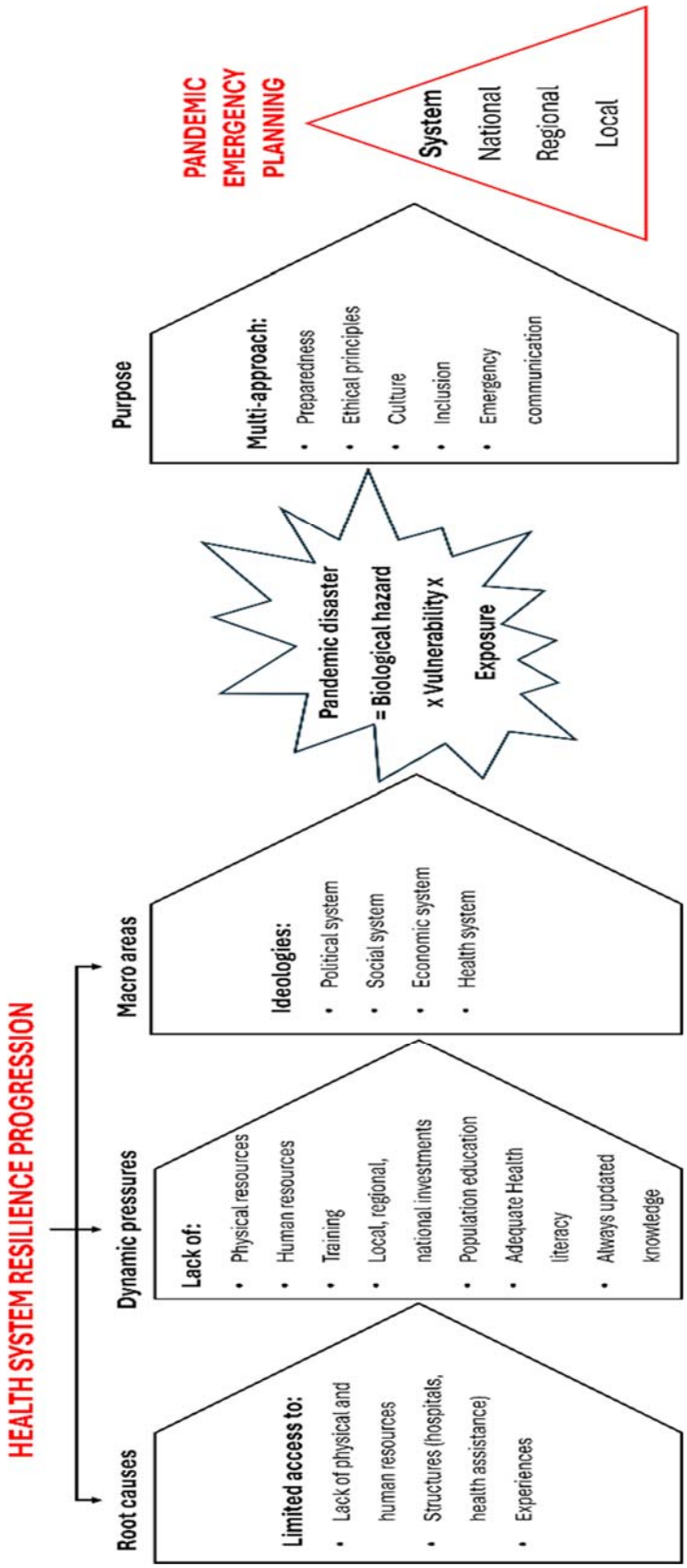


Figure 6.2*: Description of the results and key points highlighted by the research study to provide guidance for pandemic emergency planning at national, regional and local level. The evaluation considers limitations, gaps, and ideologies related to health system resilience progression when a biological risk occurs*

Information must be provided by a single individual and must be clear and understandable to all stakeholders and most of the individuals present within the territory. Therefore, information should be broadcasted in the national language, as well as in English and other languages depending on the composition of the population or the presence of minorities. At the same time, risk communication needs to be inclusive and characterised both from a top-down and a bottom-up approach. The involvement of stakeholders and population should facilitate the exchange of ideas, needs and information about the local situation and the evolution of the emergency. Furthermore, everyone should be aware of what actions to take, from the administration to the population including healthcare workers and all other involved parties.

Information and data are effective when shared and well-defined: an institutionalisation and harmonisation of database management should always be implemented. This would enable better control of the situation and optimised early detection of biological hazards.

Particular attention should be given to culture: measures designed to limit the spread of a virus should respect the culture of a community. In this way, the population is more likely to accept the Government's strategies and decisions. Culture refers to ethics: it is considered by the Government with respect to human rights when implementing new strategies; by the population in preserving individual and collective well-being; and by healthcare workers and involved parties in carrying out their job by safeguarding lives and upholding patients' interests, not only adhering to procedures. This will allow stakeholders to safeguard themselves, individuals in critical conditions, and their psychosocial well-being. By respecting culture and ethics, trust in Institutions and science within the population should increase. The psychological support for healthcare workers, patients and the population should be always implemented and guaranteed. Strengthening social infrastructure, socio-economic protection, and employment of specialists should be functional in the socio-psychological support.

Previous experiences play a crucial role in preparing for future pandemics, but simulations and training are also essential in preparing healthcare workers and relevant services. A multi- and cross-sectoral and an interdisciplinary approach should be adopted in simulation and training. This not only familiarised healthcare workers and relevant service with procedures and disaster management, but also enhances coordination across the entire emergency chain. Everyone should be aware of their roles and actions to minimise intervention time and curb the spread of the virus. On the other hand, the population should be educated in health literacy, which includes information about biological hazards and how to mitigate associated risks.

Huge investments and funds for the Health System are fundamental to ensure adequate number of health personnels and specialised doctors, resources, structures, and potential to discover effective vaccines. These should be previously in advance for pandemic with separate spaces, or structures for positive and not-positive patients, or structures that act as a filter in managing patients. Particularly, this preparation is necessary before emergencies, including the streamlining of bureaucratic procedures.

In conclusion, the implementation of the pandemic emergency plan should have a multi-stakeholder and interdisciplinarity approach. The purpose of these final observations is to provide useful indicators which could support pandemic planning and preparedness effort. Both the Italian Government and the Marche Region have implemented their pandemic emergency plans, and now hospitals should develop specific plans for pandemic in addition to the Internal Emergency Plan for the Massive Inflow of the Wounded (PEIMAF). The aims for the future include ensuring resources for the Health System and educating all individuals on managing biological hazards. Indeed, although biological risks do not occur frequently, it does not mean that this hazard does not exist. Health prevention is essential to the preservation of human life. Furthermore, the respect of nature should be cultivated, and adapting and mitigating strategies are the solution to global changes and emerging risks.

The future perspectives should involve replicating the steps of the methodology in other Italian regions or areas where it was not possible due to the lack of time during a doctoral period. It could be interesting to observe whether the outcomes vary under different conditions or to identify the most performing hospitals. Starting from healthcare workers, it could be interesting to introduce specific pandemic courses into health universities' curricula, but also inside hospitals or residential structures. The results of the analysis should be presented to the nine hospitals selected for the doctoral research, and a brochure of guidelines should be implemented in collaboration with the University, the head of the emergency department, and the whole personnel. Then the information should be shared with all hospital departments. Despite the Government having published the new pandemic communication plan, it could be useful to present it to the population. In the near future, meetings about pandemic preparedness and prevention could be organised at the local level or in collaboration with primary and secondary schools. The aim should be health education of the population. Studying the better way to reach and involve each component of communities in emergency preparedness, planning, and response activities would be a future challenge. It is essential to ensure that pandemic preparedness and risk information efforts involve all components of the community, especially those most at risk and marginalised. A deep study should be invested in the cultural and ethical aspects to be included

both in the emergency communication and in the provided measures and actions in case of emergency or during the preparation phase. Undoubtedly, a multifaceted approach is essential, involving multiple experts, and taking into account the likelihood of various hazards affecting an area during an emergency. Indeed, the measures and actions designed for various hazards often differ significantly from those appropriate for pandemics. Addressing this discrepancy should be considered one of the most challenging future directions for this research.

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APPENDIX

1.a. QUESTIONARIO RIVOLTO AI DIPENDENTI SANITARI DI MEDICINA D'URGENZA

PROGETTO DI DOTTORATO DI RICERCA DI NOEMI MARCHETTI

UNIVERSITÀ POLITECNICA DELLE MARCHE

DIPARTIMENTO DI SCIENZE DELLA VITA E DELL'AMBIENTE

LABORATORIO RIDUZIONE RISCHIO DISASTRI

UNIVERSITÀ POLITECNICA DELLE MARCHE

Gentile partecipante,

chiedo la sua cortese collaborazione per completare il seguente **questionario anonimo**. L'obiettivo di questa ricerca è quello di capire, attraverso le esperienze vissute dagli operatori sanitari durante il COVID-19, come meglio prepararsi a future emergenze pandemiche. L'attività si inserisce all'interno di un progetto di dottorato di ricerca in Protezione Civile e Ambientale, incentrato sull'analisi della pianificazione delle emergenze, intitolato: "**Diffusione di COVID-19: informare e armonizzare la preparazione e la risposta alla pandemia**". Raccogliendo informazioni riferite alle caratteristiche di ***Health System Resilience*** (Resilienza del Sistema Sanitario) nella regione Marche durante la pandemia, si spera di poter capitalizzare *le lesson learned* durante l'emergenza e possibilmente poter formulare delle linee guida mirate ad aumentare la resilienza in termini di pianificazione pandemica.

I dati forniti nei questionari saranno raccolti nel rispetto del Regolamento Europeo 2016/679 (GDPR) in materia di *privacy* e saranno utilizzati esclusivamente dalla Dottoranda Noemi Marchetti dell'Università Politecnica delle Marche. Non saranno divulgati a terzi ed i risultati saranno presentati come indici aggregati risultanti da analisi multi-criteriali.

Per maggiori informazioni contattare Noemi Marchetti all'indirizzo mail: n.marchetti@pm.univpm.it

Grazie per la collaborazione!

INFORMATIVA PER IL TRATTAMENTO DEI DATI PERSONALI NELL'AMBITO DEL PROGETTO DI DOTTORATO DI RICERCA

Il Regolamento UE 2016/679 del parlamento Europeo e del Consiglio del 27 aprile 2016, prevede la tutela delle persone fisiche rispetto al trattamento dei dati personali. Secondo la normativa indicata, tale trattamento sarà improntato ai principi di correttezza, liceità, trasparenza e di tutela della Sua riservatezza *e* dei Suoi diritti.

Titolare del trattamento dei dati è:
Università Politecnica delle Marche in persona del Magnifico Rettore pro tempore (legale rappresentante) Piazza Roma n. 22
60121 ANCONA
tel. 071.2201
E -mail: info@univpm.it
PEC: protocollo@pec.univpm.it

Ai sensi degli artt. 37 e seguenti GDPR, l'Ateneo ha nominato il Responsabile della Protezione dei Dati (RPD), contattabile ai seguenti recapiti:
Via Oberdan n. 12
60121 ANCONA Tel.: 071.2203002
E -mail: rpd@univpm.it
PEC: rpd@pec.univpm.it

Il questionario è compilato in modalità anonima e non è in alcun modo possibile ricondurre le risposte all'identità del compilatore.
Tuttavia, in virtù della risposta a particolari domande di profilo (come domanda sui dati demografici), si potrebbe restringere notevolmente il numero dei soggetti e quindi potrebbe essere possibile l'identificazione, seppure involontaria, dell'interessato. In tali casi, si provvederà ad aggregare diversamente le informazioni onde evitare che tale situazione si palesi.
I dati forniti con il questionario, ovvero le risposte fornite durante la compilazione, sono raccolti dal titolare per le finalità di analisi scientifica ed elaborazioni di indici aggregati risultanti da analisi multi-criteriali.
Tali dati non sono raccolti per essere associati ad interessati identificati.
Il titolare, in alcun modo e per nessun motivo, compirà operazione per connessione dei dati al fine di risalire alla sua identità attraverso elaborazioni e associazioni con altri dati detenuti.
La divulgazione dei risultati statistici e/o scientifici (ad esempio mediante pubblicazione di articoli scientifici e/o la creazione di banche dati, anche con modalità ad accesso aperto, partecipazione a convegni, ecc.) potrà avvenire soltanto in forma anonima e/o aggregata e comunque secondo modalità che non La rendano identificabile.

I dati sono trattati con strumenti sia cartacei che informatici, in modo tale da garantire un'adeguata sicurezza dei dati personali mediante l'utilizzo nel rispetto dei principi e delle regole concernenti le misure minime di sicurezza per evitare rischi di perdita, distruzione o accesso non autorizzato.

La gestione e la conservazione dei dati personali raccolti dall'Università Politecnica delle Marche avvengono su macchina personale della dottoranda che svolge la ricerca.

I dati in formato digitale e in formato cartaceo saranno conservati per un periodo di almeno due anni (tempo utile all'elaborazione dei dati e conclusione della ricerca).

In riferimento ai dati personali conferiti, l'interessato può esercitare i seguenti diritti:

- accesso ai propri dati personali ai sensi dell'art. 15 GDPR;
- revoca del consenso eventualmente prestato per i trattamenti non obbligatori dei dati, con la precisazione che la revoca del consenso non pregiudica la liceità del trattamento effettuato fino alla revoca stessa;

- rettifica, cancellazione o limitazione del trattamento dei dati ai sensi degli artt. 16, 17 e 18 GDPR, nei casi consentiti dalla legge;
- opposizione al trattamento dei dati, ove prevista;
- portabilità dei dati (diritto applicabile ai soli dati in formato elettronico) ai sensi dell'art. 20 GDPR;
- Al fine di esercitare i diritti di cui sopra l'interessato potrà rivolgersi al Responsabile della Protezione Dati come sopra identificato.

L'interessato al trattamento ha diritto di proporre reclamo all'Autorità Garante per la Protezione dei dati personali (www.garanteprivacy.it) ai sensi dell'art. 77 del GDPR.

QUESTIONARIO

*Le risposte alle domande del questionario possono essere di tipo **Aperte**; **Chiuse** (sì/no o scelta multipla); **Psicometriche** (domande di percezione). Su quest'ultimo tipo le chiediamo di esprimere il suo grado di accordo o disaccordo con le varie affermazioni proposte.*

*Nel questionario sono utilizzate parole come **Prevenzione** e **Gestione Pandemica**. Il termine **Prevenzione** si riferisce all'insieme delle azioni ed attività volte a ridurre morbilità, mortalità o effetti dovuti a determinati fattori di rischio, promuovendo la salute e il benessere individuale e collettivo.*

*La **Gestione** rappresenta invece l'applicazione di tecniche di problem solving (risoluzione di problemi) e decision making (capacità decisionale) per contrastare situazioni di crisi.*

1. **Precedentemente al COVID-19, lei ha avuto esperienze di emergenza epidemica o pandemica nel suo ambiente di lavoro o in altri contesti?**

Sì

No

Non ricordo

Se sì, specificare dove _____

2. **Il sistema sanitario locale e nazionale non era preparato/organizzato per fronteggiare la possibilità di un'emergenza pandemica come il COVID-19:**

☐ Completamente d'accordo

☐ D'accordo

☐ Incerto

☐ In disaccordo

☐ In completo disaccordo

3. **Nell'organizzazione della risposta al COVID-19, secondo lei che cosa è mancato e cosa poteva essere preparato meglio?**

---

4. **Quali sono stati gli aspetti positivi emersi dall'esperienza sul campo nella gestione della pandemia COVID-19? (*Lessons learned* – lezioni apprese)**

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5. **La preparazione della popolazione per fronteggiare una pandemia era adeguata:**

- ☐ Completamente d'accordo
- ☐ D'accordo
- ☐ Incerto
- ☐ In disaccordo
- ☐ In completo disaccordo

6. **La "comunicazione interna" alla struttura dove lavora è stata adeguata nella gestione dell'emergenza:**

- ☐ Completamente d'accordo
- ☐ D'accordo
- ☐ Incerto
- ☐ In disaccordo
- ☐ In completo disaccordo

7. **La "comunicazione esterna" (normative, ordinanze, mass media) è stata adeguata nella gestione dell'emergenza:**

- ☐ Completamente d'accordo
- ☐ D'accordo
- ☐ Incerto
- ☐ In disaccordo
- ☐ In completo disaccordo

8. **I social media hanno contribuito a chiarire le informazioni sulla pandemia:**

- ☐ Completamente d'accordo
- ☐ D'accordo
- ☐ Incerto
- ☐ In disaccordo
- ☐ In completo disaccordo

9. **Il personale sanitario PRIMA del COVID-19 era sufficiente alla gestione delle emergenze affrontate di consuetudine: (indicare la risposta con una X)**

Personale	**Completamente d'accordo**	**D'accordo**	**Incerto**	**In disaccordo**	**In completo disaccordo**
Specialisti					
Medici					
Infermieri					
Operatori Socio Sanitari					

10. **ATTUALMENTE, il personale sanitario è sufficiente alla gestione dell'emergenza COVID-19, oppure la condizione è peggiorata rispetto al periodo precedente la pandemia? (indicare la risposta con una X)**

Personale	Migliorata	Invariata	Peggiorata
Specialisti			
Medici			
Infermieri			
Operatori Socio Sanitari			

11. **Allo stato attuale, si ritiene che i presidi medici (DPI, caschi, ventilatori, CPAP …) a disposizione sono superiori/sovradimensionati alle necessità:**

- ☐ Completamente d'accordo
- ☐ D'accordo
- ☐ Incerto
- ☐ In disaccordo
- ☐ In completo disaccordo

12. **Investire sulla prevenzione e pianificazione, nonostante l'alto costo economico (non sempre sostenibile), è importante:**

- ☐ Completamente d'accordo
- ☐ D'accordo
- ☐ Incerto
- ☐ In disaccordo
- ☐ In completo disaccordo

13. **Durante la gestione dell'emergenza pandemica, è prevalsa esclusivamente l'etica professionale nelle azioni intraprese:**

- ☐ Completamente d'accordo
- ☐ D'accordo
- ☐ Incerto
- ☐ In disaccordo
- ☐ In completo disaccordo

Avrebbe altro da segnalare su questo aspetto dell'etica?

---

14. **Nelle attività di gestione dell'emergenza pandemica ci si sente tutelati in relazione a responsabilità e decisioni da prendere nello svolgimento della propria professione? (indicare la risposta con una X)**

	Immediatezza/prime fasi della pandemia	**Allo stato attuale**
Completamente d'accordo		
D'accordo		
Incerto		
In disaccordo		
In completo disaccordo		

15. Quale è stato il numero medio giornaliero di pazienti positivi accolti nel reparto dove lavora, durante le tre fasi riportate di seguito:

Inizio pandemia _____

Stato intermedio _____

Stato attuale _____

16. Era presente un piano di gestione pandemica a scala ospedaliera e quanto era conosciuto dal personale del suo reparto? (indicare la risposta con una X)

Esisteva un piano	**Quanto lo conoscevo**		
	Molto	**Così, così**	**Poco**
Sì			
No			
Incerto			

17. Il personale ha effettuato un corso sulla gestione dell'emergenza pandemica? (indicare la risposta con una X)

	Prima del COVID-19	**Durante la pandemia**
Sì		
No		

18. Il supporto di emergenza da remoto (es. blog, telemedicina, consulti medici a distanza…) è stato importante nella gestione pandemica:

- ☐ Completamente d'accordo
- ☐ D'accordo
- ☐ Incerto
- ☐ In disaccordo
- ☐ In completo disaccordo

19. **Il supporto delle istituzioni locali e delle organizzazioni di volontariato sul territorio sono stati fondamentali nella gestione pandemica:**

- ☐ Completamente d'accordo
- ☐ D'accordo
- ☐ Incerto
- ☐ In disaccordo
- ☐ In completo disaccordo

20. **<u>PIANIFICAZIONE DELL'EMERGENZA</u> - RIPORTI DI SEGUITO SUE LIBERE CONSIDERAZIONI CHE VORREBBE CONDIVIDERE AL FINE DI MIGLIORARE FUTURE EMERGENZE PANDEMICHE.**

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21. **<u>LEZIONI IMPARATE</u> - RIPORTI DI SEGUITO ALTRE CONSIDERAZIONI, SE VE NE SONO, CHE VORREBBE CONDIVIDERE SULLA <u>GESTIONE</u> PANDEMICA.**

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22. **<u>DIFFICOLTÀ</u> – A LIVELLO PERSONALE QUALI SONO STATI I PRINCIPALI PROBLEMI CHE HA DOVUTO AFFRONTARE DURANTE LA PANDEMIA?**

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23. QUADRO DEMOGRAFICO - Barrare le caselle di interesse:

Qual è la sua età?	**Genere**	**Qual è la sua professione?**	**Per recarsi a lavoro deve viaggiare molto?**	**Stato civile**	**Ha figli?**
< 20		**Medico specialista**	**Da 0 a 5 km**	**Sposato**	**No**
20 – 30		**Medico**	**Da 5 a 15 km**	**Convivente**	**Sì, in età 0-6 anni**
31 – 40		**Infermiere**	**Da 15 a 50 km**	**Fidanzato**	**Sì, in età 7-17 anni**
41 – 50		**Operatore Socio-Sanitario**	**Oltre (se possibile specificare)**	**Divorziato**	**Sì, maggiorenni**
51 - 60		**Altro (se possibile specificare)**		**Single**	**Preferisco non rispondere**
> 60					

La ringrazio per aver partecipato al questionario ed aver contribuito all'avanzamento della mia ricerca di dottorato.

1.b. QUESTIONNAIRE FOR HEALTHCARE EMPLOYEES IN EMERGENCY MEDICINE

DOCTORAL RESEARCH PROJECT OF NOEMI MARCHETTI

UNIVERSITÀ POLITECNICA DELLE MARCHE

DEPARTMENT OF LIFE AND ENVIRONMENTAL SCIENCE

DISASTER RISK REDUCTION LABORATORY

UNIVERSITÀ
POLITECNICA
DELLE MARCHE

Kind participant,

I ask your kind participation to complete the following anonymous questionnaire. The objective of this research is to understand, through the experience lived by health professionals during COVID-19, how to best prepare for future pandemic emergency. The activity is part of a research doctorate project in Civil and Environmental Protection, focussing on the analysis of emergency planning, entitled: "COVID-19 outbreak: informing and harmonising preparedness and response to the pandemic". By collecting information relating to the characteristics of Health System Resilience in the Marche Region during the pandemic, it is hoped to be able to capitalise on the lessons learned during the emergency and possibly be able to formulate guidelines aimed at increasing resilience in terms of pandemic planning.

The data provided in the questionnaires will be collected in compliance with the European Regulation 2016/679 (General Data Protection Regulation - GDPR) on privacy and will be used exclusively by PhD Student Noemi Marchetti of the Università Politecnica delle Marche. The data will not be disclosed to third parties and the results will be presented as aggregate indices resulting from multi-criteria analysis.

For more information, contact Noemi Marchetti at the email address: n.marchetti@pm.univpm.it

Thank you for your collaboration!

INFORMATION FOR THE PROCESSING OF PERSONAL DATA IN THE CONTEXT OF THE RESEARCH DOCTORATE PROJECT

The UE Regulation 2016/679 of the European Parliament and the Council of 27 April 2016, provides provides for the protection of individuals with respect to the processing of personal data. According to the indicated legislation, this treatment will be based on principles of correctness, lawfulness, transparency and protection of your privacy and your rights.

The data controller is:

Università Politecnica delle Marche in the person of the pro tempore Magnificent Rector (legal representative) Piazza Roma n. 22

60121 ANCONA

Tel. 071.2201

E -mail: info@univpm.it

PEC: protocollo@pec.univpm.it

The questionnaire is filled in anonymously and it is no way possible to trace the answers back to the identity of the compiler.

However, by virtue of the response to profile questions (such as a question on demographic data), the number of participants could be significantly reduced and therefore identification of them, albeit involuntary, could be possible. In such cases, the information will be aggregated differently in order to prevent this situation from happening.

The data provided with the questionnaire, or the answers provided during the compilation, are collected by the owner for the purpose of scientific analysis and processing of aggregate indices resulting from the multi-criteria analysis.

These data are not collected to be associated with identified interested parties.

The owner, in any way and for no reason, will perform an operation by connecting the data in order to trace his identity through processing and association with other data held.

The disclosure of statistical and/or scientific results (for example through the publication of scientific articles and/or the creation of databases, also with open access methods, participation in conferences, etc.) may only take place in anonymous and/or aggregate form and, in any case, in ways that do not make you identifiable.

The data are processed with both paper and informatic tools, in such a way as to guarantee adequate security of personal data through the use in compliance with the principles and rules concerning minimum security measures to avoid risks of loss, destruction or non-authorized access.

The management and storage of personal data collected by the Università Politecnica delle Marche takes place on the personal machine of the PhD Student carrying out the research.

The data in digital format and in paper format will be kept for a period of at least two years (useful time for data processing and conclusion of the research).

With reference to the personal data provided, the interested party can exercise the following rights:

- access to personal data pursuant to art. 15 GDPR;

- revocation of any consent given for non-mandatory data processing, with the specification that the withdrawal of consent does not affect the lawfulness of the processing carried out until the revocation itself;

- rectification, cancellation or limitation of data processing pursuant to art. 16, 17 and 18 GDPR, in the cases permitted by law;

- opposition to the processing of data, where provided;

- data portability (law applicable only to data in electronic format) pursuant to art. 20 GDPR;

- In order to exercise the above rights, the interested party may contact the Data Protection Officer as identified above.

The data subject has the right to lodge a complaint with the Personal Data Protection Authority (www.garanteprivacy.it) pursuant to art. 77 of the GDPR.

QUESTIONNAIRE

The answers to the questions in the questionnaire can be of the Open type; Closed (yes/no or multiple choice); Psychometric (perception questions). On the latter type, we ask you to express your degree of agreement or disagreement with the various statements proposed.

Words like Prevention and Pandemic Management are used in the questionnaire. The term Prevention refers to the set of actions and activities aimed at reducing morbidity, mortality, or effects due to certain risk factors, promoting individual and collective health and well-being. Management, on the other hand, represents the application of problem-solving techniques and decision making to counter crisis situations.

1. **Prior to COVID-19, did you have an epidemic or pandemic emergency experience in your workplace or other settings?**

Yes

No

I do not remember

If yes, specify where _____

2. **The local and national health system was not prepared/organized to deal with the possibility of a pandemic emergency such as COVID-19:**

- ☐ Completamente d'accordo
- ☐ D'accordo
- ☐ Incerto
- ☐ In disaccordo
- ☐ In completo disaccordo

3. **In organizing the response to COVID-19, what do you think was missing and what could have been better prepared?**

---

4. **What were the positive aspects that emerged from the experience in the field in the management of the COVID-19 pandemic? (Lessons learned)**

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5. **Preparation of the population for a pandemic was adequate:**

- ☐ Completamente d'accordo
- ☐ D'accordo
- ☐ Incerto
- ☐ In disaccordo
- ☐ In completo disaccordo

6. **The "internal communication" of the facility where you work has been adequate in the management of the emergency:**

- ☐ Completamente d'accordo
- ☐ D'accordo
- ☐ Incerto
- ☐ In disaccordo
- ☐ In completo disaccordo

7. **The "external communication" (regulations, ordinances, mass media) was adequate in the management of the emergency:**

- ☐ Completamente d'accordo
- ☐ D'accordo
- ☐ Incerto
- ☐ In disaccordo
- ☐ In completo disaccordo

8. **Social media helped clarify information on the pandemic:**

- ☐ Completamente d'accordo
- ☐ D'accordo
- ☐ Incerto
- ☐ In disaccordo
- ☐ In completo disaccordo

9. **The health personnel BEFORE COVID-19 were sufficient to manage the emergencies usually faced: (indicate the answer with an X)**

Personnel	Completely agree	Agree	Uncertain	Disagree	Completely disagree
Specialists					
Doctors					
Nurses					
Social Health Operators					

10. **CURRENTLY, are health personnel sufficient to manage the COVID-19 emergency, or has the condition worsened compared to the period prior to the pandemic? (Indicate the answer with an X)**

Personnel	Improved	Unchanged	Worsened
Specialists			
Doctors			
Nurses			
Social Health Operators			

11. At present, it is believed that the medical devices (PPE, helmets, ventilators, CPAP ...) available are superior/oversized to the needs:

- ☐ Completamente d'accordo
- ☐ D'accordo
- ☐ Incerto
- ☐ In disaccordo
- ☐ In completo disaccordo

12. Investing in prevention and planning, despite the high economic cost (not always sustainable), is important:

- ☐ Completamente d'accordo
- ☐ D'accordo
- ☐ Incerto
- ☐ In disaccordo
- ☐ In completo disaccordo

13. During the management of the pandemic emergency, only professional ethics prevailed in the actions taken:

- ☐ Completamente d'accordo
- ☐ D'accordo
- ☐ Incerto
- ☐ In disaccordo
- ☐ In completo disaccordo

Would you have anything else to report on this aspect of ethics? ----------
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14. **In pandemic emergency management activities, do you feel protected regarding the responsibilities and decisions to be made in carrying out your profession? (Indicate the answer with an X)**

	Immeditaly / early stage of pandemic	**At the current state**
Completely agree		
Agree		
Uncertain		
Disagree		
Completely disagree		

15. **What was the average daily number of positive patients admitted to the ward where you work, during the following three phases:**

    Early stage of pandemic _____

    Intermediate state of pandemic _____

    The current state _____

16. **Was there a hospital-wide pandemic management plan in place and how much was known to the staff in your ward? (Indicate the answer with an X)**

There was a plan	**How much did I know it**		
	Very	**So and so**	**Little**
Yes			
No			
Uncertain			

17. **Did the staff take a course on pandemic emergency management? (Indicate the answer with an X)**

	Before COVID-19	**During the pandemic**
Yes		
No		

18. **Remote emergency support (e.g., blogs, telemedicine, remote medical consultations...) was important in pandemic management:**

- ☐ Completamente d'accordo
- ☐ D'accordo
- ☐ Incerto
- ☐ In disaccordo
- ☐ In completo disaccordo

19. **The support of local institutions and voluntary organizations in the area were fundamental in the pandemic management:**

- ☐ Completamente d'accordo
- ☐ D'accordo
- ☐ Incerto
- ☐ In disaccordo
- ☐ In completo disaccordo

20. **EMERGENCY PLANNING - REPORT BELOW YOUR FREE CONSIDERATIONS THAT YOU WOULD LIKE TO SHARE IN ORDER TO IMPROVE FUTURE PANDEMIC EMERGENCIES.**

----

21. LESSONS LEARNED - MORE CONSIDERATIONS, IF THERE ARE, THAT YOU WOULD LIKE TO SHARE ABOUT PANDEMIC MANAGEMENT BELOW.

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22. DIFFICULTY - ON A PERSONAL LEVEL WHAT WERE THE MAIN PROBLEMS YOU HAD TO FACE DURING THE PANDEMIC?

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23. DEMOGRAPHIC FRAMEWORK - Tick the boxes of interest:

How old are you?	Gender	What is your job?	Do you have to travel a lot to get to work?	Marital status	Do you have children?
< 20		Specialist	From 0 to 5 km	Married	No
20 – 30		Doctor	From 5 to 15 km	Cohabitant	Yes, at the age of 0-6 year
31 – 40		Nurse	From 15 to 50 km	Fiancé	Yes, at the age of 7-17 year
41 – 50		Social-Health Operator	Over (specify if it is possible)	Divorced	Yes, of age
51 - 60		Other (specify if it is possible)		Single	Rather not answer
> 60					

Thank you for participating in the questionnaire and contributing to the advancement of my doctoral research.

2. PRISMA statement checklist

From Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. For more information, visit: http://www.prisma-statement.org/

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	

Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	
Study characteristics	17	Cite each included study and present its characteristics.	
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	

Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	
	23b	Discuss any limitations of the evidence included in the review.	
	23c	Discuss any limitations of the review processes used.	
	23d	Discuss implications of the results for practice, policy, and future research.	
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	
Competing interests	26	Declare any competing interests of review authors.	
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	

STEP 1 - identify the indicator matrix

	Health & Safety																
	0,2																
	Number o	Number o	Emergenc	Informati	Coordinat	Medical s	Physicians	Nurse	Social wo	Interdisci	Medicine	Triage tag	Tent	Number o	Helipad sp	Accessibil	Flexibility
Pesaro	0,0070	0,0750	5	5	5	0	0,0038	0,0100	0,0050	5	1	1	0	5	0	1	5
Torrette	0,0100	0,1090	5	5	5	0	0,0020	0,0060	0,0012	5	1	1	1	3	1	1	5
Jesi	0,0100	0,1090	5	5	5	0	0,0008	0,0042	0,0018	5	0	0	1	5	0	1	5
Camerino	0,0090	0,0790	5	5	5	0	0,0004	0,0003	0,0001	5	1	0	0	5	0	1	5
Fabriano	0,0100	0,1090	5	5	5	1	0,0006	0	0	5	1	0	1	4	0	1	5
Civitanova Marche	0,0090	0,0790	5	5	5	1	0,0010	0,0052	0,0029	5	1	1	1	5	0	1	5
San Benedetto del Tronto	0,0020	0,0330	5	5	5	1	0,0016	0,0012	0,0004	5	1	1	1	1	0	1	5
Condition	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
Weights	0,000412	0,000412	0,000412	0,000412	0,000412	0,000412	0,000412	0,000412	0,000412	0,000412	0,000412	0,000412	0,000412	0,000412	0,000412	0,000412	0,000412

STEP 2 - Calculate normalized Matrix (distributive normalization)

	Number o	Number o	Emergenc	Informati	Coordinat	Medical s	Physicians	Nurse	Social wo	Interdisci	Medicine	Triage tag	Tent	Number o	Helipad sp	Accessibil	Flexibility
Pesaro	0,30846	0,32027	0,37796	0,37796	0,37796	0	0,78961	0,74082	0,80835	0,37796	0,40825	0,50000	0	0,44544	0	0,37796	0,37796
Torrette	0,44065	0,46546	0,37796	0,37796	0,37796	0	0,41559	0,44449	0,19400	0,37796	0,40825	0,50000	0,44721	0,26726	1	0,37796	0,37796
Jesi	0,44065	0,46546	0,37796	0,37796	0,37796	0	0,16623	0,31115	0,29100	0,37796	0	0	0,44721	0,44544	0	0,37796	0,37796
Camerino	0,39659	0,33735	0,37796	0,37796	0,37796	0	0,08312	0,02222	0,01617	0,37796	0,40825	0	0	0,44544	0	0,37796	0,37796
Fabriano	0,44065	0,46546	0,37796	0,37796	0,37796	0,57735	0,12468	0	0	0,37796	0,40825	0,00000	0,44721	0,35635	0	0,37796	0,37796
Civitanova Marche	0,39659	0,33735	0,37796	0,37796	0,37796	0,57735	0,20779	0,38523	0,46884	0,37796	0,40825	0,50000	0,44721	0,44544	0	0,37796	0,37796
San Benedetto del Tronto	0,08813	0,14092	0,37796	0,37796	0,37796	0,57735	0,33247	0,08890	0,06467	0,37796	0,40825	0,50000	0,44721	0,08909	0	0,37796	0,37796
Normalization	0,022694	0,234177	13,22876	13,22876	13,22876	1,732051	0,004812	0,013499	0,006185	13,22876	2,44949	2	2,236068	11,22497	1	2,645751	13,22876

STEP 3 - Calculate the normalized weighted Matrix

	Number o	Number o	Emergenc	Informati	Coordinat	Medical s	Physicians	Nurse	Social wo	Interdisci	Medicine	Triage tag	Tent	Number o	Helipad sp	Accessibil	Flexibility
Pesaro	0,00363	0,00377	0,00445	0,00445	0,00445	0	0,00929	0,00872	0,00951	0,00445	0,00480	0,00588	0	0,00524	0	0,00445	0,00445
Torrette	0,00518	0,00548	0,00445	0,00445	0,00445	0	0,00489	0,00523	0,00228	0,00445	0,00480	0,00588	0,00526	0,00314	0,01176	0,00445	0,00445
Jesi	0,00518	0,00548	0,00445	0,00445	0,00445	0	0,00196	0,00366	0,00342	0,00445	0	0	0,00526	0,00524	0	0,00445	0,00445
Camerino	0,00467	0,00397	0,00445	0,00445	0,00445	0	0,00098	0,00026	0,00019	0,00445	0,00480	0	0	0,00524	0	0,00445	0,00445
Fabriano	0,00518	0,00548	0,00445	0,00445	0,00445	0,00679	0,00147	0	0	0,00445	0,00480	0	0,00526	0,00419	0	0,00445	0,00445
Civitanova Marche	0,00467	0,00397	0,00445	0,00445	0,00445	0,00679	0,00244	0,00453	0,00552	0,00445	0,00480	0,00588	0,00526	0,00524	0	0,00445	0,00445
San Benedetto del Tronto	0,00104	0,00166	0,00445	0,00445	0,00445	0,00679	0,00391	0,00105	0,00076	0,00445	0,00480	0,00588	0,00526	0,00105	0	0,00445	0,00445

STEP 4 - Calculate the worst and ideal

ideal v+	0,00518	0,00548	0,00445	0,00445	0,00445	0,00679	0,00929	0,00872	0,00951	0,00445	0,00480	0,00588	0,00526	0,00524	0,01176	0,00445	0,00445
the worst v-	0,00104	0,00166	0,00445	0,00445	0,00445	0	0,00098	0	0	0,00445	0	0	0	0,00105	0	0,00445	0,00445

STEP 1 - identify the indicator matrix						
	Political & Economic					
	0,2					
	Partnership	Governanc	Human righ	Aid suppor	Aid continu	Multi-stake
Pesaro	1	0	1	1	1	1
Torrette	1	0	1	1	1	1
Jesi	1	0	1	1	1	1
Camerino	1	0	1	1	1	1
Fabriano	1	0	1	1	1	1
Civitanova Marche	1	0	1	1	1	1
San Benedetto del Tronto	1	0	1	1	1	1
Condition	MAX	MAX	MAX	MAX	MAX	MAX
Weights	0,0333333	0,0333333	0,0333333	5	0,0333333	0,0333333

STEP 2 - Calculate normalized Matrix (distributive normalization)						
	Partnership	Governanc	Human righ	Aid suppor	Aid continu	Multi-stake
Pesaro	0,37796	0	0,37796	0,37796	0,37796	0,37796
Torrette	0,37796	0	0,37796	0,37796	0,37796	0,37796
Jesi	0,37796	0	0,37796	0,37796	0,37796	0,37796
Camerino	0,37796	0	0,37796	0,37796	0,37796	0,37796
Fabriano	0,37796	0	0,37796	0,37796	0,37796	0,37796
Civitanova Marche	0,37796	0	0,37796	0,37796	0,37796	0,37796
San Benedetto del Tronto	0,37796	0	0,37796	0,37796	0,37796	0,37796
Normalization	2,6457513	0	2,6457513	2,6457513	2,6457513	2,6457513

STEP 3 - Calculate the normalized weighted Matrix						
	Partnership	Governanc	Human righ	Aid suppor	Aid continu	Multi-stake
Pesaro	0,01260	0	0,01260	1,88982	0,01260	0,01260
Torrette	0,01260	0	0,01260	1,88982	0,01260	0,01260
Jesi	0,01260	0	0,01260	1,88982	0,01260	0,01260
Camerino	0,01260	0	0,01260	1,88982	0,01260	0,01260
Fabriano	0,01260	0	0,01260	1,88982	0,01260	0,01260
Civitanova Marche	0,01260	0	0,01260	1,88982	0,01260	0,01260
San Benedetto del Tronto	0,01260	0	0,01260	1,88982	0,01260	0,01260

STEP 4 - Calculate the worst and ideal						
ideal v+	0,01260	0	0,01260	1,88982	0,01260	0,01260
the worst v-	0,01260	0	0,01260	1,88982	0,01260	0,01260

STEP 1 - identify the indicator matrix

	Socio-Psychological						
	0,2						
	Availabilit	Common a	Sport / rel	Psycholog	Psycholog	Ethical pri	Social orga
Pesaro	1	1	1	1	1	1	0
Torrette	0	0	0	1	1	1	1
Jesi	1	1	1	1	1	1	1
Camerino	0	1	0	0	0	1	1
Fabriano	1	1	0	0	0	1	1
Civitanova Marche	1	0	0	1	1	1	1
San Benedetto del Tronto	0	1	1	1	1	1	1
Condition	MAX	MAX	MAX	MAX	MAX	MAX	MAX
Weights	0,028571	0,028571	0,028571	0,028571	0,028571	0,028571	0,028571

STEP 2 - Calculate normalized Matrix (distributive normalization)

	Availabilit	Common a	Sport / rel	Psycholog	Psycholog	Ethical pri	Social orga
Pesaro	0,50	0,44721	0,57735	0,44721	0,44721	0,37796	0
Torrette	0	0	0	0,44721	0,44721	0,37796	0,40825
Jesi	0,50	0,44721	0,57735	0,44721	0,44721	0,37796	0,40825
Camerino	0,00	0,44721	0	0	0	0,37796	0,40825
Fabriano	0,50	0,44721	0	0	0	0,37796	0,40825
Civitanova Marche	0,50	0	0	0,44721	0,44721	0,37796	0,40825
San Benedetto del Tronto	0	0,44721	0,57735	0,44721	0,44721	0,37796	0,40825
Normalization	2	2,236068	1,732051	2,236068	2,236068	2,645751	2,44949

STEP 3 - Calculate the normalized weighted Matrix

	Availabilit	Common a	Sport / rel	Psycholog	Psycholog	Ethical pri	Social orga
Pesaro	0,01429	0,01278	0,01650	0,01278	0,01278	0,01080	0
Torrette	0	0	0	0,01278	0,01278	0,01080	0,01166
Jesi	0,01429	0,01278	0,01650	0,01278	0,01278	0,01080	0,01166
Camerino	0,00000	0,01278	0	0	0	0,01080	0,01166
Fabriano	0,01429	0,01278	0	0	0	0,01080	0,01166
Civitanova Marche	0,01429	0	0	0,01278	0,01278	0,01080	0,01166
San Benedetto del Tronto	0	0,01278	0,01650	0,01278	0,01278	0,01080	0,01166

STEP 4 - Calculate the worst and ideal

ideal v+	0,01429	0,01278	0,01650	0,01278	0,01278	0,01080	0,01166
the worst v-	0	0	0	0	0	0,01080	0

STEP 1 - identify the indicator matrix

	Demographic										
	0,2										
	Mean age	Gender m	Gender fe	Resident	Populatio	Active po	Commutir	Commutir	Commutir	Commutir	Populatio
Pesaro	46,6	49	51	35,6497	138,8300	63	3,61	0,45	8,1	2,01	70,9
Torrette	46,9	48	52	46,7451	238,1000	62	2,98	0,25	6,27	1,49	70,9
Jesi	46,9	48	52	46,7451	238,1000	62	2,98	0,25	6,27	1,49	70,9
Camerino	47	49	51	31,0815	111,8300	63	1,68	0,42	3,29	1,56	70,9
Fabriano	46,9	48	52	46,7451	238,1000	62	2,98	0,25	6,27	1,49	70,9
Civitanova Marche	47	49	51	31,0815	111,8300	63	1,68	0,42	3,29	1,56	70,9
San Benedetto del Tronto	47,3	49	51	20,6172	167,8600	64	2,68	0,6	4,71	3	70,9
Condition	MIN	MIN	MAX	MIN	MIN	MAX	MIN	MIN	MIN	MIN	MAX
Weights	0,018182	0,018182	0,018182	0,018182	0,018182	0,018182	0,018182	0,018182	0,018182	0,018182	0,018182

STEP 2 - Calculate normalized Matrix (distributive normalization)

	Age group	Gender m	Gender fe	Resident	Populatio	Active po	Commutir	Commutir	Commutir	Commutir	Populatio
Pesaro	0,37520	0,38128	0,37480	0,35327	0,28190	0,37966	0,49822	0,42851	0,53717	0,40552	0,37796
Torrette	0,37762	0,37350	0,38215	0,46322	0,48347	0,37364	0,41128	0,23806	0,41581	0,30061	0,37796
Jesi	0,37762	0,37350	0,38215	0,46322	0,48347	0,37364	0,41128	0,23806	0,41581	0,30061	0,37796
Camerino	0,37842	0,38128	0,37480	0,30800	0,22707	0,37966	0,23186	0,39995	0,21818	0,31473	0,37796
Fabriano	0,37762	0,37350	0,38215	0,46322	0,48347	0,37364	0,41128	0,23806	0,41581	0,30061	0,37796
Civitanova Marche	0,37842	0,38128	0,37480	0,30800	0,22707	0,37966	0,23186	0,39995	0,21818	0,31473	0,37796
San Benedetto del Tronto	0,38084	0,38128	0,37480	0,20431	0,34085	0,38569	0,36987	0,57135	0,31235	0,60526	0,37796
Normalization	124,2002	128,5146	136,0735	100,9128	492,4809	165,9367	7,245723	1,050143	15,07916	4,956571	187,5838

STEP 3 - Calculate the normalized weighted Matrix

	Age group	Gender m	Gender fe	Resident	Populatio	Active po	Commutir	Commutir	Commutir	Commutir	Populatio
Pesaro	0,00682	0,00693	0,00681	0,00642	0,00513	0,00690	0,00906	0,00779	0,00977	0,00737	0,00687
Torrette	0,00687	0,00679	0,00695	0,00842	0,00879	0,00679	0,00748	0,00433	0,00756	0,00547	0,00687
Jesi	0,00687	0,00679	0,00695	0,00842	0,00879	0,00679	0,00748	0,00433	0,00756	0,00547	0,00687
Camerino	0,00688	0,00693	0,00681	0,00560	0,00413	0,00690	0,00422	0,00727	0,00397	0,00572	0,00687
Fabriano	0,00687	0,00679	0,00695	0,00842	0,00879	0,00679	0,00748	0,00433	0,00756	0,00547	0,00687
Civitanova Marche	0,00688	0,00693	0,00681	0,00560	0,00413	0,00690	0,00422	0,00727	0,00397	0,00572	0,00687
San Benedetto del Tronto	0,00692	0,00693	0,00681	0,00371	0,00620	0,00701	0,00672	0,01039	0,00568	0,01100	0,00687

STEP 4 - Calculate the worst and ideal

ideal v+	0,00682	0,00679	0,00695	0,00371	0,00413	0,00701	0,00422	0,00433	0,00397	0,00547	0,00687
the worst v-	0,00692	0,00693	0,00681	0,00842	0,00879	0,00679	0,00906	0,01039	0,00977	0,01100	0,00687

STEP 1 - identify the indicator matrix

	Pandemic																						
	0,2																						
	COVID-19	Updated p	Updated p	Updated h	Maximum	COVID-19	Convertib	Continger	Overtime	Personal p	Pandemic	Previous e	Distinct rc	Supply ch	Health lite	Contact-tr	Vaccinatic	Communi	Funds (pe	Flexibility	Timelines	Remote m	Emergenc
Pesaro	0,77	0	0	1	0,0857	1	0,0010	0	42	5	1	0	1	3	4	5	5	5	1	5	5	5	5
Torrette	0,40	0	0	1	0,2083	1	0,0015	0	42	1	1	1	1	1	3	5	5	5	1	5	5	3	5
Jesi	0,40	0	0	1	0,0284	1	0,0007	0	42	3	0	0	1	3	2	5	5	4	1	5	5	5	5
Camerino	0,36	0	0	1	0,0088	1	0,0088	0	42	1	1	1	1	4	3	4	3	5	1	5	5	1	5
Fabriano	0,40	0	0	1	0,0165	1	0	0	42	5	1	0	1	5	4	5	5	4	1	5	5	4	5
Civitanova Marche	0,36	0	0	1	0,1080	1	0,0024	0	42	3	1	1	1	5	1	5	5	5	0	5	5	5	1
San Benedetto del Tronto	0,14	0	0	1	0,0526	1	0,0031	0	42	5	1	1	1	5	2	5	5	5	0	5	5	3	3
Condition	MIN	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MIN	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
Weights	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696

STEP 2 - Calculate normalized Matrix (distributive normalization)

	COVID-19	Updated p	Updated p	Updated h	Maximum	COVID-19	Convertib	Continger	Overtime	Personal p	Pandemic	Previous e	Distinct rc	Supply ch	Health lite	Contact-tr	Vaccinatic	Communi	Funds (pe	Flexibility	Timelines	Remote m	Emergenc
Pesaro	0,66229	0	0	0,37796	0,33278	0,37796	0,10177	0	0,37796	0,51299	0,40825	0	0,37796	0,28604	0,52076	0,38808	0,39653	0,39904	0,44721	0,37796	0,37796	0,47673	0,43033
Torrette	0,34405	0	0	0,37796	0,80885	0,37796	0,15266	0	0,37796	0,10260	0,40825	0,50000	0,37796	0,09535	0,39057	0,38808	0,39653	0,39904	0,44721	0,37796	0,37796	0,28604	0,43033
Jesi	0,34405	0	0	0,37796	0,11028	0,37796	0,07124	0	0,37796	0,30779	0	0	0,37796	0,28604	0,26038	0,38808	0,39653	0,31923	0,44721	0,37796	0,37796	0,47673	0,43033
Camerino	0,30964	0	0	0,37796	0,03417	0,37796	0,89558	0	0,37796	0,10260	0,40825	0,50000	0,37796	0,38139	0,39057	0,31046	0,23792	0,39904	0,44721	0,37796	0,37796	0,09535	0,43033
Fabriano	0,34405	0	0	0,37796	0,06407	0,37796	0	0	0,37796	0,51299	0,40825	0	0,37796	0,47673	0,52076	0,38808	0,39653	0,31923	0,44721	0,37796	0,37796	0,38139	0,43033
Civitanova Marche	0,30964	0	0	0,37796	0,41937	0,37796	0,24425	0	0,37796	0,30779	0,40825	0,50000	0,37796	0,47673	0,13019	0,38808	0,39653	0,39904	0	0,37796	0,37796	0,47673	0,08607
San Benedetto del Tronto	0,12042	0	0	0,37796	0,20425	0,37796	0,31549	0	0,37796	0,51299	0,40825	0,50000	0,37796	0,47673	0,26038	0,38808	0,39653	0,39904	0	0,37796	0,37796	0,28604	0,25820
Normalization	1,162626	0	0	2,645751	0,257527	2,645751	0,009826	0	111,1216	9,746794	2,44949	2	2,645751	10,48809	7,681146	12,8841	12,60952	12,52996	2,236068	13,22876	13,22876	10,48809	11,61895

STEP 3 - Calculate the normalized weighted Matrix

	COVID-19	Updated p	Updated p	Updated h	Maximum	COVID-19	Convertib	Continger	Overtime	Personal p	Pandemic	Previous e	Distinct rc	Supply ch	Health lite	Contact-tr	Vaccinatic	Communi	Funds (pe	Flexibility	Timelines	Remote m	Emergenc
Pesaro	0,00576	0	0	0,00329	0,00289	0,00329	0,00088	0	0,00329	0,00446	0,00355	0	0,00329	0,00249	0,00453	0,00337	0,00345	0,00347	0,00389	0,00329	0,00329	0,00415	0,00374
Torrette	0,00299	0	0	0,00329	0,00703	0,00329	0,00133	0	0,00329	0,00089	0,00355	0,00435	0,00329	0,00083	0,00340	0,00337	0,00345	0,00347	0,00389	0,00329	0,00329	0,00249	0,00374
Jesi	0,00299	0	0	0,00329	0,00096	0,00329	0,00062	0	0,00329	0,00268	0	0	0,00329	0,00249	0,00226	0,00337	0,00345	0,00278	0,00389	0,00329	0,00329	0,00415	0,00374
Camerino	0,00269	0	0	0,00329	0,00030	0,00329	0,00779	0	0,00329	0,00089	0,00355	0,00435	0,00329	0,00332	0,00340	0,00270	0,00207	0,00347	0,00389	0,00329	0,00329	0,00083	0,00374
Fabriano	0,00299	0	0	0,00329	0,00056	0,00329	0	0	0,00329	0,00446	0,00355	0	0,00329	0,00415	0,00453	0,00337	0,00345	0,00278	0,00389	0,00329	0,00329	0,00332	0,00374
Civitanova Marche	0,00269	0	0	0,00329	0,00365	0,00329	0,00212	0	0,00329	0,00268	0,00355	0,00435	0,00329	0,00415	0,00113	0,00337	0,00345	0,00347	0	0,00329	0,00329	0,00415	0,00075
San Benedetto del Tronto	0,00105	0	0	0,00329	0,00178	0,00329	0,00274	0	0,00329	0,00446	0,00355	0,00435	0,00329	0,00415	0,00226	0,00337	0,00345	0,00347	0	0,00329	0,00329	0,00249	0,00225

STEP 4 - Calculate the worst and ideal

ideal v+	0,00105	0	0	0,00329	0,00703	0,00329	0,00779	0	0,00329	0,00446	0,00355	0,00435	0,00329	0,00415	0,00453	0,00337	0,00345	0,00347	0,00389	0,00329	0,00329	0,00415	0,00374
the worst v-	0,00576	0	0	0,00329	0,00030	0,00329	0	0	0,00329	0,00089	0	0	0,00329	0,00083	0,00113	0,00270	0,00207	0,00278	0	0,00329	0,00329	0,00083	0,00075

STEP 5 - Calculate the Euclidean distance from the ideal/worst			STEP 6 - Calculate the relative closeness coefficient (Pi) or performance score	Final rank
Si+ (ideal)	Si- (antiideal)		Pi	
0,023	0,038		0,617	1
0,030	0,031		0,507	5
0,024	0,037		0,606	2
0,037	0,025		0,402	7
0,035	0,028		0,451	6
0,027	0,033		0,547	4
0,027	0,034		0,563	3

STEP 1 - identify the indicator matrix

	Health & Safety																
	0,20																
	Number o	Number o	Emergenc	Informati	Coordinat	Medical s	Physician	Nurse	Social wor	Interdisci	Medicine	Triage tag	Tent	Number o	Helipad sp	Accessibil	Flexibility
Pesaro	0,00400	0,14000	5	5	5	0	0,00380	0,01000	0,00500	5	1	1	0	5	0	1	5
Torrette	0,00700	0,20100	5	5	5	0	0,00200	0,00600	0,00120	5	1	1	1	3	1	1	5
Jesi	0,01000	0,10900	5	5	5	0	0,00080	0,00420	0,00180	5	0	0	1	5	0	1	5
Camerino	0,00900	0,07900	5	5	5	0	0,00040	0,00030	0,00010	5	1	0	0	5	0	1	5
Fabriano	0,01000	0,10900	5	5	5	1	0,00060	0	0	5	1	0	1	4	0	1	5
Civitanova Marche	0,00500	0,14100	5	5	5	1	0,00100	0,00520	0,00290	5	1	1	1	5	0	1	5
San Benedetto del Tronto	0,00200	0,12600	5	5	5	1	0,00160	0,00120	0,00040	5	1	1	1	1	0	1	5
Condition	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
Weights	0,011765	0,011765	0,011765	0,011765	0,011765	0,011765	0,011765	0,011765	0,011765	0,011765	0,011765	0,011765	0,011765	0,011765	0,011765	0,011765	0,011765

STEP 2 - Calculate normalized Matrix (distributive normalization)

	Number o	Number o	Emergenc	Informati	Coordinat	Medical s	Physician	Nurse	Social wor	Interdisci	Medicine	Triage tag	Tent	Number o	Helipad sp	Accessibil	Flexibility
Pesaro	0,20656	0,39478	0,37796	0,37796	0,37796	0	0,78961	0,74082	0,80835	0,37796	0,40825	0,5	0	0,44544	0	0,37796	0,37796
Torrette	0,36148	0,56679	0,37796	0,37796	0,37796	0	0,41559	0,44449	0,19400	0,37796	0,40825	0,5	0,44721	0,26726	1	0,37796	0,37796
Jesi	0,51640	0,30736	0,37796	0,37796	0,37796	0	0,16623	0,31115	0,29100	0,37796	0,00000	0	0,44721	0,44544	0	0,37796	0,37796
Camerino	0,46476	0,22277	0,37796	0,37796	0,37796	0	0,08312	0,02222	0,01617	0,37796	0,40825	0	0,00000	0,44544	0	0,37796	0,37796
Fabriano	0,51640	0,30736	0,37796	0,37796	0,37796	0,57735	0,12468	0,00000	0,00000	0,37796	0,40825	0	0,44721	0,35635	0	0,37796	0,37796
Civitanova Marche	0,25820	0,39760	0,37796	0,37796	0,37796	0,57735	0,20779	0,38523	0,46884	0,37796	0,40825	0,5	0,44721	0,44544	0	0,37796	0,37796
San Benedetto del Tronto	0,10328	0,35530	0,37796	0,37796	0,37796	0,57735	0,33247	0,08890	0,06467	0,37796	0,40825	0,5	0,44721	0,08909	0	0,37796	0,37796
Normalization	0,019365	0,354628	13,22876	13,22876	13,22876	1,732051	0,004812	0,013499	0,006185	13,22876	2,44949	2	2,236068	11,22497	1	2,645751	13,22876

STEP 3 - Calculate the normalized weighted Matrix

	Number o	Number o	Emergenc	Informati	Coordinat	Medical s	Physician	Nurse	Social wor	Interdisci	Medicine	Triage tag	Tent	Number o	Helipad sp	Accessibil	Flexibility
Pesaro	0,00243	0,00464	0,00445	0,00445	0,00445	0	0,00929	0,00872	0,00951	0,00445	0,00480	0,00588	0	0,00524	0	0,00445	0,00445
Torrette	0,00425	0,00667	0,00445	0,00445	0,00445	0	0,00489	0,00523	0,00228	0,00445	0,00480	0,00588	0,00526	0,00314	0,01176	0,00445	0,00445
Jesi	0,00608	0,00362	0,00445	0,00445	0,00445	0	0,00196	0,00366	0,00342	0,00445	0	0	0,00526	0,00524	0	0,00445	0,00445
Camerino	0,00547	0,00262	0,00445	0,00445	0,00445	0	0,00098	0,00026	0,00019	0,00445	0,00480	0	0	0,00524	0	0,00445	0,00445
Fabriano	0,00608	0,00362	0,00445	0,00445	0,00445	0,00679	0,00147	0,00000	0	0,00445	0,00480	0	0,00526	0,00419	0	0,00445	0,00445
Civitanova Marche	0,00304	0,00468	0,00445	0,00445	0,00445	0,00679	0,00244	0,00453	0,00552	0,00445	0,00480	0,00588	0,00526	0,00524	0	0,00445	0,00445
San Benedetto del Tronto	0,00122	0,00418	0,00445	0,00445	0,00445	0,00679	0,00391	0,00105	0,00076	0,00445	0,00480	0,00588	0,00526	0,00105	0	0,00445	0,00445

STEP 4 - Calculate the worst and ideal

ideal v+	0,00608	0,00667	0,00445	0,00445	0,00445	0,00679	0,00929	0,00872	0,00951	0,00445	0,00480	0,00588	0,00526	0,00524	0,01176	0,00445	0,00445
the worst v-	0,00122	0,00262	0,00445	0,00445	0,00445	0	0,00098	0	0	0,00445	0	0	0	0,00105	0	0,00445	0,00445

STEP 1 - identify the indicator matrix

	Political & Economic					
	0,20					
	Partnersh	Governan	Human rig	Aid suppo	Aid contin	Multi-stak
Pesaro	1	0	1	1	1	1
Torrette	1	0	1	1	1	1
Jesi	1	0	1	1	1	1
Camerino	1	0	1	1	1	1
Fabriano	1	0	1	1	1	1
Civitanova Marche	1	0	1	1	1	1
San Benedetto del Tronto	1	0	1	1	1	1
Condition	MAX	MAX	MAX	MAX	MAX	MAX
Weights	0,033333	0,033333	0,033333	0,033333	0,033333	0,033333

STEP 2 - Calculate normalized Matrix (distributive normalization)

	Partnersh	Governan	Human rig	Aid suppo	Aid contin	Multi-stak
Pesaro	0,37796	0	0,37796	0,37796	0,37796	0,37796
Torrette	0,37796	0	0,37796	0,37796	0,37796	0,37796
Jesi	0,37796	0	0,37796	0,37796	0,37796	0,37796
Camerino	0,37796	0	0,37796	0,37796	0,37796	0,37796
Fabriano	0,37796	0	0,37796	0,37796	0,37796	0,37796
Civitanova Marche	0,37796	0	0,37796	0,37796	0,37796	0,37796
San Benedetto del Tronto	0,37796	0	0,37796	0,37796	0,37796	0,37796
Normalization	2,645751	0	2,645751	2,645751	2,645751	2,645751

STEP 3 - Calculate the normalized weighted Matrix

	Partnersh	Governan	Human rig	Aid suppo	Aid contin	Multi-stak
Pesaro	0,01260	0	0,01260	0,01260	0,01260	0,01260
Torrette	0,01260	0	0,01260	0,01260	0,01260	0,01260
Jesi	0,01260	0	0,01260	0,01260	0,01260	0,01260
Camerino	0,01260	0	0,01260	0,01260	0,01260	0,01260
Fabriano	0,01260	0	0,01260	0,01260	0,01260	0,01260
Civitanova Marche	0,01260	0	0,01260	0,01260	0,01260	0,01260
San Benedetto del Tronto	0,01260	0	0,01260	0,01260	0,01260	0,01260

STEP 4 - Calculate the worst and ideal

ideal v+	0,01260	0	0,01260	0,01260	0,01260	0,01260
the worst v-	0,01260	0	0,01260	0,01260	0,01260	0,01260

STEP 1 - identify the indicator matrix

	Socio-Psychological						
	0,20						
	Availabilit	Common a	Sport / rel	Psycholog	Psycholog	Ethical pri	Social orga
Pesaro	1	1	1	1	1	1	0
Torrette	0	0	0	1	1	1	1
Jesi	1	1	1	1	1	1	1
Camerino	0	1	0	0	0	1	1
Fabriano	1	1	0	0	0	1	1
Civitanova Marche	1	0	0	1	1	1	1
San Benedetto del Tronto	0	1	1	1	1	1	1
Condition	MAX	MAX	MAX	MAX	MAX	MAX	MAX
Weights	0,028571	0,028571	0,028571	0,028571	0,028571	0,028571	0,028571

STEP 2 - Calculate normalized Matrix (distributive normalization)

	Availabilit	Common a	Sport / rel	Psycholog	Psycholog	Ethical pri	Social orga
Pesaro	0,50	0,44721	0,57735	0,44721	0,44721	0,37796	0
Torrette	0,00	0	0	0,44721	0,44721	0,37796	0,40825
Jesi	0,50	0,44721	0,57735	0,44721	0,44721	0,37796	0,40825
Camerino	0,00	0,44721	0	0	0	0,37796	0,40825
Fabriano	0,50	0,44721	0	0	0	0,37796	0,40825
Civitanova Marche	0,50	0	0	0,44721	0,44721	0,37796	0,40825
San Benedetto del Tronto	0,00	0,44721	0,57735	0,44721	0,44721	0,37796	0,40825
Normalization	2	2,236068	1,732051	2,236068	2,236068	2,645751	2,44949

STEP 3 - Calculate the normalized weighted Matrix

	Availabilit	Common a	Sport / rel	Psycholog	Psycholog	Ethical pri	Social orga
Pesaro	0,01429	0,01278	0,01650	0,01278	0,01278	0,01080	0
Torrette	0	0	0	0,01278	0,01278	0,01080	0,01166
Jesi	0,01429	0,01278	0,01650	0,01278	0,01278	0,01080	0,01166
Camerino	0	0,01278	0	0	0	0,01080	0,01166
Fabriano	0,01429	0,01278	0	0	0	0,01080	0,01166
Civitanova Marche	0,01429	0	0	0,01278	0,01278	0,01080	0,01166
San Benedetto del Tronto	0	0,01278	0,01650	0,01278	0,01278	0,01080	0,01166

STEP 4 - Calculate the worst and ideal

ideal v+	0,01429	0,01278	0,01650	0,01278	0,01278	0,01080	0,01166
the worst v-	0	0	0	0	0	0,01080	0

STEP 1 - identify the indicator matrix

	Demographic										
	0,20										
	Mean age	Gender m	Gender fe	Resident	Populatio	Active po	Commutir	Commutir	Commutir	Commutir	Populatio
Pesaro	46,7	49	51	35,327	137,58	64	3,61	0,45	8,10	2,01	70,90
Torrette	47,1	49	51	46,442	236,56	63	2,98	0,25	6,27	1,49	70,90
Jesi	46,9	48	52	46,745	238,10	62	2,98	0,25	6,27	1,49	70,90
Camerino	47	49	51	31,082	111,83	63	1,68	0,42	3,29	1,56	70,90
Fabriano	46,9	48	52	46,745	238,10	62	2,98	0,25	6,27	1,49	70,90
Civitanova Marche	47,1	49	51	30,741	110,60	63	1,68	0,42	3,29	1,56	70,90
San Benedetto del Tronto	47,6	49	51	20,343	165,63	63	2,68	0,60	4,71	3	70,90
Condition	MIN	MIN	MAX	MIN	MIN	MAX	MIN	MIN	MIN	MIN	MIN
Weights	0,018182	0,018182	0,018182	0,018182	0,018182	0,018182	0,018182	0,018182	0,018182	0,018182	0,018182

STEP 2 - Calculate normalized Matrix (distributive normalization)

	Age group	Gender m	Gender fe	Resident	Populatio	Active po	Commutir	Commutir	Commutir	Commutir	Populatio
Pesaro	0,37520	0,38016	0,37584	0,35152	0,28057	0,38482	0,49822	0,42851	0,53717	0,40552	0,37796
Torrette	0,37842	0,38016	0,37584	0,46212	0,48243	0,37880	0,41128	0,23806	0,41581	0,30061	0,37796
Jesi	0,37681	0,37241	0,38321	0,46513	0,48557	0,37279	0,41128	0,23806	0,41581	0,30061	0,37796
Camerino	0,37761	0,38016	0,37584	0,30927	0,22806	0,37880	0,23186	0,39995	0,21818	0,31473	0,37796
Fabriano	0,37681	0,37241	0,38321	0,46513	0,48557	0,37279	0,41128	0,23806	0,41581	0,30061	0,37796
Civitanova Marche	0,37842	0,38016	0,37584	0,30589	0,22555	0,37880	0,23186	0,39995	0,21818	0,31473	0,37796
San Benedetto del Tronto	0,38243	0,38016	0,37584	0,20242	0,33778	0,37880	0,36987	0,57135	0,31235	0,60526	0,37796
Normalization	124,4656	128,8914	135,6945	100,4985	490,3506	166,313	7,245723	1,050143	15,07916	4,956571	187,58

STEP 3 - Calculate the normalized weighted Matrix

	Age group	Gender m	Gender fe	Resident	Populatio	Active po	Commutir	Commutir	Commutir	Commutir	Populatio
Pesaro	0,00682	0,00691	0,00683	0,00639	0,00510	0,00700	0,00906	0,00779	0,00977	0,00737	0,00687
Torrette	0,00688	0,00691	0,00683	0,00840	0,00877	0,00689	0,00748	0,00433	0,00756	0,00547	0,00687
Jesi	0,00685	0,00677	0,00697	0,00846	0,00883	0,00678	0,00748	0,00433	0,00756	0,00547	0,00687
Camerino	0,00687	0,00691	0,00683	0,00562	0,00415	0,00689	0,00422	0,00727	0,00397	0,00572	0,00687
Fabriano	0,00685	0,00677	0,00697	0,00846	0,00883	0,00678	0,00748	0,00433	0,00756	0,00547	0,00687
Civitanova Marche	0,00688	0,00691	0,00683	0,00556	0,00410	0,00689	0,00422	0,00727	0,00397	0,00572	0,00687
San Benedetto del Tronto	0,00695	0,00691	0,00683	0,00368	0,00614	0,00689	0,00672	0,01039	0,00568	0,01100	0,00687

STEP 4 - Calculate the worst and ideal

ideal v+	0,00682	0,00677	0,00697	0,00368	0,00410	0,00700	0,00422	0,00433	0,00397	0,00547	0,00687
the worst v-	0,00695	0,00691	0,00683	0,00846	0,00883	0,00678	0,00906	0,01039	0,00977	0,01100	0,00687

STEP 1 - identify the indicator matrix

	Pandemic																						
	0,20																						
	COVID-19	Updated p	Updated p	Updated h	Maximum	COVID-19	Convertib	Continger	Overtime	Personal p	Pandemic	Previous e	Distinct ro	Supply ch	Health lite	Contact-tr	Vaccinatic	Communi	Funds (pe	Flexibility	Timelines	Remote m	Emergenc
Pesaro	5,77	1	0	1	0,0857	1	0,0010	0	42	5	1	0	1	3	4	5	5	5	1	5	5	5	5
Torrette	6,69	1	0	1	0,2083	1	0,0021	0	42	1	1	1	1	1	3	5	5	5	1	5	5	3	5
Jesi	6,69	0	0	1	0,0284	1	0,0007	0	42	3	0	0	1	3	2	5	5	4	1	5	5	5	5
Camerino	6,54	0	0	1	0,0088	1	0,0088	0	42	1	1	1	1	4	3	4	3	5	1	5	5	1	5
Fabriano	6,69	0	0	1	0,0165	1	0	0	42	5	1	0	1	5	4	5	5	4	1	5	5	4	5
Civitanova Marche	6,54	1	0	1	0,1080	1	0,0032	0	42	3	1	1	1	5	1	5	5	5	0	5	5	5	1
San Benedetto del Tronto	5,38	1	0	1	0,0526	1	0,0050	0	42	5	1	1	1	5	2	5	5	5	0	5	5	3	3
Condition	MIN	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MIN	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
Weights	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696

STEP 2 - Calculate normalized Matrix (distributive normalization)

	COVID-19	Updated p	Updated p	Updated h	Maximum	COVID-19	Convertib	Continger	Overtime	Personal p	Pandemic	Previous e	Distinct ro	Supply ch	Health lite	Contact-tr	Vaccinatic	Communi	Funds (pe	Flexibility	Timelines	Remote m	Emergenc
Pesaro	0,34357	0,50	0	0,37796	0,33278	0,37796	0,09183	0	0,37796	0,51299	0,40825	0	0,37796	0,28604	0,52076	0,38808	0,39653	0,39904	0,44721	0,37796	0,37796	0,47673	0,43033
Torrette	0,39835	0,50	0	0,37796	0,80885	0,37796	0,19285	0	0,37796	0,10260	0,40825	0,50	0,37796	0,09535	0,39057	0,38808	0,39653	0,39904	0,44721	0,37796	0,37796	0,28604	0,43033
Jesi	0,39835	0,00	0	0,37796	0,11028	0,37796	0,06428	0	0,37796	0,30779	0	0,00	0,37796	0,28604	0,26038	0,38808	0,39653	0,31923	0,44721	0,37796	0,37796	0,47673	0,43033
Camerino	0,38942	0,00	0	0,37796	0,03417	0,37796	0,80812	0	0,37796	0,10260	0,40825	0,50	0,37796	0,38139	0,39057	0,31046	0,23792	0,39904	0,44721	0,37796	0,37796	0,09535	0,43033
Fabriano	0,39835	0,00	0	0,37796	0,06407	0,37796	0	0	0,37796	0,51299	0,40825	0,00	0,37796	0,47673	0,52076	0,38808	0,39653	0,31923	0,44721	0,37796	0,37796	0,38139	0,43033
Civitanova Marche	0,38942	0,50	0	0,37796	0,41937	0,37796	0,29386	0	0,37796	0,30779	0,40825	0,50	0,37796	0,47673	0,13019	0,38808	0,39653	0,39904	0	0,37796	0,37796	0,47673	0,08607
San Benedetto del Tronto	0,32035	0,50	0	0,37796	0,20425	0,37796	0,45916	0	0,37796	0,51299	0,40825	0,50	0,37796	0,47673	0,26038	0,38808	0,39653	0,39904	0	0,37796	0,37796	0,28604	0,25820
Normalization	16,79431	2	0	2,645751	0,257527	2,645751	0,010889	0	111,1216	9,746794	2,44949	2	2,645751	10,48809	7,681146	12,8841	12,60952	12,52996	2,236068	13,22876	13,22876	10,48809	11,61895

STEP 3 - Calculate the normalized weighted Matrix

	COVID-19	Updated p	Updated p	Updated h	Maximum	COVID-19	Convertib	Continger	Overtime	Personal p	Pandemic	Previous e	Distinct ro	Supply ch	Health lite	Contact-tr	Vaccinatic	Communi	Funds (pe	Flexibility	Timelines	Remote m	Emergenc
Pesaro	0,00299	0,00435	0	0,00329	0,00289	0,00329	0,00080	0	0,00329	0,00446	0,00355	0	0,00329	0,00249	0,00453	0,00337	0,00345	0,00347	0,00389	0,00329	0,00329	0,00415	0,00374
Torrette	0,00346	0,00435	0	0,00329	0,00703	0,00329	0,00168	0	0,00329	0,00089	0,00355	0,00435	0,00329	0,00083	0,00340	0,00337	0,00345	0,00347	0,00389	0,00329	0,00329	0,00249	0,00374
Jesi	0,00346	0	0	0,00329	0,00096	0,00329	0,00056	0	0,00329	0,00268	0	0	0,00329	0,00249	0,00226	0,00337	0,00345	0,00278	0,00389	0,00329	0,00329	0,00415	0,00374
Camerino	0,00339	0	0	0,00329	0,00030	0,00329	0,00703	0	0,00329	0,00089	0,00355	0,00435	0,00329	0,00332	0,00340	0,00270	0,00207	0,00347	0,00389	0,00329	0,00329	0,00083	0,00374
Fabriano	0,00346	0	0	0,00329	0,00056	0,00329	0	0	0,00329	0,00446	0,00355	0	0,00329	0,00415	0,00453	0,00337	0,00345	0,00278	0,00389	0,00329	0,00329	0,00332	0,00374
Civitanova Marche	0,00339	0,00435	0	0,00329	0,00365	0,00329	0,00256	0	0,00329	0,00268	0,00355	0,00435	0,00329	0,00415	0,00113	0,00337	0,00345	0,00347	0	0,00329	0,00329	0,00415	0,00075
San Benedetto del Tronto	0,00279	0,00435	0	0,00329	0,00178	0,00329	0,00399	0	0,00329	0,00446	0,00355	0,00435	0,00329	0,00415	0,00226	0,00337	0,00345	0,00347	0	0,00329	0,00329	0,00249	0,00225

STEP 4 - Calculate the worst and ideal

ideal v+	0,00279	0,00435	0	0,00329	0,00703	0,00329	0,00703	0	0,00329	0,00446	0,00355	0,00435	0,00329	0,00415	0,00453	0,00337	0,00345	0,00347	0,00389	0,00329	0,00329	0,00415	0,00374
the worst v-	0,00346	0	0	0,00329	0,00030	0,00329	0	0	0,00329	0,00089	0	0	0,00329	0,00083	0,00113	0,00270	0,00207	0,00278	0	0,00329	0,00329	0,00083	0,00075

STEP 5 - Calculate the Euclidean distance from the ideal/worst				STEP 6 - Calculate the relative closeness coefficient (Pi) or performance score	Final rank
Si+ (ideal)	Si- (antiideal)			Pi	
0,023	0,038			0,622	1
0,030	0,031			0,509	5
0,024	0,036			0,602	2
0,037	0,024			0,396	7
0,035	0,028			0,447	6
0,027	0,033			0,547	4
0,026	0,035			0,567	3

STEP 1 - identify the indicator matrix

	Health & Safety																
	0,20																
	Number o	Number o	Emergenc	Informati	Coordinat	Medical s	Physicians	Nurse	Social wo	Interdisci	Medicine	Triage tag	Tent	Number o	Helipad sp	Accessibil	Flexibility
Pesaro	0,00400	0,14000	5	5	5	0	0,00380	0,01000	0,00500	5	1	1	0	5	0	1	5
Torrette	0,00700	0,20100	5	5	5	0	0,00180	0,00550	0,00060	5	1	1	1	3	1	1	5
Jesi	0,01000	0,10900	5	5	5	0	0,00080	0,00420	0,00180	5	0	0	1	5	0	1	5
Camerino	0,00900	0,07900	5	5	5	0	0,00040	0,00030	0,00010	5	1	0	0	5	0	1	5
Fabriano	0,01000	0,10900	5	5	5	1	0,00060	0	0	5	1	0	1	4	0	1	5
Civitanova Marche	0,00500	0,14100	5	5	5	1	0,00100	0,00450	0,00290	5	1	1	1	5	0	1	5
San Benedetto del Tronto	0,00200	0,12600	5	5	5	1	0,00130	0,00100	0,00040	5	1	1	1	1	0	1	5
Condition	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
Weights	0,011765	0,011765	0,011765	0,011765	0,011765	0,011765	0,011765	0,011765	0,011765	0,011765	0,011765	0,011765	0,011765	0,011765	0,011765	0,011765	0,011765
																	0,2

STEP 2 - Calculate normalized Matrix (distributive normalization)

	Number o	Number o	Emergenc	Informati	Coordinat	Medical s	Physicians	Nurse	Social wo	Interdisci	Medicine	Triage tag	Tent	Number o	Helipad sp	Accessibil	Flexibility
Pesaro	0,20656	0,39478	0,37796	0,37796	0,37796	0	0,81896	0,76871	0,82000	0,37796	0,40825	0,5	0	0,44544	0	0,37796	0,37796
Torrette	0,36148	0,56679	0,37796	0,37796	0,37796	0	0,38793	0,42279	0,09840	0,37796	0,40825	0,5	0,44721	0,26726	1	0,37796	0,37796
Jesi	0,51640	0,30736	0,37796	0,37796	0,37796	0	0,17241	0,32286	0,29520	0,37796	0	0	0,44721	0,44544	0	0,37796	0,37796
Camerino	0,46476	0,22277	0,37796	0,37796	0,37796	0	0,08621	0,02306	0,01640	0,37796	0,40825	0	0	0,44544	0	0,37796	0,37796
Fabriano	0,51640	0,30736	0,37796	0,37796	0,37796	0,57735	0,12931	0	0	0,37796	0,40825	0	0,44721	0,35635	0	0,37796	0,37796
Civitanova Marche	0,25820	0,39760	0,37796	0,37796	0,37796	0,57735	0,21552	0,34592	0,47560	0,37796	0,40825	0,5	0,44721	0,44544	0	0,37796	0,37796
San Benedetto del Tronto	0,10328	0,35530	0,37796	0,37796	0,37796	0,57735	0,28017	0,07687	0,06560	0,37796	0,40825	0,5	0,44721	0,08909	0	0,37796	0,37796
Normalization	0,019365	0,354628	13,22876	13,22876	13,22876	1,732051	0,00464	0,013009	0,006098	13,22876	2,44949	2	2,236068	11,22497	1	2,645751	13,22876

STEP 3 - Calculate the normalized weighted Matrix

	Number o	Number o	Emergenc	Informati	Coordinat	Medical s	Physicians	Nurse	Social wo	Interdisci	Medicine	Triage tag	Tent	Number o	Helipad sp	Accessibil	Flexibility
Pesaro	0,00243	0,00464	0,00445	0,00445	0,00445	0	0,00963	0,00904	0,00965	0,00445	0,00480	0,00588	0	0,00524	0	0,00445	0,00445
Torrette	0,00425	0,00667	0,00445	0,00445	0,00445	0	0,00456	0,00497	0,00116	0,00445	0,00480	0,00588	0,00526	0,00314	0,01176	0,00445	0,00445
Jesi	0,00608	0,00362	0,00445	0,00445	0,00445	0	0,00203	0,00380	0,00347	0,00445	0	0	0,00526	0,00524	0	0,00445	0,00445
Camerino	0,00547	0,00262	0,00445	0,00445	0,00445	0	0,00101	0,00027	0,00019	0,00445	0,00480	0	0	0,00524	0	0,00445	0,00445
Fabriano	0,00608	0,00362	0,00445	0,00445	0,00445	0,00679	0,00152	0,00000	0	0,00445	0,00480	0	0,00526	0,00419	0	0,00445	0,00445
Civitanova Marche	0,00304	0,00468	0,00445	0,00445	0,00445	0,00679	0,00254	0,00407	0,00560	0,00445	0,00480	0,00588	0,00526	0,00524	0	0,00445	0,00445
San Benedetto del Tronto	0,00122	0,00418	0,00445	0,00445	0,00445	0,00679	0,00330	0,00090	0,00077	0,00445	0,00480	0,00588	0,00526	0,00105	0	0,00445	0,00445

STEP 4 - Calculate the worst and ideal

ideal v+	0,00608	0,00667	0,00445	0,00445	0,00445	0,00679	0,00963	0,00904	0,00965	0,00445	0,00480	0,00588	0,00526	0,00524	0,01176	0,00445	0,00445
the worst v-	0,00122	0,00262	0,00445	0,00445	0,00445	0	0,00101	0	0	0,00445	0	0	0	0,00105	0	0,00445	0,00445

STEP 1 - identify the indicator matrix

	Political & Economic					
	0,20					
	Partnersh	Governan	Human rig	Aid suppo	Aid contin	Multi-stak
Pesaro	1	0	1	1	1	1
Torrette	1	0	1	1	1	1
Jesi	1	0	1	1	1	1
Camerino	1	0	1	1	1	1
Fabriano	1	0	1	1	1	1
Civitanova Marche	1	0	1	1	1	1
San Benedetto del Tronto	1	0	1	1	1	1
Condition	MAX	MAX	MAX	MAX	MAX	MAX
Weights	0,033333	0,033333	0,033333	0,033333	0,033333	0,033333

STEP 2 - Calculate normalized Matrix (distributive normalization)

	Partnersh	Governan	Human rig	Aid suppo	Aid contin	Multi-stak
Pesaro	0,37796	0	0,37796	0,37796	0,37796	0,37796
Torrette	0,37796	0	0,37796	0,37796	0,37796	0,37796
Jesi	0,37796	0	0,37796	0,37796	0,37796	0,37796
Camerino	0,37796	0	0,37796	0,37796	0,37796	0,37796
Fabriano	0,37796	0	0,37796	0,37796	0,37796	0,37796
Civitanova Marche	0,37796	0	0,37796	0,37796	0,37796	0,37796
San Benedetto del Tronto	0,37796	0	0,37796	0,37796	0,37796	0,37796
Normalization	2,645751	0	2,645751	2,645751	2,645751	2,645751

STEP 3 - Calculate the normalized weighted Matrix

	Partnersh	Governan	Human rig	Aid suppo	Aid contin	Multi-stak
Pesaro	0,01260	0	0,01260	0,01260	0,01260	0,01260
Torrette	0,01260	0	0,01260	0,01260	0,01260	0,01260
Jesi	0,01260	0	0,01260	0,01260	0,01260	0,01260
Camerino	0,01260	0	0,01260	0,01260	0,01260	0,01260
Fabriano	0,01260	0	0,01260	0,01260	0,01260	0,01260
Civitanova Marche	0,01260	0	0,01260	0,01260	0,01260	0,01260
San Benedetto del Tronto	0,01260	0	0,01260	0,01260	0,01260	0,01260

STEP 4 - Calculate the worst and ideal

ideal v+	0,01260	0	0,01260	0,01260	0,01260	0,01260
the worst v-	0,01260	0	0,01260	0,01260	0,01260	0,01260

STEP 1 - identify the indicator matrix

	Socio-Psychological						
	0,20						
	Availabilit	Common a	Sport / rel	Psycholog	Psycholog	Ethical pri	Social orga
Pesaro	1	1	1	1	1	1	0
Torrette	0	0	0	1	1	1	1
Jesi	1	1	1	1	1	1	1
Camerino	0	1	0	0	0	1	1
Fabriano	1	1	0	0	0	1	1
Civitanova Marche	1	0	0	1	1	1	1
San Benedetto del Tronto	0	1	1	1	1	1	1
Condition	MAX	MAX	MAX	MAX	MAX	MAX	MAX
Weights	0,028571	0,028571	0,028571	0,028571	0,028571	0,028571	0,028571

STEP 2 - Calculate normalized Matrix (distributive normalization)

	Availabilit	Common a	Sport / rel	Psycholog	Psycholog	Ethical pri	Social orga
Pesaro	0,50	0,44721	0,57735	0,44721	0,44721	0,37796	0
Torrette	0,00	0	0	0,44721	0,44721	0,37796	0,40825
Jesi	0,50	0,44721	0,57735	0,44721	0,44721	0,37796	0,40825
Camerino	0,00	0,44721	0	0	0	0,37796	0,40825
Fabriano	0,50	0,44721	0	0	0	0,37796	0,40825
Civitanova Marche	0,50	0	0	0,44721	0,44721	0,37796	0,40825
San Benedetto del Tronto	0,00	0,44721	0,57735	0,44721	0,44721	0,37796	0,40825
Normalization	2	2,236068	1,732051	2,236068	2,236068	2,645751	2,44949

STEP 3 - Calculate the normalized weighted Matrix

	Availabilit	Common a	Sport / rel	Psycholog	Psycholog	Ethical pri	Social orga
Pesaro	0,01429	0,01278	0,01650	0,01278	0,01278	0,01080	0
Torrette	0	0	0	0,01278	0,01278	0,01080	0,01166
Jesi	0,01429	0,01278	0,01650	0,01278	0,01278	0,01080	0,01166
Camerino	0	0,01278	0	0	0	0,01080	0,01166
Fabriano	0,01429	0,01278	0	0	0	0,01080	0,01166
Civitanova Marche	0,01429	0	0	0,01278	0,01278	0,01080	0,01166
San Benedetto del Tronto	0	0,01278	0,01650	0,01278	0,01278	0,01080	0,01166

STEP 4 - Calculate the worst and ideal

ideal v+	0,01429	0,01278	0,01650	0,01278	0,01278	0,01080	0,01166
the worst v-	0	0	0	0	0	0,01080	0

STEP 1 - identify the indicator matrix

	Demographic										
	0,20										
	Mean age	Gender m	Gender fe	Resident	Populatio	Active po	Commutir	Commutir	Commutir	Commutir	Populatio
Pesaro	46,7	49	51	35,327	137,58	64	3,61	0,45	8,10	2,01	70,90
Torrette	47,1	49	51	46,442	236,56	63	2,98	0,25	6,27	1,49	70,90
Jesi	46,9	48	52	46,745	238,10	62	2,98	0,25	6,27	1,49	70,90
Camerino	47	49	51	31,082	111,83	63	1,68	0,42	3,29	1,56	70,90
Fabriano	46,9	48	52	46,745	238,10	62	2,98	0,25	6,27	1,49	70,90
Civitanova Marche	47,1	49	51	30,741	110,60	63	1,68	0,42	3,29	1,56	70,90
San Benedetto del Tronto	47,6	49	51	20,343	165,63	63	2,68	0,60	4,71	3	70,90
Condition	MIN	MIN	MAX	MIN	MIN	MAX	MIN	MIN	MIN	MIN	MIN
Weights	0,018182	0,018182	0,018182	0,018182	0,018182	0,018182	0,018182	0,018182	0,018182	0,018182	0,018182

STEP 2 - Calculate normalized Matrix (distributive normalization)

	Age group	Gender m	Gender fe	Resident	Populatio	Active po	Commutir	Commutir	Commutir	Commutir	Populatio
Pesaro	0,37520	0,38016	0,37584	0,35152	0,28057	0,38482	0,49822	0,42851	0,53717	0,40552	0,37796
Torrette	0,37842	0,38016	0,37584	0,46212	0,48243	0,37880	0,41128	0,23806	0,41581	0,30061	0,37796
Jesi	0,37681	0,37241	0,38321	0,46513	0,48557	0,37279	0,41128	0,23806	0,41581	0,30061	0,37796
Camerino	0,37761	0,38016	0,37584	0,30927	0,22806	0,37880	0,23186	0,39995	0,21818	0,31473	0,37796
Fabriano	0,37681	0,37241	0,38321	0,46513	0,48557	0,37279	0,41128	0,23806	0,41581	0,30061	0,37796
Civitanova Marche	0,37842	0,38016	0,37584	0,30589	0,22555	0,37880	0,23186	0,39995	0,21818	0,31473	0,37796
San Benedetto del Tronto	0,38243	0,38016	0,37584	0,20242	0,33778	0,37880	0,36987	0,57135	0,31235	0,60526	0,37796
Normalization	124,4656	128,8914	135,6945	100,4985	490,3506	166,313	7,245723	1,050143	15,07916	4,956571	187,58

STEP 3 - Calculate the normalized weighted Matrix

	Age group	Gender m	Gender fe	Resident	Populatio	Active po	Commutir	Commutir	Commutir	Commutir	Populatio
Pesaro	0,00682	0,00691	0,00683	0,00639	0,00510	0,00700	0,00906	0,00779	0,00977	0,00737	0,00687
Torrette	0,00688	0,00691	0,00683	0,00840	0,00877	0,00689	0,00748	0,00433	0,00756	0,00547	0,00687
Jesi	0,00685	0,00677	0,00697	0,00846	0,00883	0,00678	0,00748	0,00433	0,00756	0,00547	0,00687
Camerino	0,00687	0,00691	0,00683	0,00562	0,00415	0,00689	0,00422	0,00727	0,00397	0,00572	0,00687
Fabriano	0,00685	0,00677	0,00697	0,00846	0,00883	0,00678	0,00748	0,00433	0,00756	0,00547	0,00687
Civitanova Marche	0,00688	0,00691	0,00683	0,00556	0,00410	0,00689	0,00422	0,00727	0,00397	0,00572	0,00687
San Benedetto del Tronto	0,00695	0,00691	0,00683	0,00368	0,00614	0,00689	0,00672	0,01039	0,00568	0,01100	0,00687

STEP 4 - Calculate the worst and ideal

ideal v+	0,00682	0,00677	0,00697	0,00368	0,00410	0,00700	0,00422	0,00433	0,00397	0,00547	0,00687
the worst v-	0,00695	0,00691	0,00683	0,00846	0,00883	0,00678	0,00906	0,01039	0,00977	0,01100	0,00687

STEP 1 - identify the indicator matrix

	Pandemic																						
	0,20																						
	COVID-19	Updated p	Updated p	Updated h	Maximum	COVID-19	Convertib	Continger	Overtime	Personal p	Pandemic	Previous e	Distinct rc	Supply ch	Health lite	Contact-tr	Vaccinatic	Communi	Funds (pe	Flexibility	Timelines	Remote m	Emergenc
Pesaro	15,34	1	1	1	0,08570	1	0,0010	0	0	5	1	0	1	3	4	5	5	5	1	5	5	5	5
Torrette	18,48	1	1	1	0,20830	1	0,0021	0	0	1	1	1	1	1	3	5	5	5	1	5	5	3	5
Jesi	18,48	0	0	1	0,02840	1	0,0007	0	42	3	0	0	1	3	2	5	5	4	1	5	5	5	5
Camerino	18,20	0	0	1	0,00880	1	0,0088	0	42	1	1	1	1	4	3	4	3	5	1	5	5	1	5
Fabriano	18,48	0	0	1	0,01650	1	0	0	42	5	1	0	1	5	4	5	5	4	1	5	5	4	5
Civitanova Marche	18,20	1	1	1	0,10800	1	0,0032	0	0	3	1	1	1	5	1	5	5	5	0	5	5	5	1
San Benedetto del Tronto	20,04	1	1	1	0,05260	1	0,0050	0	0	5	1	1	1	5	2	5	5	5	0	5	5	3	3
Condition	MIN	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MIN	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
Weights	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696	0,008696

STEP 2 - Calculate normalized Matrix (distributive normalization)

	COVID-19	Updated p	Updated p	Updated h	Maximum	COVID-19	Convertib	Continger	Overtime	Personal p	Pandemic	Previous e	Distinct rc	Supply ch	Health lite	Contact-tr	Vaccinatic	Communi	Funds (pe	Flexibility	Timelines	Remote m	Emergenc
Pesaro	0,31821	0,50000	0,50000	0,37796	0,33278	0,37796	0,09183	0	0	0,51299	0,40825	0	0,37796	0,28604	0,52076	0,38808	0,39653	0,39904	0,44721	0,37796	0,37796	0,47673	0,43033
Torrette	0,38335	0,50000	0,50000	0,37796	0,80885	0,37796	0,19285	0	0	0,10260	0,40825	0,50000	0,37796	0,09535	0,39057	0,38808	0,39653	0,39904	0,44721	0,37796	0,37796	0,28604	0,43033
Jesi	0,38335	0	0	0,37796	0,11028	0,37796	0,06428	0	0,57735	0,30779	0	0	0,37796	0,28604	0,26038	0,38808	0,39653	0,31923	0,44721	0,37796	0,37796	0,47673	0,43033
Camerino	0,37754	0	0	0,37796	0,03417	0,37796	0,80812	0	0,57735	0,10260	0,40825	0,50000	0,37796	0,38139	0,39057	0,31046	0,23792	0,39904	0,44721	0,37796	0,37796	0,09535	0,43033
Fabriano	0,38335	0	0	0,37796	0,06407	0,37796	0	0	0,57735	0,51299	0,40825	0	0,37796	0,47673	0,52076	0,38808	0,39653	0,31923	0,44721	0,37796	0,37796	0,38139	0,43033
Civitanova Marche	0,37754	0,50000	0,50000	0,37796	0,41937	0,37796	0,29386	0	0	0,30779	0,40825	0,50000	0,37796	0,47673	0,13019	0,38808	0,39653	0,39904	0	0,37796	0,37796	0,47673	0,08607
San Benedetto del Tronto	0,41571	0,50000	0,50000	0,37796	0,20425	0,37796	0,45916	0	0	0,51299	0,40825	0,50000	0,37796	0,47673	0,26038	0,38808	0,39653	0,39904	0	0,37796	0,37796	0,28604	0,25820
Normalization	48,20714	2	2	2,645751	0,257527	2,645751	0,010889	0	72,74613	9,746794	2,44949	2	2,645751	10,48809	7,681146	12,8841	12,60952	12,52996	2,236068	13,22876	13,22876	10,48809	11,61895

STEP 3 - Calculate the normalized weighted Matrix

	COVID-19	Updated p	Updated p	Updated h	Maximum	COVID-19	Convertib	Continger	Overtime	Personal p	Pandemic	Previous e	Distinct rc	Supply ch	Health lite	Contact-tr	Vaccinatic	Communi	Funds (pe	Flexibility	Timelines	Remote m	Emergenc
Pesaro	0,00277	0,00435	0,00435	0,00329	0,00289	0,00329	0,00080	0	0	0,00446	0,00355	0	0,00329	0,00249	0,00453	0,00337	0,00345	0,00347	0,00389	0,00329	0,00329	0,00415	0,00374
Torrette	0,00333	0,00435	0,00435	0,00329	0,00703	0,00329	0,00168	0	0	0,00089	0,00355	0,00435	0,00329	0,00083	0,00340	0,00337	0,00345	0,00347	0,00389	0,00329	0,00329	0,00249	0,00374
Jesi	0,00333	0	0	0,00329	0,00096	0,00329	0,00056	0	0,00502	0,00268	0	0	0,00329	0,00249	0,00226	0,00337	0,00345	0,00278	0,00389	0,00329	0,00329	0,00415	0,00374
Camerino	0,00328	0	0	0,00329	0,00030	0,00329	0,00703	0	0,00502	0,00089	0,00355	0,00435	0,00329	0,00332	0,00340	0,00270	0,00207	0,00347	0,00389	0,00329	0,00329	0,00083	0,00374
Fabriano	0,00333	0	0	0,00329	0,00056	0,00329	0	0	0,00502	0,00446	0,00355	0	0,00329	0,00415	0,00453	0,00337	0,00345	0,00278	0,00389	0,00329	0,00329	0,00332	0,00374
Civitanova Marche	0,00328	0,00435	0,00435	0,00329	0,00365	0,00329	0,00256	0	0	0,00268	0,00355	0,00435	0,00329	0,00415	0,00113	0,00337	0,00345	0,00347	0	0,00329	0,00329	0,00415	0,00075
San Benedetto del Tronto	0,00361	0,00435	0,00435	0,00329	0,00178	0,00329	0,00399	0	0	0,00446	0,00355	0,00435	0,00329	0,00415	0,00226	0,00337	0,00345	0,00347	0	0,00329	0,00329	0,00249	0,00225

STEP 4 - Calculate the worst and ideal

ideal v+	0,00277	0,00435	0,00435	0,00329	0,00703	0,00329	0,00703	0	0	0,00446	0,00355	0,00435	0,00329	0,00415	0,00453	0,00337	0,00345	0,00347	0,00389	0,00329	0,00329	0,00415	0,00374
the worst v-	0,00361	0	0	0,00329	0,00030	0,00329	0	0	0,00502	0,00089	0	0	0,00329	0,00083	0,00113	0,00270	0,00207	0,00278	0	0,00329	0,00329	0,00083	0,00075

STEP 5 - Calculate the Euclidean distance from the ideal/worst				STEP 6 - Calculate the relative closeness coefficient (Pi) or performance score	Final rank
Si+ (ideal)	Si- (antiideal)			Pi	
0,0229	0,039			0,627	1
0,0305	0,032			0,510	5
0,0251	0,036			0,592	2
0,0382	0,024			0,391	7
0,0356	0,028			0,441	6
0,0276	0,034			0,550	4
0,0268	0,035			0,567	3

4. AHP Datasheet showing the classification of indicators divided per macro areas

Health & Safety

Expert A		Expert B	
Nurse	0,103	Number of hospitals	0,131
Information quality	0,098	Coordination	0,102
Coordination	0,092	Emergency network	0,101
Specialist	0,084	Information quality	0,096
Triage tag	0,077	Number of residential services	0,083
Number of residential services	0,069	Triage tag	0,082
Emergency network	0,069	Number of vehicles	0,074
Doctor	0,064	Nurse	0,066
Social worker in public health service	0,056	Doctor	0,057
Medicine/patient	0,056	Specialist	0,056
Accessibility (roads)	0,055	Tent	0,037
Number of hospitals	0,048	Interdisciplinarity	0,030
Interdisciplinarity	0,043	Medicine/patient	0,027
Number of vehicles	0,034	Social worker in public health service	0,022
Tent	0,028	Helipad space	0,022
Helipad space	0,015	Accessibility (roads)	0,011
Flexibility in the use of facilities	0,011	Flexibility in the use of facilities	0,004
Expert C		**Expert D**	
Emergency network	0,108	Specialist	0,114
Information quality	0,108	Doctor	0,105
Coordination	0,108	Medicine/patient	0,102
Triage tag	0,079	Nurse	0,101
Interdisciplinarity	0,075	Coordination	0,073
Nurse	0,072	Social worker in public health service	0,072
Doctor	0,070	Emergency network	0,071
Flexibility in the use of facilities	0,060	Triage tag	0,051
Number of hospitals	0,057	Tent	0,050
Social worker in public health service	0,056	Number of vehicles	0,047
Medicine/patient	0,056	Helipad space	0,039
Specialist	0,047	Number of hospitals	0,036
Number of residential services	0,045	Flexibility in the use of facilities	0,032
Tent	0,027	Interdisciplinarity	0,031
Number of vehicles	0,015	Accessibility (roads)	0,029
Accessibility (roads)	0,009	Number of residential services	0,028
Helipad space	0,007	Information quality	0,020
Expert E		**Expert F**	

Specialist	0,114	Doctor	0,157
Doctor	0,111	Number of hospitals	0,096
Medicine/patient	0,102	Specialist	0,095
Number of hospitals	0,096	Nurse	0,079
Nurse	0,096	Medicine/patient	0,077
Social worker in public health service	0,084	Number of vehicles	0,072
Number of residential services	0,077	Coordination	0,071
Accessibility (roads)	0,060	Triage tag	0,063
Emergency network	0,044	Emergency network	0,062
Triage tag	0,036	Tent	0,047
Interdisciplinarity	0,033	Flexibility in the use of facilities	0,044
Tent	0,031	Helipad space	0,041
Information quality	0,029	Social worker in public health service	0,024
Coordination	0,025	Interdisciplinarity	0,023
Number of vehicles	0,025	Accessibility (roads)	0,022
Flexibility in the use of facilities	0,024	Information quality	0,014
Helipad space	0,012	Number of residential services	0,013

Politic & Economic

Expert A		Expert B	
Human rights	0,469	Partnership / international / interregional cooperation	0,312
Governance (strength stability)	0,145	Governance (strength stability)	0,268
Aid support	0,143	Human rights	0,202
Aid continuity	0,143	Aid support	0,136
Multi-stakeholders' engagement	0,065	Aid continuity	0,070
Partnership / international / interregional cooperation	0,034	Multi-stakeholders' engagement	0,012
Expert C		**Expert D**	
Governance (strength stability)	0,303	Partnership / international / interregional cooperation	0,308
Aid support	0,219	Governance (strength stability)	0,282
Human rights	0,146	Human rights	0,218
Partnership / international / interregional cooperation	0,144	Aid support	0,088
Aid continuity	0,142	Aid continuity	0,088
Multi-stakeholders' engagement	0,047	Multi-stakeholders' engagement	0,016
Expert E		**Expert F**	
Human rights	0,305	Human rights	0,264
Aid continuity	0,213	Partnership / international / interregional cooperation	0,239
Governance (strength stability)	0,173	Aid continuity	0,185
Aid support	0,142	Aid support	0,182
Partnership / international / interregional cooperation	0,108	Multi-stakeholders' engagement	0,091
Multi-stakeholders' engagement	0,058	Governance (strength stability)	0,039

Socio-Psychological

Expert A		Expert B	
Ethical principles	0,270	Availability of green areas	0,326
Social organization in the territory	0,190	Common area with sufficient physical distance	0,236
Common area with sufficient physical distance	0,138	Psychological support	0,158
Sport / relaxing spaces	0,138	Sport / relaxing spaces	0,156
Availability of green areas	0,106	Ethical principles	0,053
Psychological support	0,090	Psychological training	0,052
Psychological training	0,069	Social organization in the territory	0,019
Expert C		**Expert D**	
Psychological training	0,234	Ethical principles	0,297
Psychological support	0,195	Psychological training	0,211

Social organization in the territory	0,182	Psychological support	0,205
Ethical principles	0,160	Social organization in the territory	0,145
Common area with sufficient physical distance	0,120	Common area with sufficient physical distance	0,077
Availability of green areas	0,071	Sport / relaxing spaces	0,053
Sport / relaxing spaces	0,038	Availability of green areas	0,011
Expert E		**Expert F**	
Ethical principles	0,387	Availability of green areas	0,203
Sport / relaxing spaces	0,136	Ethical principles	0,169
Psychological support	0,125	Sport / relaxing spaces	0,152
Social organization in the territory	0,122	Psychological support	0,144
Psychological training	0,089	Psychological training	0,135
Common area with sufficient physical distance	0,086	Social organization in the territory	0,135
Availability of green areas	0,055	Common area with sufficient physical distance	0,063

Demographic

Expert A		**Expert B**	
Population in good health (Marche Region)	0,184	Mean age	0,214
Commuting for working (2019) outside the Municipality	0,161	Population density	0,170
Commuting for studying (2019) outside the Municipality	0,144	Active population (school / job)	0,110
Commuting for working (2019) into the Municipality	0,126	Gender male	0,091
Commuting for studying (2019) into the Municipality	0,112	Commuting for studying (2019) into the Municipality	0,090
Active population (school / job)	0,100	Gender female	0,082
Mean age	0,074	Commuting for studying (2019) outside the Municipality	0,077
Population density	0,064	Commuting for working (2019) into the Municipality	0,075
Gender male	0,018	Commuting for working (2019) outside the Municipality	0,066
Gender female	0,018	Population in good health (Marche Region)	0,026
Expert C		**Expert D**	
Commuting for studying (2019) outside the Municipality	0,196	Mean age	0,217
Commuting for working (2019) outside the Municipality	0,196	Active population (school / job)	0,159
Population density	0,120	Commuting for studying (2019) outside the Municipality	0,153
Commuting for studying (2019) into the Municipality	0,111	Commuting for working (2019) outside the Municipality	0,153
Commuting for working (2019) into the Municipality	0,111	Commuting for working (2019) into the Municipality	0,087
Active population (school / job)	0,099	Commuting for studying (2019) into the Municipality	0,087
Population in good health (Marche Region)	0,077	Population density	0,074
Mean age	0,063	Population in good health (Marche Region)	0,048
Gender male	0,014	Gender male	0,011
Gender female	0,014	Gender female	0,011
Expert E		**Expert F**	
Population in good health (Marche Region)	0,211	Mean age	0,100
Commuting for studying (2019) outside the Municipality	0,129	Gender male	0,100
Commuting for studying (2019) into the Municipality	0,118	Gender female	0,100
Commuting for working (2019) into the Municipality	0,109	Population density	0,100
Population density	0,106	Active population (school / job)	0,100
Commuting for working (2019) outside the Municipality	0,095	Commuting for studying (2019) into the Municipality	0,100
Active population (school / job)	0,091	Commuting for studying (2019) outside the Municipality	0,100
Mean age	0,078	Commuting for working (2019) into the Municipality	0,100
Gender male	0,034	Commuting for working (2019) outside the Municipality	0,100
Gender female	0,029	Population in good health (Marche Region)	0,100

Pandemic

Expert A		Expert B	
COVID-19 positive cases (per province)	0,061	COVID-19 positive cases (per province)	0,165
Personal protective equipment	0,061	COVID-19 ward	0,065
Communication	0,061	Vaccination	0,052
Funds (per healthcare workers or tools)	0,060	Updated pandemic national plan	0,049
Contingency staff (% increase)	0,059	Updated hospital emergency plan	0,049
Vaccination	0,056	Communication	0,049
Distinct roads for COVID-19 and non-COVID-19 patient	0,054	Updated pandemic regional plan	0,048
Supply chain of medicines and medical supplies (diversified)	0,054	Health literacy status	0,047
Health literacy status	0,054	Funds (per healthcare workers or tools)	0,044
Contact-tracing	0,054	Pandemic emergency training	0,042
Emergency number	0,054	Remote medical support	0,038
Timeliness	0,053	Contact-tracing	0,037
Updated hospital emergency plan	0,038	Contingency staff (% increase)	0,036
Overtime working hours	0,034	Supply chain of medicines and medical supplies (diversified)	0,036
Updated pandemic regional plan	0,033	Distinct roads for COVID-19 and non-COVID-19 patient	0,034
Updated pandemic national plan	0,033	Convertible bed for COVID-19 patients	0,031
Remote medical support	0,032	Flexibility	0,030
COVID-19 ward	0,030	Maximum hospital capacity	0,030
Previous experience	0,028	Previous experience	0,029
Maximum hospital capacity	0,028	Personal protective equipment	0,025
Flexibility	0,023	Overtime working hours	0,024
Convertible bed for COVID-19 patients	0,022	Emergency number	0,023
Pandemic emergency training	0,017	Timeliness	0,018
Expert C		**Expert D**	
Updated pandemic national plan	0,089	Contingency staff (% increase)	0,081
Personal protective equipment	0,084	Personal protective equipment	0,075
Supply chain of medicines and medical supplies (diversified)	0,072	Supply chain of medicines and medical supplies (diversified)	0,071
Updated pandemic regional plan	0,072	Vaccination	0,071
Vaccination	0,066	Updated pandemic national plan	0,064
Updated hospital emergency plan	0,064	Updated pandemic regional plan	0,064
COVID-19 ward	0,063	Updated hospital emergency plan	0,064
Funds (per healthcare workers or tools)	0,053	COVID-19 ward	0,061
Distinct roads for COVID-19 and non-COVID-19 patient	0,052	Maximum hospital capacity	0,051
Previous experience	0,049	Timeliness	0,047
Contingency staff (% increase)	0,042	Emergency number	0,047
Pandemic emergency training	0,038	Funds (per healthcare workers or tools)	0,046
Convertible bed for COVID-19 patients	0,036	Convertible bed for COVID-19 patients	0,044
Communication	0,035	Remote medical support	0,037
Contact-tracing	0,028	Pandemic emergency training	0,032
Remote medical support	0,026	Health literacy status	0,032
Overtime working hours	0,024	Communication	0,027
COVID-19 positive cases (per province)	0,024	Contact-tracing	0,026
Emergency number	0,024	Distinct roads for COVID-19 and non-COVID-19 patient	0,022
Flexibility	0,018	Flexibility	0,017
Timeliness	0,018	Previous experience	0,013
Maximum hospital capacity	0,017	Overtime working hours	0,007
Health literacy status	0,007	COVID-19 positive cases (per province)	0,003
Expert E		**Expert F**	
Personal protective equipment	0,091	Updated hospital emergency plan	0,107
Vaccination	0,083	Maximum hospital capacity	0,090
COVID-19 ward	0,079	Updated pandemic regional plan	0,068
COVID-19 positive cases (per province)	0,068	Contingency staff (% increase)	0,067

Contingency staff (% increase)	0,057	Supply chain of medicines and medical supplies (diversified)	0,061
Convertible bed for COVID-19 patients	0,056	Personal protective equipment	0,060
Funds (per healthcare workers or tools)	0,050	Flexibility	0,060
Previous experience	0,047	Updated pandemic national plan	0,050
Timeliness	0,043	Vaccination	0,047
Overtime working hours	0,042	Funds (per healthcare workers or tools)	0,045
Flexibility	0,042	Convertible bed for COVID-19 patients	0,043
Pandemic emergency training	0,040	Contact-tracing	0,042
Health literacy status	0,038	COVID-19 positive cases (per province)	0,036
Maximum hospital capacity	0,036	Distinct roads for COVID-19 and non-COVID-19 patient	0,035
Communication	0,032	Communication	0,034
Updated hospital emergency plan	0,032	Pandemic emergency training	0,028
Supply chain of medicines and medical supplies (diversified)	0,031	Overtime working hours	0,025
Distinct roads for COVID-19 and non-COVID-19 patient	0,030	Remote medical support	0,022
Contact-tracing	0,028	Emergency number	0,021
Emergency number	0,023	Previous experience	0,021
Updated pandemic regional plan	0,022	Timeliness	0,015
Updated pandemic national plan	0,019	COVID-19 ward	0,013
Remote medical support	0,013	Health literacy status	0,010

Macro areas

Expert A		**Expert B**	
Health & Safety	0,308	Demographic	0,318
Politic & Economic	0,308	Socio-Psychological	0,269
Pandemic	0,201	Pandemic	0,245
Socio-Psychological	0,128	Politic & Economic	0,118
Demographic	0,054	Health & Safety	0,049
Expert C		**Expert D**	
Politic & Economic	0,310	Health & Safety	0,370
Pandemic	0,310	Pandemic	0,313
Health & Safety	0,214	Politic & Economic	0,203
Demographic	0,120	Demographic	0,091
Socio-Psychological	0,046	Socio-Psychological	0,023
Expert E		**Expert F**	
Health & Safety	0,346	Pandemic	0,369
Politic & Economic	0,230	Health & Safety	0,290
Pandemic	0,183	Politic & Economic	0,169
Demographic	0,141	Socio-Psychological	0,088
Socio-Psychological	0,099	Demographic	0,084

5. Question number 15: What was the average daily number of positive patients admitted to the ward where you work, during the following three phases: a) EARLY STAGE OF PANDEMIC; b) INTERMEDIATE STAGE OF PANDEMIC; c) THE CURRENT STAGE.

a) Table: *Question number 15: What was the average daily number of positive patients admitted to the ward where you work, during the following three phases: EARLY STAGE OF PANDEMIC. Cumulative data for the seven selected hospitals.*

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	**No answer**	80	35,6	35,6	35,6
	1	1	0,4	0,4	36,0
	2	4	1,8	1,8	37,8
	3	5	2,2	2,2	40,0
	4	6	2,7	2,7	42,7
	5	5	2,2	2,2	44,9
	6	9	4,0	4,0	48,9
	7	2	0,9	0,9	49,8
	8	5	2,2	2,2	52,0
	9	2	0,9	0,9	52,9
	10	11	4,9	4,9	57,8
	11	4	1,8	1,8	59,6
	12	2	0,9	0,9	60,4
	13	10	4,4	4,4	64,9
	14	1	0,4	0,4	65,3
	15	12	5,3	5,3	70,7
	16	1	0,4	0,4	71,1
	18	1	0,4	0,4	71,6
	20	22	9,8	9,8	81,3
	21	1	0,4	0,4	81,8
	25	7	3,1	3,1	84,9
	26	2	0,9	0,9	85,8
	28	2	0,9	0,9	86,7
	30	13	5,8	5,8	92,4
	32	1	0,4	0,4	92,9
	35	1	0,4	0,4	93,3
	37	1	0,4	0,4	93,8
	38	1	0,4	0,4	94,2
	40	6	2,7	2,7	96,9
	50	2	0,9	0,9	97,8
	60	1	0,4	0,4	98,2
	70	1	0,4	0,4	98,7
	100	1	0,4	0,4	99,1
	160	1	0,4	0,4	99,6
	360	1	0,4	0,4	100,0
	Total	225	100,0	100,0	

b) Table: *Question number 15: What was the average daily number of positive patients admitted to the ward where you work, during the following three phases: INTERMEDIATE STAGE OF PANDEMIC. Cumulative data for the seven selected hospitals*

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	**No answer**	70	31,1	31,1	31,1
	1	2	0,9	0,9	32,0
	2	4	1,8	1,8	33,8
	3	11	4,9	4,9	38,7
	4	6	2,7	2,7	41,3
	5	5	2,2	2,2	43,6
	6	10	4,4	4,4	48,0
	7	1	0,4	0,4	48,4
	8	11	4,9	4,9	53,3
	9	3	1,3	1,3	54,7
	10	21	9,3	9,3	64,0
	11	1	0,4	0,4	64,4
	12	4	1,8	1,8	66,2
	13	11	4,9	4,9	71,1
	14	1	0,4	0,4	71,6
	15	15	6,7	6,7	78,2
	16	2	0,9	0,9	79,1
	18	3	1,3	1,3	80,4
	19	1	0,4	0,4	80,9
	20	19	8,4	8,4	89,3
	25	8	3,6	3,6	92,9
	27	1	0,4	0,4	93,3
	30	8	3,6	3,6	96,9
	33	1	0,4	0,4	97,3
	50	3	1,3	1,3	98,7
	60	1	0,4	0,4	99,1
	80	1	0,4	0,4	99,6
	681	1	0,4	0,4	100,0
	Total	225	100,0	100,0	

c) Table: *Question number 15: What was the average daily number of positive patients admitted to the ward where you work, during the following three phases: THE CURRENT STAGE. Cumulative data for the seven selected hospitals*

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	**No answer**	65	28,9	28,9	28,9
	1	21	9,3	9,3	38,2
	2	39	17,3	17,3	55,6
	3	23	10,2	10,2	65,8
	4	13	5,8	5,8	71,6
	5	29	12,9	12,9	84,4
	6	11	4,9	4,9	89,3
	7	6	2,7	2,7	92,0
	8	8	3,6	3,6	95,6
	10	5	2,2	2,2	97,8
	11	1	0,4	0,4	98,2
	12	1	0,4	0,4	98,7
	15	1	0,4	0,4	99,1
	30	1	0,4	0,4	99,6
	282	1	0,4	0,4	100,0
	Total	225	100,0	100,0	