



Department of Business and Management

Course of Healthcare Management

RESTRUCTURING THE HEALTHCARE
SYSTEM DURING A PANDEMIC:
THE ITALIAN COVID-19 CASE

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INTRODUCTION

For almost a year and a half our lives have totally changed in relation to the world situation that is developing with regard to the disease caused by the Sars-Covid-2 virus, everything that we believed to be taken for granted, such as the right to go to university to attend lectures or make a dissertation face to face with a committee, has all of a sudden become almost utopian. Our way of approaching the reality of things and our daily lives has been turned upside down. As people, in such a difficult situation, we had to search inwardly for motivation to continue with our everyday lives, adapting to what was a totally new reality. This transition, or the ability to cope with a traumatic event in a positive way, psychological science defines it as the word resilience. This concept has become in recent years a topic of fundamental academic importance, with numerous publications that deal with it not only in the psychological field, but also in other fields such as engineering or economics. However, from the point of view of business organization, and specifically the organization and management of a healthcare system, with the advent of the epidemic that we are still experiencing, resilience has become central in creating a dynamic model capable of adapting to any possible and unpredictable situation. Our country in particular has found itself fighting with this disease in the front row, being practically the second nation in the world, after China, to see a high increase in contagions, thus finding itself facing a pressure on the health system that until now was unforeseeable and unknown. The question this study attempts to answer is how our health care system organized itself in response to the ongoing pandemic and what health care policies were actually effective. It will therefore be necessary to analyze first what it means to have a resilient healthcare system, then the specific features of our country and finally to move on to the actual response that has been given to the pandemic. The pivotal point will certainly be the comparison between regions, since our healthcare system is organized on three levels of government, two of which are located at the regional level, and therefore the answer to the question of which region, and consequently the organizational model, has been best able to respond, and therefore prove resilient, to the pandemic situation.

THE HEALTHCARE RESILIENCE DURING A PANDEMIC

Before addressing the situation of healthcare systems and how they react to various situations, the concept of resilience needs to be addressed more broadly. This concept resides in many disciplines, such as psychology, sociology or engineering and is defined (Comfort, 2010) as the ability “to proactively adapt to and recover from disturbances that are perceived within the system to fall outside the range of normal and expected disturbances”, or as (Hollanger, 2006) “the intrinsic ability of an organization (system) to maintain or regain a dynamically stable state, which allows it to continue operations after a major mishap and/or in the presence of a continuous stress”.

These two definitions highlight fundamental steps in the understanding characteristics that a circumstance must have in order to be defined as resilience. Certainly, the first element to be emphasized is the triggering factor; there must be an event that modifies the initial situation, going beyond the normal management of a system. In this context it is important to distinguish this trigger, which is called a disruption event, from normal variations or interruptions in organizational activity. The “disruptive interruption” is so defined (Macrae, 2019) as the situation that “interrupts an activity in such a way that it derails the ongoing flow of that activity and requires the mobilization of supplementary sociotechnical resources to restore order and control, beyond those that would ordinarily be enrolled in that particular activity.”

Always Macrae sets an interesting theoretical framework concerning resilience that refers to the time and space in which it manifests itself: in fact, three distinct moments can be identified, and each of them characterizes, in terms of duration and involvement of a system, organizational activities.

- **Situated resilience:** arising from the operational management of the organization, it is referring to a micro-level between people and their surrounding work environment, disturbed by an unexpected event that needs to be resolved quickly on the spot. An example might be a hemorrhage during a surgical operation or an unexpected problem during the departure of a plane. Usually, the time span varies from a few seconds up to a week.

- Structural resilience: represents the processes of restructuring and reforming socio-technical resources and situated practices¹. In this case we are talking about meso-level, it is, in fact, the reorganization of activities as a result of past experience or through the simulation of a disruption event. The time horizon ranges from weeks to months.
- Systemic resilience: represents the fundamental reconfiguration and reform of the processes that design, produce, constitute and circulate the sociotechnical resources that underpin safety. In this situation we are looking at the macro level of an organization. Systemic resilience can also involve considerable reconfigurations of the system wide architecture for detecting and responding to disruptions. This process takes years or even decades to complete.

¹ R.Miettinen, J.Virkkunen, Epistemic objects, artefacts and organizational change. *Organization* 12(3), 437–456 (2005)

Resilience in the healthcare organizations

As explained in the brief introduction to the chapter, the concept of resilience can be understood multidisciplinary and with many different facets. As regards, more specifically, resilience applied to health systems, a first definition is provided by Blanchet and James in 2013 and is referred to as "a measure of the amount of change a system can experience while maintaining the same controls on structure and function".

This research topic took on greater interest and importance with the 2014² Ebola outbreak, where it is observed that the concept of resilience is applied within a top-down approach (Martineau 2016). In this context, the idea of everyday resilience is proposed (Barasa et al. 2017) where the notion of situated resilience is taken up; thus, a situation where the delivery of the health system undergoes daily small changes applied in the spot by the operators and not at the macro level, given the political and organizational instability provided by the undeveloped countries in which Ebola spread. This idea is also developed in a first model for addressing resilience in this area. In this sector, however, there is a basic problem, namely the inability to match demand with hospital capacity. These two factors will align over time, and if there is a mismatch due to a temporary shortage of staff, for instance, there is a need to adapt, which will inevitably lead to either positive or negative outcomes. This little cycle was defined (Anderson, 2016) as the CARE³ model and is an example of how resilience has always been present within the healthcare world.

² In Biddle et al. Health system resilience: a literature review of empirical research, 2020 they analyzed 71 empirical studies between 2008 and 2019, more than two-thirds were published after 2014. Thus, certifying the academic increasing fervor.

³ Concepts for Applying Resilience Engineering

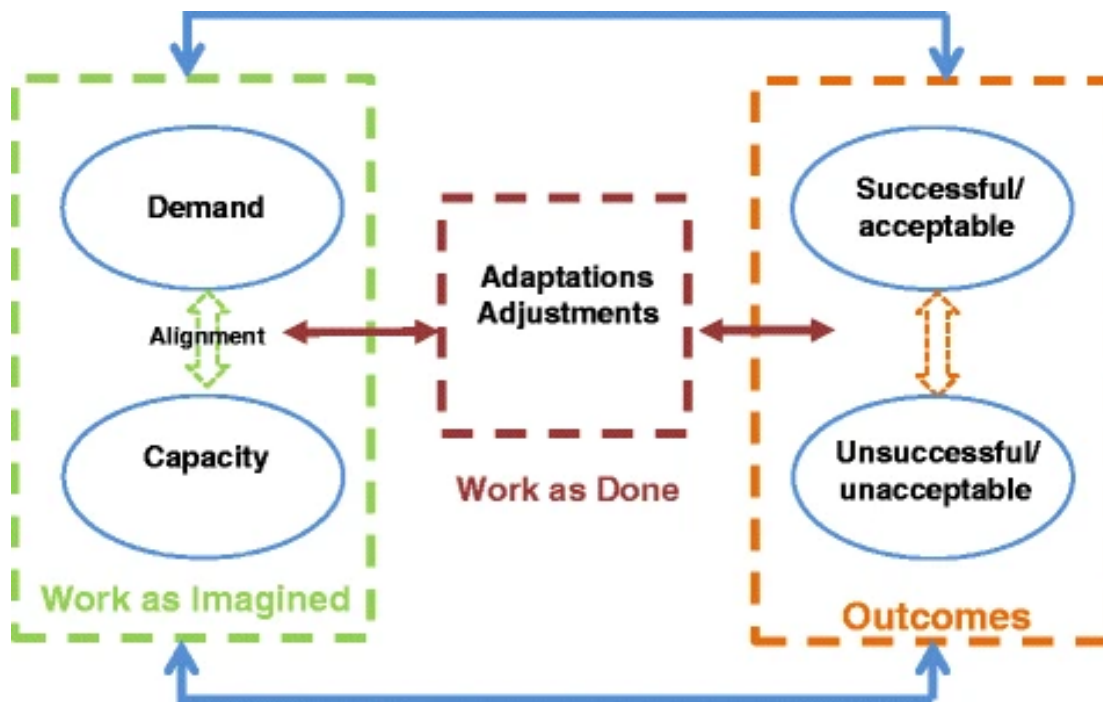


Figure 1: Concepts for Applying Resilience Engineering (CARE) model (Anderson et.al, 2016)

The CARE model proposes two main areas of work, work as imagine and work as done. The first is conceived as an expected, or imagined, match between demands in the system and the capacity to meet those demands, in an economics' classic supply-demand vision. Demand and capacity, however, can never be fully aligned because of the complex structure of the system; there will always be unforeseen events, variations, and interactions that require workers to adapt in place. On the other hand, work as done refers to the adjustments that are necessary to accommodate these misalignments and the natural variability in how tasks are performed. The prediction of acceptable and unacceptable outcomes depends largely on understanding these crucial work as done dynamics under different demand-capacity circumstances. Anderson finally proposes some points of reflection on the model; first of all, it considers the outcomes not like a point of arrival but like a point of departure for a new cycle. The endured adaptations in fact, can be treated like new protocols in the new organizational structure post-resilience. Finally, it focuses on the evaluation of adaptations, which can hardly be defined as right or wrong due the dynamic nature of the health care system, with its non-stable elements. In fact, even a small change in the context could lead to totally different outcomes.

Furthermore, Blanchet et al (2017), proposed two interesting frameworks regarding the resilience and the overarching organizational structure and management. The first framework relates the degree of change, explained earlier in the middle of the CARE model, as the

adjustment of the system inside an organization with the intensity and impact of the humanitarian crisis and it works as the figure below suggest.

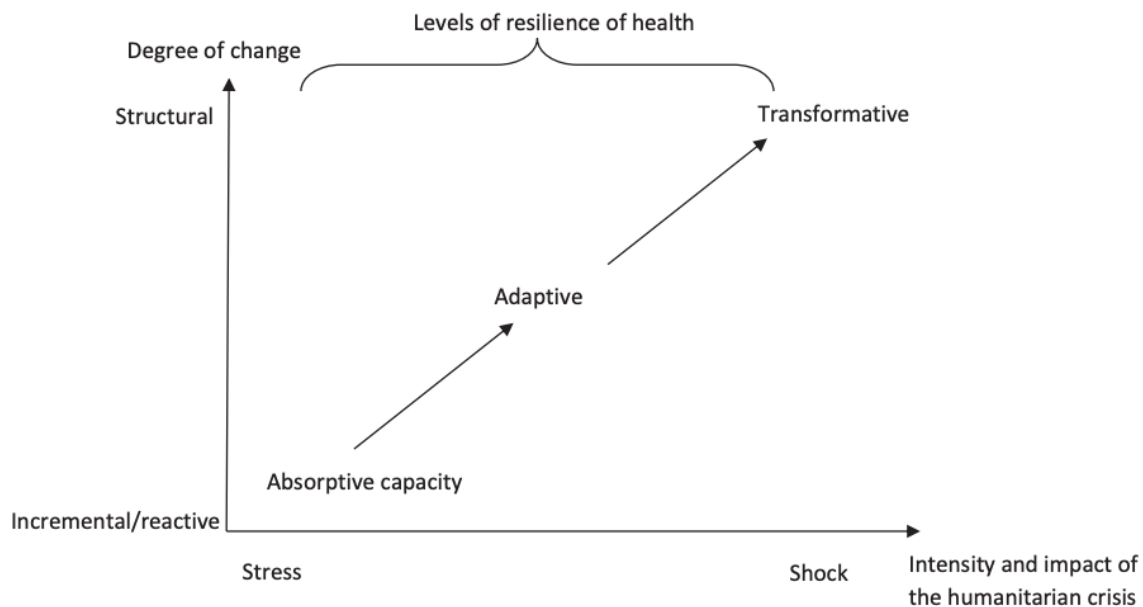


Figure 2: The levels of resilience of health systems by intensity of the humanitarian crisis and Degree of change (Blanchet et al. 2017)

This graph can be related to the theoretical model subsequently hypothesized by Macrae, the three levels of change in the health system can in fact be associated with the three different levels of resilience: Absorptive capacity, defined as the ability to offer the same service using the same number of resources, despite the fact that the disruptive factor refers to situated resilience, and it requires an adaptation of operational management and the reactivity of operators within their working environment. Adaptive capacity, on the other hand, refers to structural resilience, as it involves the delivery of the same service using more limited capacity or resources and thus a change within the organizational structure. Finally, transformative capacity, refers to the ability of actors within the health sector to transform system functions and structures in response to environmental change and is related to system resilience. These two trichotomies are clearly related and demonstrate, once again, that resilience is a multidisciplinary subject that is adaptable to many situations and is necessary, nowadays, for the optimal functioning of any organization, including healthcare.

In the same research, Blanchet et al. propose four dimensions that need to be considered within the governance structure to best suit a resilient system:

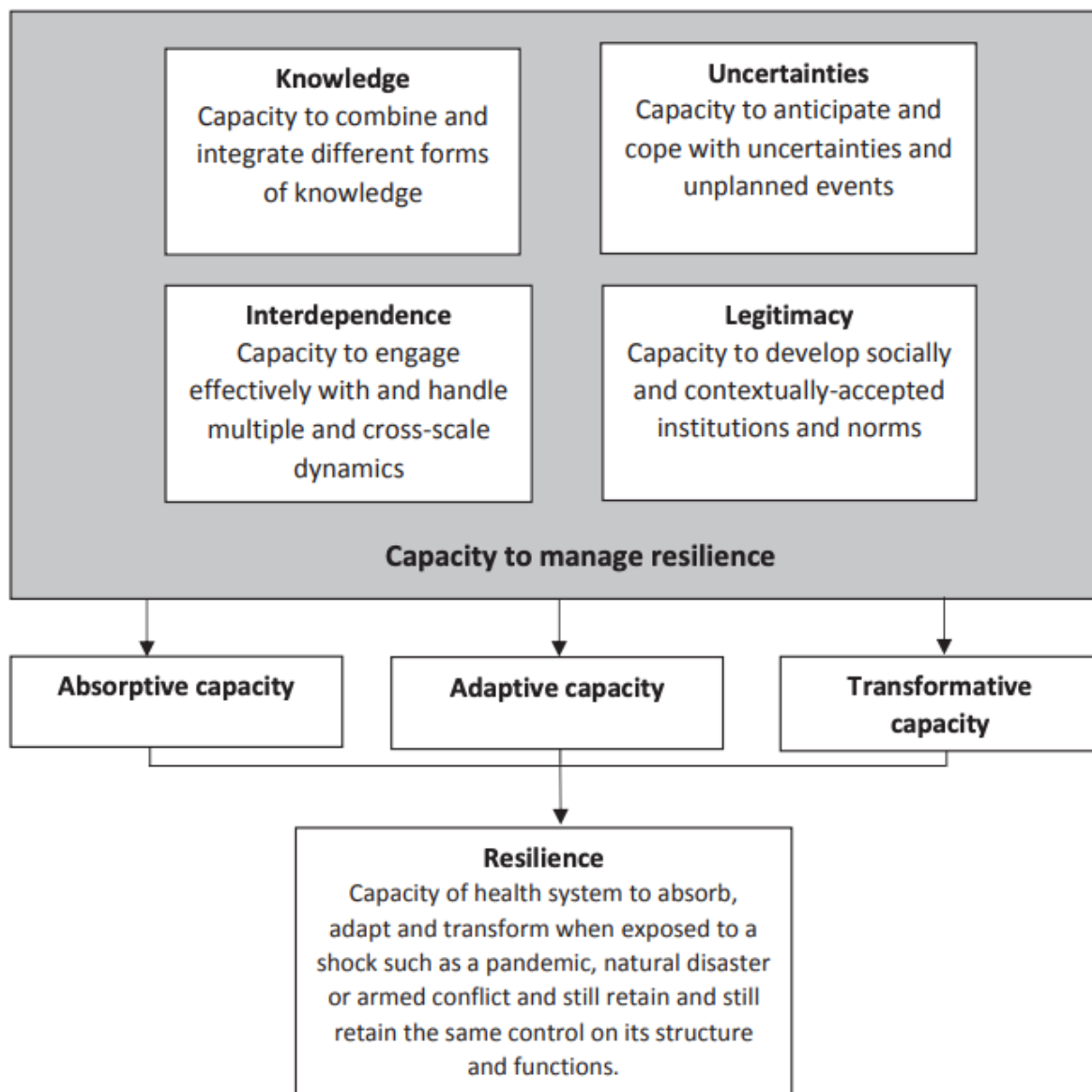


Figure 3: The dimension of resilience governance (Blanchet et al. 2017)

These four dimensions lay the foundations on which we have to build an healthcare system that could best respond to unexpected situations, such as a pandemic like the one we are currently experiencing. More in detail: knowledge relates not only to the expertise in the health field, but to a whole corollary of managerial and executive skills that refer also to a more economic and political sphere. In this case we are speaking about the figure of the social broker, defined as (Borgatti et al. 2009) "individuals who create links between users and researchers". On the other hand, the concept of interdependence always refers to a broader context than the health sector and, is how it relates to the surrounding environment and all its stakeholders, which can be abstracted into society as a whole. Often, this dimension is not given the weight and importance it deserves and is often the main cause for a non-resilient health system. An

example of this is the Ebola epidemic, which affected countries on the African continent that were particularly prone to political instability and internal wars⁴, which have not been able to respond effectively to the ongoing emergency. The third characteristic is the ability to anticipate uncertainties, it can be understood as all the so-called risk management activities that can predict the capabilities needed by the actors in a system, in order to respond at the stresses and shocks brought to it.⁵ The last component, which takes on enormous importance in the light of the current situation, is the legitimacy. A healthcare system, in order to be resilient, must be able to build a trustworthy relationship with the population, and this must be achieved through three main actions: putting the patient at the center of the health project, remembering that he is the ultimate goal of the health service delivery⁶. The construction of a structure with competencies both at the base, with trained nurses and doctors, but also at a higher level through management⁷. And finally, an administrative transparency that informs the population of the measures in place to fight the outbreak factor.

Furthermore, Hollnagel (2018) identified four resilience potentials that are: anticipating, monitoring, responding, learning. These potentials are proposed to support the success of "work as done", being resilient to shifts and issues that occur in the work environment is essential to guarantee the maintenance of good performance:

- **Responding** is a huge part of the healthcare staff's skill set and so it might be reasonably well expected to be practiced and acknowledged in their professional practice.
- **Monitoring** describes the capacity to catch things that could impact health care outcomes and is prominently linked to responding.
- **Anticipation** refers to the ability to understand and intercept future needs, this involves identifying emerging issues, risks, limitations or potential opportunities.
- **Learning** from experience is a critical step in both increasing positive outcomes and limiting damage in negative outcomes.

These four potentials should not be considered individually but should be taken into account in their totality and interdependence. In addition, Anderson et al. (2020) proposes a framework

⁴ Ramalingam B. 2013. Aid on the Edge of Chaos. Oxford: OUP.

⁵ Westley F, Zimmerman B, Patton MQ. 2006. Getting to Maybe: How the World is Changed. Toronto: Random House.

⁶ Gilson L. 2005. Building trust and value in health systems in low- and middle-income countries. Soc Sci Med.

⁷ Kiény MP, Dovlo D. 2015. Beyond Ebola: a new agenda for resilient health systems. Lancet. 91-92.

that relates the four potentials proposed by Hollnagel to the three types of resilience (situated, structural, and systemic). According to the authors of this framework, it should be used not in a dogmatic way, as it gives insights to the world of research to implement the possibilities of understanding how resilience acts in health care. In fact, this study can be used to once again understand the spatiotemporal multidimensionality of resilience and add insights into understanding the balance between demand and capacity as it works across levels. At the systemic level, they show how strategy plays a key role in the overall response, it has to be programmatic work over the long term to work best. At the structural level, on the other hand, it is necessary to look for tactical actions that allow the organization to respond appropriately to any pressures by performing properly. Finally, at the situational level, the reasoning is to anticipate possible stresses on the system, such as a large number of patients at a given time.

Resilience potentials	Situated resilience - Re-adjusting processes by integrating and applying existing resources and practices	Structural resilience - Re-organising and restructuring sociotechnical resources and practices	Systemic resilience - Reforming and reconfiguring how resources and practices are produced
Anticipating -disruptions or opportunities in the future	Anticipate <ul style="list-style-type: none"> • demand-capacity misalignments in ongoing practical work • opportunities to apply and draw on resources and skills Capacity to anticipate	Anticipate <ul style="list-style-type: none"> • demand-capacity misalignments between resources and requirements • opportunities to restructure resources and practices Capacity to anticipate	Anticipate <ul style="list-style-type: none"> • demand-capacity misalignments in the processes that produce and circulate resources and practices • opportunities to reconfigure methods and systems Capacity to anticipate
Monitoring – the work system or environment	Monitor <ul style="list-style-type: none"> • task demand-capacity misalignments • team performance • task environment • task tools and equipment • performance outcomes • opportunities Capacity to monitor	Monitor <ul style="list-style-type: none"> • service demand and capacity misalignments • service environment • service tools and equipment • performance outcomes • opportunities Capacity to monitor	Monitor <ul style="list-style-type: none"> • system demand and capacity misalignments • environment • tools and equipment • performance outcomes • opportunities Capacity to monitor
Responding – to demands	Respond to <ul style="list-style-type: none"> • task demands • opportunities via flexible adaptation Capacity to respond	Respond to <ul style="list-style-type: none"> • service demands • opportunities at a service level Capacity to respond	Respond to <ul style="list-style-type: none"> • system demands • opportunities at a system level Capacity to respond
Learning – from experience	Case based learning Experience based learning Performance feedback Capacity to learn and implement changes	Organisational performance feedback Capacity to learn and implement changes	System learning and feedback Capacity to learn and implement changes

Figure 4: Integrated resilience attributes framework (Anderson et al.2020)

In order to finalize the discussion over resilience within the health system, it is also important to understand how it relates to the regulation side. In fact, following the topic of the relevance of interdependence between areas in order to have a resilience that performs at its best. Braithwaite (2011) proposes several strategies consisting of a pyramid of normative solutions, at the summit we have interventionist solutions, while at the bottom we have increasingly flexible approaches. The process that we can find at the base is also named internal control, which can be defined also as self-imposed regulation. Through legislation, particular actions within regulation should be self-selected, thus ensuring internal control consisting of a regulatory governmental model through risk self-regulation that is very prone to operational flexibility and resilience. Furthermore, Oyri and Wiig (2019) define two macro-themes related

to the relationship between regulation and the potential for resilience in the health care system, which are respectively how regulation can facilitate or hinder resilience. To be helpful, the regulator must make laws tailored to the organization; in this mechanism, a key role is played by the organization itself, that have to remaining as an active participant in the regulatory process, giving advice to the legislator, coordinating local activities and facilitating the distribution of information. Another key part comes from the standardization of processes that would seem to be in opposition to the very concept of dynamic resilience, Macrae (2013) instead proposes a vision of this mechanism that, instead of placing limits on professionals, leaves them free to focus on the possible contingencies that may occur during the practice of the medical profession. The second area, which is where the regulator limits the resilience process in some way, has as its main point the fact that laws limit the situational adaptations (Heimer, 2013). More in detail, Macrae (2013) pointed out regulatory actions that could hinder resilience that are “standards and requirements designed with no concern for practicality at the sharp end might reduce the capacities of mindful local adaptation to unexpected events”.

In the practice, the United Nations proposed in 2015 a framework, so called the Sendai framework for disaster risk reduction (SFDRR), which defines a series of priorities and actions to be taken in the context of risk management and following disastrous events, such as the occurrence of natural catastrophes or epidemics. It follows the lead of the Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters, which was used as a guide in disaster management until 2015 by the UN. According to the SFDRR official document it aims to “The substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries”⁸. In order to reach that goal, the UN sets seven global targets to be achieved until 2030: they project the reduction of mortality, economic losses, number of affected people globally and damage to critical infrastructure during global disasters. On the other hand, the last three objectives include the increasing number of countries that have a strategic plan for local risk management, the increasing international cooperation for developing countries to expand and complete their national actions to achieve the objectives of the framework and, finally, the increasing of availability and access to multi-hazard early warning systems and disaster risk information. To put the plan

⁸ United Nations. 2015. Sendai framework for disaster risk reduction 2015-2030.

into practice and the goals to be achieved, the UN foresees four macro areas of intervention which are:

1. Understanding disaster risk
2. Strengthening disaster risk governance to manage disaster risk
3. Investing in disaster risk reduction for resilience
4. Enhancing disaster preparedness for effective response and to “Build Back Better” in recovery, rehabilitation and reconstruction.

The implementation of this framework, as stated by Aitsi-Selmi (2015) will involve multi-level work to be carried out simultaneously across local, national, regional and international level. Doing so “this should improve alignment with shifts in the health sector from a health-care focused, vertical-systems approach to an approach that strengthens health systems, promotes equity, and collaborates closely with non-health sectors to influence the wider, societal determinant of health for the health benefit of people and communities”. National ministries of health and WHO will have a key role in implementing all of the principles proposed by the United Nations in disaster risk reduction. In addition, they must be able to collaborate with the United Nations Office for Disaster Risk Reduction as best they can, since this office is the one designated by the UN to implement the framework in practice as stated in the UN report at paragraph 25: *“Enhance the scientific and technical work on DRR⁹ and its mobilization through the coordination of existing networks and scientific research institutions at all levels and all regions with the support of the UNISDR¹⁰ Scientific and Technical Advisory Group in order to: strengthen the evidence-base in support of the implementation of this framework; promote scientific research of disaster risk patterns, causes and effects; disseminate risk information with the best use of geospatial information technology; provide guidance on methodologies and standards for risk assessments, disaster risk modelling and the use of data; identify research and technology gaps and set recommendations for research priority areas in DRR; promote and support the availability and application of science and technology to decision-making; contribute to the update of the 2009 UNISDR Terminology on DRR; use post-disaster reviews as opportunities to enhance learning and public policy; and disseminate studies”* (UNISDR, 2015)

⁹ Disaster risk reduction

¹⁰ United Nations Office for Disaster Risk Reduction

Understanding the importance of the Sendai framework for disaster risk reduction in its entirety, and communicating it in the best way possible to relevant stakeholders, must be a priority of every global government to better prepare for any eventuality and prove to be resilient from a health perspective, to avoid situations like the one we are experiencing nowadays.

Pandemics in modern history, a roadmap through the healthcare governance

During the course of history, humanity had always to deal with more or less recurrent pandemics. The first historical traces are with typhoid fever occurred in the Great Greece before the birth of Christ, in the Middle Ages people have always fought against the plague, while in what historians call the long '800 medicine has faced cholera epidemics. The last century saw the beginning of flu pandemics: the infamous Spanish flu, which spread at the end of the First World War, caused more than 50 million deaths. Until this moment, states responded autonomously, at most to small international groups, such as the forerunner of the Pan American Health Organization (PAHO), the International Sanitary Bureau, that was established in 1902 in North America. In 1919, following the formation of the League of Nations and given the pandemic that had just passed, the first world health organization was created, the Health Organization of the League of Nations¹¹. Finally, in 1946, the International Health Conference in New York approved the Constitution of the World Health Organisation, which is the highest body of global health and has as its goal "the attainment by all peoples of the highest possible level of health"¹². In this passage, the intention is to analyze the various outbreaks throughout recent history to better understand what lessons have been useful to health governance to be able to fully prepare for the covid pandemic. The HIV outbreaks will be analyzed to understand how the fight against viruses in modern health care began; SARS, for its medical proximity to the covid pandemic and because it was born in the same country where it originated and finally the Ebola epidemic that, for its temporal proximity and scientific response, will give indications to the international community that will prove almost prophetic for the future course of events.

The HIV virus represents for modern science the first major challenge to pandemics. It was first isolated in 1983, but the first truly coordinated response was carried out in 1987 when the WHO established a global program, involving strategic leadership, coordinating scientific research and the exchange of information, assuring technical cooperation and coordinating resources¹³. The aim of this program can be summarized in three pivotal points, the main objective was to prevent the transmission of the virus¹⁴. Firstly, it sought to promote the use of

¹¹ McCarthy. 2002. *A brief history of the World Health Organization*. The Lancet.

¹² WHO. 2020. Basic Documents

¹³ Mann JM. The World Health Organization's global strategy for the prevention and control of AIDS. *West J Med*. 1987;147(6):732-734.

¹⁴ WHO. 1997. Global Programme on AIDS 1987-1995: final report with emphasis on 1994-1995 biennium

condoms, to raise awareness of safer injecting in drug use and to prevent the transmission of the virus within the blood transfusion in health facilities. Parallel to these measures, a program of research has been launched on possible prevention technologies such as the discovery of new vaccines or microbicides. The second key point was the search for a cure to the disease, which in this case translates into the adoption of technologies aimed not at the complete elimination of the disease, which is unfortunately impossible, but at the alleviation of symptoms related to it. All this has been possible through the improvement of health facilities, both from the organizational point of view, and from the operational point of view with teams dedicated to clinical advice. Finally, the third major goal of the program was to mobilize and unify both national and international efforts through strengthening national prevention systems, coordinating the global response, and monitoring and forecasting the progress of the pandemic. The report published by WHO at the end of the program states that it has been able to raise the level of awareness on the subject, the advancement of scientific research with the distribution of new medicines and tools useful for vaccine diagnosis and finally a successfully global strategy of coordination. According to the executive director of the program, despite its achievements, it was unable to bring together all the policy needs of participating countries¹⁵, being replaced in 1996 by the Joint United Nations Programme on HIV/AIDS (UNAIDS) with a mandate to lead an expanded, better coordinated, multisectoral global response. This program is still ongoing and is renewed periodically with new goals and strategies. In spite of all efforts, we are used to living with this virus that, in recent years, has increasingly infected the world population as reported in figure 5, and has affected especially developing countries where information and prevention are more lacking. The current objectives of the fight against this virus are, according to their strategic plan for 2025, "the removal of societal and legal impediments to service delivery, and on linking or integrating the provision of HIV services with the other services needed by people living with HIV and communities at risk to stay healthy and build sustainable livelihoods"¹⁶.

¹⁵ Merson. 2006. The HIV–AIDS Pandemic at 25 — The Global Response. The New England Journal of Medicine

¹⁶ Unaid. 2020. Aids target 2025.

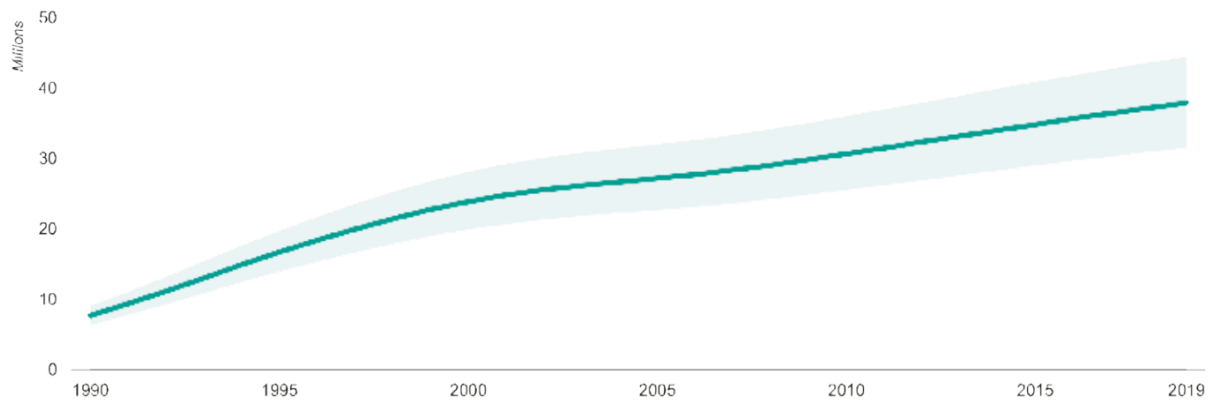


Figure 5: People estimate to be living with HIV during the last two decades (UNAIDS DATA, 2020)

This passage mainly demonstrates two things: the possibility of living with a virus where you can't defeat it, secondly it shows how there is a strong connection between medicine and society, and where society fails to redeem itself, the fight against certain diseases by the healthcare systems, also has as its goal a social improvement.

After briefly looking at the first true pandemic in modern history and the implications it had on global health management, the discussion regarding SARS is addressed. This epidemic is among all the pandemics in history the one that most resembles the Covid epidemic that we are currently experiencing, both for similarities in transmissibility and geographical location of the epicenter. It developed in the first half of 2003 in the Hong Kong region and in most of China and it poses a major challenge for the Chinese government in terms of healthcare and its own resilience. First of all, a distinction must be made between Hong Kong and China, since the first has inherited a British colonial system, which also brings with it the legislative and bureaucratic model typical of the commonwealth. On the other hand, China has a purely authoritarian system of government and legislation, it is therefore interesting to see the difference in direction within health management. Initially, central health governance let each individual region deal independently with the health care approach to SARS, treating it as a mere medical problem. It was only when SARS started to spread around the world that China, too, began to address it in a coordinated and centralized way. The initial difficulty was partially due to the fragmented Chinese bureaucracy, since it was a completely new virus that took the entire scientific world by surprise. Lai (2004) highlighted the difficulties of the national health system, blaming in large part the information symmetry between the regions and the central

system. Local bureaucrats have tried to hide or transform certain negative data in order to protect their own personal interests or those of their region, such as bad media publicity for both tourists and residents. In addition to lack of vertical communication, Lai also denounces lack of horizontal communication between regions, thus hindering the spread of important news for the fight against the epidemic. Furthermore, information symmetry also manifests itself in the hospitals, lacking effective communication between military and civilian hospitals. Beyond the initial difficulties, once China managed to centralize and organize a response, the effects were almost immediate and excellent. From this crisis Zou (2014) finds resilience from a legal standpoint that in the months following the pandemic had a large movement toward rules of law; in fact, China's deficient legal system, helped facilitate the spread of the pandemic. To give an example, the laws did not provide whether a hospital had the right to refuse a patient entry. On the other hand, the Honk Kong government showed unity of purpose and effective, if slightly delayed, communication; they imposed measures that we still use today in the fight against covid such as temporary school closures, quarantine and immigration screenings to try to limit contagions. Thomson (2014) shows how organizations within civil society, played a key role in informing the public about the risks and complexities of the ongoing pandemic, especially considering a politically unstable territory like Hong Kong, where in 2003 there was a major economic recession and fervor towards the Chinese central state was at one of its peaks. To draw conclusions, both governments have managed to learn from their mistakes and have prepared for future crises. China's central government has succeeded in initiating a series of structural reforms to the healthcare system, increasing investment, creating a national SARS information and dissemination system and strengthening facilities in rural areas. At the same time, the Hong Kong government has managed to improve its information process and to fully understand the importance of a civil society that has played a key role in the fight against the pandemic. Thus, the 2003 SARS outbreak helped project China's healthcare system into a more resilient model capable of responding to the covid epidemic more effectively than other nations as we're going to see at the end of the chapter.

To draw conclusions historical conclusions, we're going to talk about the most recent pandemic, and perhaps best etched in our memory, that is the Ebola's outbreak. It developed in West Africa, beginning its contagions in Guinea in 2013, and is divided by the literature into four distinct phases, each with its own errors (reported in figure 7) on the part of the organizations engaged in the international and national health security process.

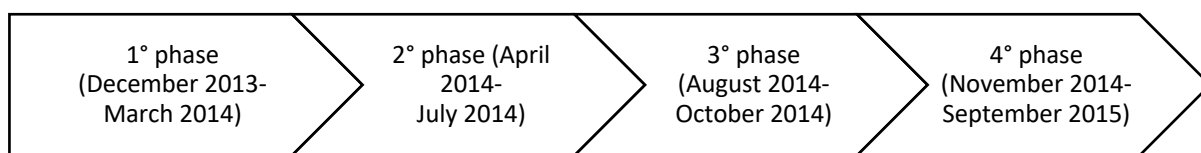


Figure 6: Ebola outbreak's timeline

The first phase involves the first infections in a rural area of Guinea, with subsequent spread to neighboring countries Sierra Leone and Liberia. In these first four months, there has been a failure by the national health authorities to identify the danger and the ongoing pandemic. This, obviously, was a key error in the overall picture of the situation and was due to both a very low investment in the national health system but also to a lack of support from the WHO in helping these three countries. The second phase was the initiation of a response to the ongoing epidemic; Médecins Sans Frontières alerted the WHO, as well as two out of three affected countries. The virus, which had hit the capitals of the three states, was however downplayed by health authorities for fear of creating panic and huge economic damage¹⁷. After the alarm, WHO sent a team of experts, but they noted a decrease in deaths and overlooked the increasing number of contagions by returning home¹⁸. At this stage, three main correlated errors are highlighted, a lack of political leadership, a very serious error by the team of experts sent by the WHO and following this, a failure, again on the part of the WHO, to compensate the lack of local health organization. The third phase begins in July as the epidemic finally becomes known to the majority of the world's population, having crossed the borders of the three small African countries to hit the United States of America with the first contagions. The mobilization of funds from the world bank (200 million dollars) and the testing of two different vaccines represent two important steps of this phase. Despite the large international mobilization, several mistakes were made in this situation: the response was too slow from the operational point of view after seven months the start of the outbreak, the information useful to health personnel and the previous experience of doctors in the countries affected by the first two phases were not effective¹⁹ and above all, health system operators did not feel helped in any way by the international community²⁰. The last phase sees a decrease in infections and the progressive disappearance of the virus. This time frame sees greater effectiveness in data and

¹⁷ Medicines Sans Frontier. *Pushed to the Limit and Beyond. A year into the largest ever Ebola outbreak. 2015*

¹⁸ Garrett L. *Ebola's lessons: how the WHO mishandled the crisis. 2015. Foreign Affairs.*

¹⁹ Abramowitz et al. 2015. Community-centered responses to Ebola in urban Liberia: the view from below. PLoS Neglected Tropical Disease.

²⁰ Jambawai. 2014. We are dying of Ebola; where is the world? Africa Review.

information sharing, as well as an improvement in organizational speed with the WHO finally playing a central coordinating role in the fight against Ebola²¹.



Figure 7: Relationship between Ebola outbreak phases and lack of application with resilience potentials/dimensions

In the wake of the outbreak, researchers from the Harvard Global Health Institute and the London School of Hygiene & Tropical Medicine formed a research panel, in which they seek to provide the international community with guidelines for improving health resilience to better prepare for any subsequent crises²². This group of researchers came up with conclusion and ten recommendations on four different topic areas which are the prevention and the response of major disease outbreak, the reorganization of the global research and governance reform for the coordination of global medical activities. These recommendations are extremely relevant given the situation we are experiencing with COVID-19.

²¹ WHO. 2015. Ebola R&D effort vaccines, therapeutics, diagnostics.

²² Moon et al. 2015. Will Ebola change the game? Ten essential reforms before the next pandemic. The report of the Harvard-LSHTM Independent Panel on the Global Response to Ebola. The Lancet.

PREVENTING MAJOR DISEASE OUTBRAKES:

1. A clear and effective common strategy is recommended to international bodies to secure a minimum level of health care and preparedness. Direction must be given through an independent but nonetheless interconnected body; this principle invokes the interdependence dimension within the framework of the four characteristics of a resilient system.
2. The second suggestion for this thematic area is speed and transparency in the communication and collection of information from national authorities, the WHO must be able to monitor and liaise with government bodies regarding key industries when it comes to a pandemic, such as aviation or shipping.

RESPONDING TO MAJOR DISEASE OUTBRAKE:

3. For joint response, the formation of a dedicated center with strong skills and a high degree of transparency is recommended. This passage calls for resilient health care management skills of knowledge and legitimacy.
4. A special committee must be created for the declaration of a possible state of health emergency, with the objective of pursuing a response in the shortest possible time.
5. A central tracking system dedicated to emergencies must be created, addressing the monitoring requirement seen in the previous chapter for resilience potentials.

RESEARCH: PRODUCTION AND SHARING OF DATA:

6. It is recommended that a set of rules and regulations be put in place in advance to allow the scientific world to operate at its best once the emergency has been triggered. In this case, the appeal to the theoretical framework of anticipation is obvious, preparing as best as possible and then maximizing the results under stress turns out to be always a winning choice.

7. It is necessary to create a common worldwide research panel and, above all, a financing system that allows the procurement of medicines and medical devices in the shortest possible time, where private investments are not sufficient.

*GOVERNING THE GLOBAL SYSTEM FOR PREVENTING AND RESPONDING
OUTBRAKES:*

8. The formation of a dedicated global health body within the United Nations is recommended, which will be tasked with keeping the alert with political bodies at all times to keep the issue of health at the center of their agendas.
9. Governance reforms are needed to rebuild trust between institutions and WHO after the failed management of the Ebola outbreak. These reforms must have two key functions in their intentions: technical support for building health facilities and rapid decision-making in emergencies.
10. The last recommendation given includes a series of reforms establishing freedom of information, a restructuring of the human resources department, and an office for internal inspections. It is also recommended that member states push for a chief executive officer capable of taking on tasks and challenging even the most powerful states on behalf of healthcare.

The global and European response to Covid-19 pandemic

From a medical perspective, the SARS-CoV-2 virus is a so-called coronavirus, that are (Velvan, Meyer. 2020) “positive single-stranded large RNA viruses that infect humans, but also a wide range of animals”. Instead, from a clinical point of view, it is a virus that manifests itself through pneumonia, gastrointestinal symptoms but also with asymptomatic infections²³. It has an average incubation period of five days²⁴ with a median of three²⁵. To give a general idea of the virus' mortality rate, in Italy, as of April 2, 2021, there is a 3% fatality rate²⁶.

The outbreak takes as its possible starting point the Huanan Seafood Wholesale Market in Wuhan, which was closed on January 1, 2020²⁷. Subsequently, the entire city of Wuhan was placed under lockdown, and by the end of January, already 30 provinces in China had activated the first level of public health emergency mechanism. The Chinese state at the time of the events arranged for an additional \$1.44 billion for emergency management²⁸. In addition, a number of restrictive measures have been put in place such as reducing the capacity of public transportation and eliminating mass events. Chinese experience in managing airborne diseases, as demonstrated in the previous subchapter discussing the SARS outbreak, has certainly helped: the habit of using masks, social distancing, and self-isolation were immediately adopted by the population with informational help from civil society organizations.

Chinese production activities were halted for a very limited period of time, gradually resuming normal activity as early as the beginning of February, responding promptly to the shortage of sanitary material, such as masks, increasing daily production capacity to more than 110 million units by the end of February²⁹. With a strong containment strategy, which also included a 14-day quarantine of all close contacts of positives and suspected cases, and a health system resilient to daily adversity, China was able to have a decrease in cases as early as the end of

²³ Chan et al. 2020. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. *Lancet*.

²⁴ Li et al. 2020. Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. *N Engl J Med*.

²⁵ Guan et al. 2020. Clinical characteristics of 2019 novel coronavirus infection in China. *medRxiv*.

²⁶ EpiCentro - Istituto Superiore di Sanità. 2020.

²⁷ The Health Commission of Wuhan. 2020. 41 COVID-19 patients were confirmed in Wuhan.

²⁸ The Ministry of Finance and the National Health Commission of the People's Republic of China. 2020. China issues 9.95b yuan additional funds for public health, epidemic control.

²⁹ The National Development and Reform Commission of the People's Republic of China. 2020. China's daily mask output exceeds 110 million units.

February (Figure 8), demonstrating how a rapid response and immediate restrictive measures were able to reverse the trend of ongoing infections³⁰.

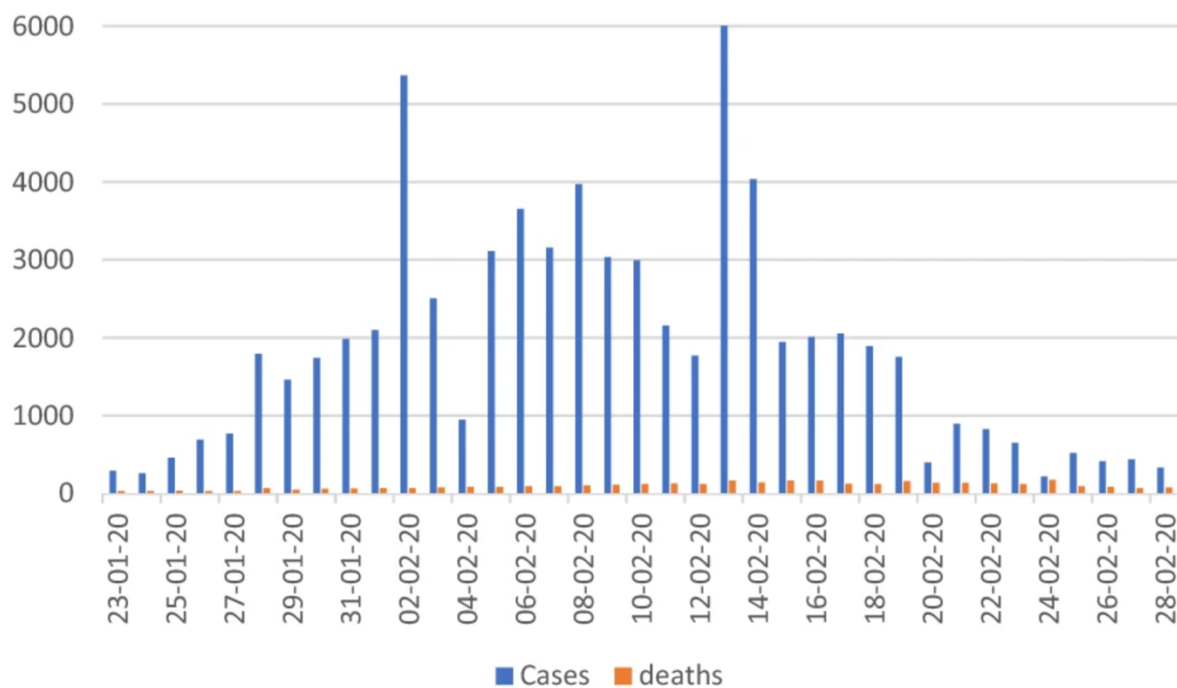


Figure 8: Daily death/case in China in the first two months after the covid outbreak. (WHO report on the covid-19 outbreak in China)

Going deeper and analyzing the Chinese clinical response, we see that the presence of testing, personal protection equipment, and a strong commitment from health care providers played a key role in combating the epidemic. In fact, more than 40,000 health workers were mobilized from other regions of China to the epicenter of the epidemic, in addition, two specialized hospitals and several mobile cabin hospitals were set up³¹. For the fight against the virus, the campaign of preventive diagnosis carried out has been fundamental, understanding in fact the infectivity of a person, during the incubation period, leads to a significant decrease in transmissibility. In this direction, China has proved to be immediately in the forefront, developing various diagnostic tools: at the beginning of March, in fact, 14 different virus detection kits were approved. Once positive patients were identified, a protocol for patient management was developed, called the "Diagnostic and treatment protocol for Novel Coronavirus Pneumonia"³². This protocol was renewed weekly to improve the management of the patient, providing invasive ventilation and extracorporeal membrane oxygenation in the

³⁰ Wang et al. 2020. Phase-adjusted estimation of the number of coronavirus disease 2019 cases in Wuhan, China. Cell Discov.

³¹ WHO. 2020. Report of the WHO-China Joint Mission on Coronavirus Disease 2019 (COVID-19).

³² General Office of National Health Commission, General Office of National Administration of Traditional Chinese Medicine. 2020. Diagnostic and treatment protocol for novel coronavirus pneumonia.

most severe cases, thus putting in place advanced technological tools. As a result, three months after the start of the infection more than 55000 patients were cured of the disease³³. These steps show how China was able to respond in a resilient way to the outbreak in progress, applying all, or almost, the theoretical principles of resilience and proving to be a model to be followed in the Western world. Along with the hospital and regulatory aspects an exceptional work has been done by the scientific community and the research community. As reported by Zhang (2020) “more than 200 COVID-19 original articles have been published worldwide, and nearly 100 articles, news, and commentaries have been published in prestigious journals among which more than 60% are from Chinese researchers”. Already on January 5, the Chinese scientific community, and in particular the Wuhan Institute of Virology were able to identify the pathogenic sequences of the virus, succeeding on the 10th to sequence the entire genome and transmit it to international bodies, thus succeeding in immediately putting into practice the much sought-after international cooperation required in the wake of the Ebola epidemic. Always following the guidance of the 2015 report proposed by the Harvard Global Health Institute and the London School of Hygiene & Tropical Medicine, more than 300 clinical cases of covid were first tracked and the vaccine research machine was set in motion, managing to bring forward five different types of vaccine with funds guaranteed by the Chinese government. In addition, a manual has been created in English and French, with instant information sharing³⁴. The Chinese learning has send a core message: the outbreak can be controlled if the proper interventions are put in place, we speak of control and not of eradication as the international community has been warned clinical application of a vaccine or treatment are still some distance away. Following the Chinese example, it was necessary to be ready to trace the cases and isolate them, taking into account the contacts that had taken place and protecting the nerve centers of the health system with all the necessary measures. But how has the old continent responded to the ongoing pandemic?

The European Union began having the first cases of covid in late January. The first one, was traced to France on January 24, with a clear link to a trip to China³⁵. The EU focused its responses on six main cornerstones shown in Figure 9; unfortunately, it was not able to act as

³³ The National Health Commission of the People’s Republic of China. 2020. Report on 2019- nCoV.

³⁴ The Chinese Center for Disease Control and Prevention. 2020. China CDC publishes multilingual epidemic control manuals for COVID-19.

³⁵ Stoecklin et al. 2020. First cases of coronavirus disease 2019 (COVID-19) in France: Surveillance, investigations and control measures. *Eurosurveillance*.

quickly as the Chinese state, managing to draft a plan during a video conference only on March 26 after starting discussions two weeks earlier.



Figure 9: EU response to covid-19 (Goniewicz et al. 2020)

First, the EU focused on limiting contagions, first closing several national borders and imposing temporary restrictions on non-essential travel within the union³⁶. This was done because there was a difficulty in the tracking of community data and therefore, as opposed to the principle of sharing a common strategy and, following what has repeatedly proved to be a European Union with great difficulty in acting as a unit, it was decided initially to leave the management of the pandemic to individual countries. Seeking to make up for this, on 28 January the Council activated the EU's Integrated Crisis Response Mechanism, which provides for a unified response to crises, increasing decision-making flexibility by giving the Permanent Representatives Committee and the Council strong decision-making power, thus enabling a more immediate response; this mechanism also provides unrestricted access for member states to EU situation reports. In addition, the European Commission is committed to facilitating the interconnection between states and especially between ministries of member states. Secondly, the union engages in the provision of medical equipment with two specific actions. First of all, on March 19 was created rescEU, that is a community reserve of all medical equipment useful to fight the virus, it was financed for 90% through the European Commission. Subsequently,

³⁶ Chinazzi et al. 2020. The effect of travel restrictions on the spread of the 2019 novel coronavirus (COVID-19) outbreak. Science.

an attempt was made to increase the in-house production of these devices by creating four calls between late February and mid-March for the production of medical and personal protection instruments.³⁷ The third programmatic point of the European Union concerns the promotion and research of vaccines: on April 1, the EU begins the procedures for monitoring 60 million tests carried out in laboratories. In addition, 47.5 million euros are allocated for 17 vaccine projects through the EU Horizon 2020, also involving private research centers and a further 164 million euros are allocated to companies and startups for innovative solutions in the fight against covid19³⁸. Lastly, the union is also focused on combating misinformation through transparency and immediacy of communication, engaged economically in supporting business and work and facilitating the return of European citizens who were abroad at the time the pandemic broke out.

From an academic point of view, following the Sendai Framework; Djalante, Shaw and Dewit (2020) lead the voice of the research inside the UN, trying to give some indication for better respond to the covid19 outbreak. From that research we can extrapolate a matrix:

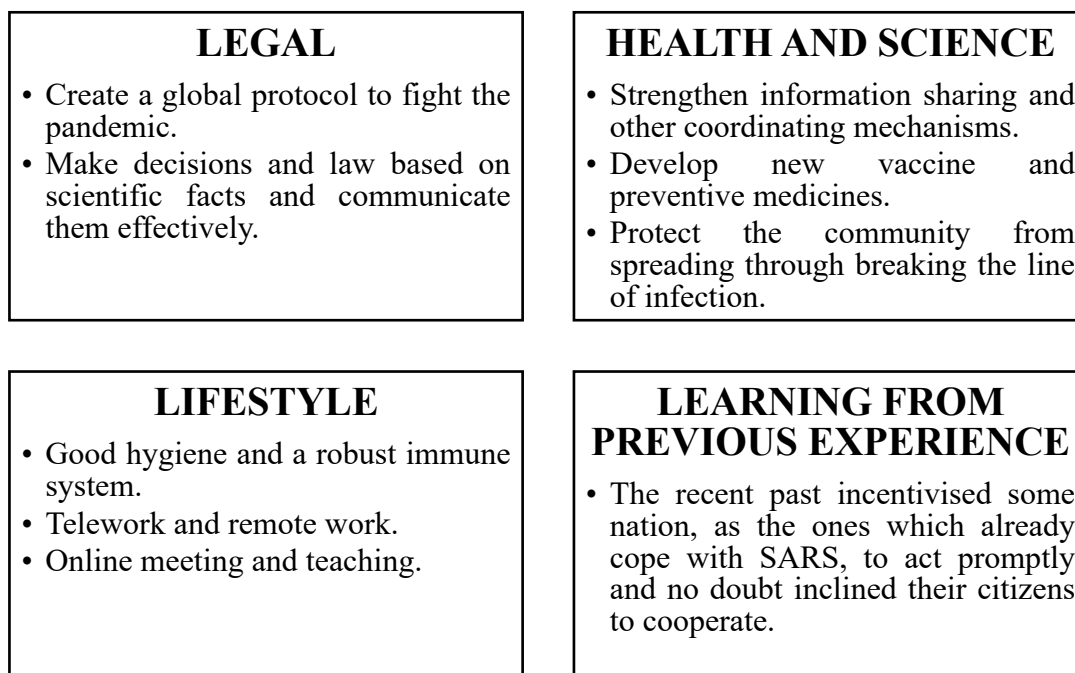


Figure 10: Recommendations on how current strategies for disaster resilience can contribute to responses to COVID-19

Furthermore, they give 5 recommendations specifically on the disaster risk reduction

³⁷ European Commission. 2020. Ensuring the Availability of Supplies and Equipment.

³⁸ Djalante, Shaw, Dewit. 2020. Building resilience against biological hazards and pandemics: COVID-19 and its implications for the Sendai Framework. Prog. Disaster Sci.

1. *Stronger knowledge and science provision in understanding disaster and health-related emergency risks:* All the scientific technologies already working with disaster risk assessment should be used, trying to involve in the research also the scientific community for activities in which they already have experience such as, for example, models on the spread of the virus.
2. *Mobilize existing disaster risk governance structure to manage disaster risk and potential health-emergencies:* International organizations such as the international red cross, accustomed to managing risk situations, should be integrated into the management of the epidemic.
3. *Utilize existing disaster coordination mechanisms at regional level to inform epidemic response:* Following the global procedure, the regional bodies like EU should use their risk management's offices to create regional protocol in order to protect all the environment, decide over movement and tracking cross border.
4. *Understand COVID-19 economic implications and resilience:* The interconnection between different areas of society requires that, especially the economic aspect of it, should not be neglected. The chain reaction within the markets, for instance, could lead to the non-achievement of production targets useful to support the fight against the virus.
5. *Prepare inclusive early recovery plans:* The March 2020 data already predicted a decrease in infections in certain areas of the world such as China or Japan, the results obtained should not be overlooked and we must learn from what happened and keep the social alert high, preparing a well function recovery plan.

With the benefit of hindsight, as April 2021, we can certainly say that certain advice has not been fully followed by the international community. We find ourselves with a still persistent lockdown and a recovery plan more focused on the economic aspect than on the health one.

THE ITALIAN HEALTHCARE SYSTEM

The Italian national health system, in the post-war period, went from a form of social security, supported by the state and religious bodies (1945-1956), to the full model of social insurance (1957-1974). With the establishment of the regions, after a short period of adaptation, the national health system (SSN) was established in 1980. Currently, all Italian and foreign citizens are entitled to health care in a direct and free form. To give an idea of how one of the first pandemics we faced, that of tuberculosis, was managed at an organizational level, the health system provided for compulsory insurance for citizens as of 1927³⁹. With its foundation, which occurred precisely in the eighties, the national health system in the first article of the reform approved by parliament defines its mission (art. 1 L.833/1978) "The national health system consists of the complex of functions, structures, services and activities intended to promote, maintain and recover the physical and mental health of the entire population."

This law is based on six core principles:

1. The **universality** of the right to health care for all persons and all forms of disease, without discrimination, time or cost limits.
2. The **comprehensiveness** of the provision of services to people ranging from diagnostic and treatment services to health integration through, for example, physical therapy.
3. The **uniqueness** of service management through the ASL⁴⁰.
4. The **uniformity of treatment** in all areas of the country.
5. **Democracy** applied to the management of the ASL through the election of administrators.
6. The **planning** of services and expenditures.

Therefore, a health care system based on two levels of government is defined: the first is political, with the state and the regions, while the second is entrusted to local government.

³⁹ Mapelli. 2012. Il sistema sanitario nazionale. Il Mulino.

⁴⁰ "Azienda Sanitaria Locale", local health agency.

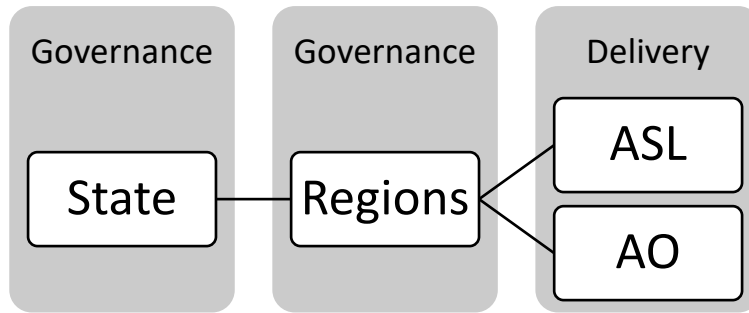


Figure 11: Level of governance and management of the SSN

The state has the tasks of legislating, establishing the essential levels of care, planning and guidance of health policies; on the other hand, the regions have the right to legislate according to the constraints imposed by the state, to plan the development of the regional network of services and to control the Asl. At the local level there are local health agencies (ASL) and hospital agencies (AO⁴¹) configured as public companies of the SSN, with their own legal status. The first must deliver the health care service, allocating its resources and organizing its operations as best they can while the AO are the large hospitals, independent of the ASL, that produce inpatient and specialist services according to agreements made with them. From this starting point, three main institutional types of ASL were formed: Integrated, Separated, and Mixed.

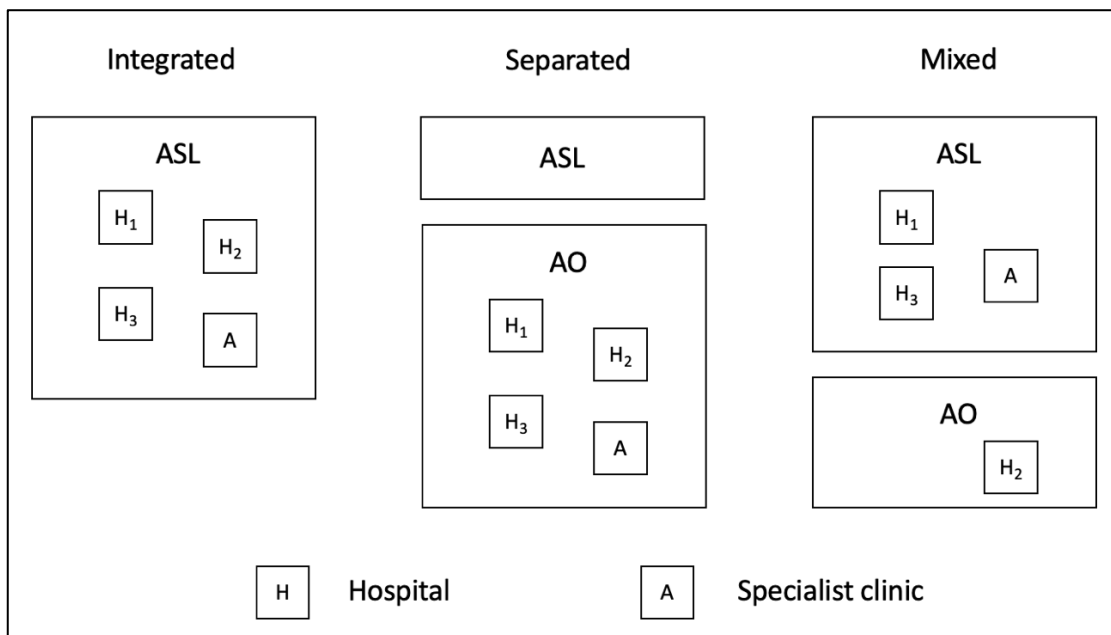


Figure 12: The institutional types of ASL

⁴¹ “Azienda Ospedaliera”, Hospital authority.

The **integrated** form, in continuation of the previous organization, places the ASL at the center of the organizational scheme. This model is at the limits of regulated competition and the risks associated with its implementation are those related to the persistence of the status quo prior to reform. In this perspective, the ASLs make priority use of their own facilities, limiting the role of private providers to the sole integration of the public offer and, within the framework of the contracts stipulated with all providers, negotiate the maximum volumes of services and financing. This type of organization is adopted by the autonomous provinces of Trento and Bolzano, Veneto, Valle D'Aosta, Abruzzo and Molise.

On the other hand, under the **separate** model, all hospitals and specialty facilities are spun off from the ASL and incorporated as an AO. This model is inspired by the scheme of public competition, since competition is achieved by allowing the patient to exercise full freedom of choice. Accredited public and private providers compete with each other to increase their market shares and are remunerated at a rate by the USL, which plays the role of third-party payer. This increases the quality of service by compensating for the market failure of public intervention and thus stimulating competition. Among the disadvantages of this scheme are highlighted the limited possibilities for planning the overall offer and a possible growth of the private sector, which is more flexible and therefore relatively facilitated with respect to public structures, at least in the initial phase. Currently only the Lombardy region adopts this model.

Finally, **mixed** increases the degree of regulation of competition, since the ASL, selects public and private hospitals on the market that offer the best combination of price and quality and concludes contracts with them on the basis of tariffs negotiated rates. This model maintains a strong degree of planning and governance of the system at the regional level, currently all 13 regions not mentioned so far use this organizational system.

Within the National Health System, first of all, there is a hospital differentiation between first- and second-level DEA: first of all, the DEA represents a functional aggregation of operating units that maintain their own autonomy and clinical-assistance responsibility, but that acknowledge their interdependence by adopting a common code of care behaviour, in order to ensure, in connection with the structures operating on the territory, a rapid and complete response. As mentioned above, the DEAs are based on two levels of complexity, according to the operational units that make them up: Level I DEAs and Level II DEAs. Level I DEAs guarantee, in addition to the services provided by hospitals with emergency rooms, the

functions of observation and short stays, resuscitation and, at the same time, diagnostic and therapeutic interventions in general medicine, general surgery, orthopaedics and traumatology, cardiology with UTIC (Cardiology Intensive Care Unit). Chemical-clinical and microbiological analysis, diagnostic imaging and transfusion laboratories are also provided. On the other hand, the second-level units ensure, in addition to the services provided by the first-level DEA, the most highly qualified functions linked to emergencies, including cardiac surgery, neurosurgery, neonatal intensive care, vascular surgery and thoracic surgery, in accordance with the indications established by regional planning. Other particularly qualified components, such as the units for large burns, and spinal units, where they are included in the regional planning, are located in the level II DEAs, thus guaranteeing a balanced distribution throughout the country and a close interrelation with the operational centres of the regions.

This distinction becomes particularly important when referring to DM 70/2015, which attempts to give a Hub & Spoke organizational imprint to regional health systems. First of all, guidelines are set for the number of average inhabitants for basic, first and second level hospitals, which are one per 150000, 300000 and 1200000 inhabitants respectively. This distinction between levels of care defines the basis of what is a Hub & Spoke system, in fact we can consider this organizational model as a network of hospitals where the second level hospital is at the center and the first and basic care hospitals are at the sides.

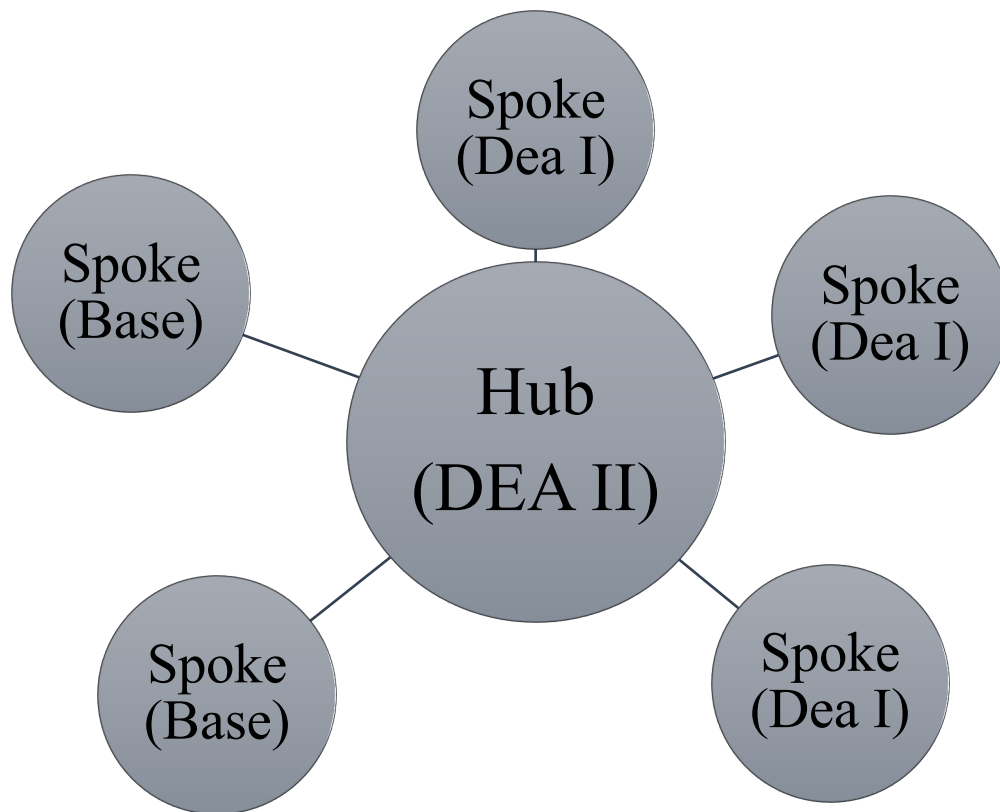


Figure 13: Hub & Spoke organizational design

This model has as its strengths a win-win network model for both parties, on the one hand, Hub centers are relieved of some services that are carried out peripherally, on the other hand Spoke centers can refer to Hub centers for the implementation of very complex services that could not be done in a smaller community because they require economies of scale to be economically sustainable.

Peculiarities of regional health systems

By organizing themselves institutionally, the regions, and consequently the ASLs, have full power over the internal governance structure. In the health care reform that took place in 1992, the challenge was to move from a system of government to a system of governance, which was more focused on the strategic vision of the company and results orientation instead of process orientation. The governance of regional health operates according to two general conditions: the central regional structure, that of the health policies adopted and secondly the peripheral system that they adopt for the delivery of service and the management of relations with stakeholders. The regional governance systems are distinguished by the vision of the relationship between regions and health companies, by the sharing/imposition of the objectives set for the companies, by the number of governance instruments and by the stipulation of inter-company contracts. From this starting point, therefore, we find three distinct models of governance, which are distinguished primarily by the presence of governance instruments and the stipulation of inter-agency contracts.

		Instruments of governance	
		Few	Many
Contracts with AO and nursing homes	Without		<p><i>3. Contractual</i></p> <p>Vision: Region: pivot and arbiter</p> <p>Relationships: Consultation</p>
	With	<p><i>1. Bureaucratic</i></p> <p>Vision: Region: higher authority</p> <p>Relationships: Communication</p>	<p><i>2. Centralized</i></p> <p>Vision: Region: holding</p> <p>Relationships: Communication and listening</p>

Figure 14: Typology of regional governance systems

The **bureaucratic** model is characterized by a vision of the company as a superior body, which governs through laws and deliberations with very formal relationships and little sharing of decision-making choices. The communication model adopted by governance is top-down, with

an inevitable delay in adapting to national regulations and a low degree of resilience. In the ASLs of these regions, a culture of governance has never been established, and there are no instruments of managerial control. Summing up everything in one sentence, in the bureaucratic system we have stopped at the bureaucratic model proposed by Max Weber, remaining stuck in the 80's and precluding a legitimacy given by the acts and not by the actions carried out.

The **centralized** model provides internally for a large amount of resources, is in tune with the latest NHS reform except for contractual agreements with AOs. It operates in a systematic way, with cooperation at the center of planning, along with strategy and controlled growth, there is more focus on results and not how you get them. Therefore, the ASLs act as if they were the holding company, defining goals and spending caps for each company, often the centralized model is found in the integrated regions.

The last model, the **contractual** one, is the one that more reflects the legislative will of the reform of 1999, trying to conjugate stability and previsionality of growth, equilibrium of its components and decisional participation between region and sanitary company. The region is the pivot of the process, controlling and monitoring the results, leaving the right degree of freedom of action and self-regulation to the health sector. At the peripheral level, budgeting and control of results is fundamental, keeping the right degree of participatory decision-making and negotiation on the objectives to be achieved. It is probably the most resilient system and, at the forefront, a more resilient response to the covid situation is expected.

From this distinction of organization, therefore, a map of Italy divided by organizational model can be derived.

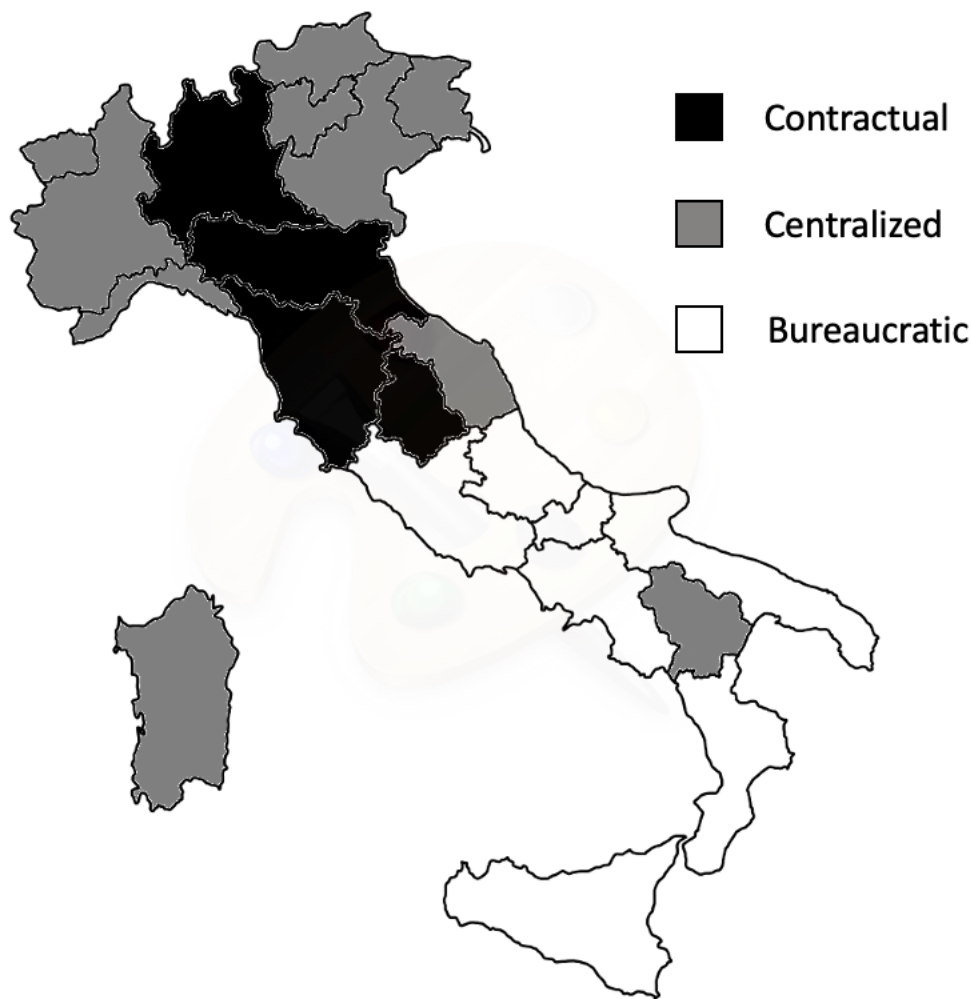


Figure 15: Map of the institutional organizations of Italian regional health care systems.

As can be observed in the figure above, the centralized model prevails in the northeast, which historically is close to Austro-Hungarian organizational models. A first reason for this is the small size of the regions or autonomous provinces, which clearly prefer a model of this type given the geographical affinities of the areas. At the hospital level, for example, Trentino is organized with a single central hospital located in the capital, directly managed by the regional health organization, and four hospitals located in the four main towns of the province. Another example of the application of this model for reasons of geographical size is Valle D'Aosta. Another interesting insight comes from southern Italy, which favors a bureaucratic model, clearly influenced by the local society, typically organized through certification of its processes. The Southern Italy's backwardness problem can be seen, therefore, in the health sector where, with an organization more focused on results the North of the country proves, even in this area, to be more advanced and more likely to better respond to any breaking points. A special mention must be made of the organizational system of the Emilia-Romagna and

Tuscany regions. In fact, it has a model called **concertation**, that is, an organization where, for the discussion of objectives, there are particular moments of dialogue between the various levels of government for the decision of strategies and objectives to be reached.

From this discussion, it is possible to derive in practice a matrix that represents the models adopted by the various Italian regions, thus giving us the opportunity to observe all regional structures in as much detail as possible and prepare us to better read what will be the overall results on the individual response to the pandemic.

<i>Institutional structure</i> <i>Type of governance</i>	Integrated	Separated	Mixed
Bureaucratic	Abruzzo, Molise		Campania, Sicily, Calabria, Apulia, Lazio
Centralized	Veneto, Trentino, Alto Adige, Valle d'Aosta		Basilicata, Sardinia, Piedmont, Liguria, FVG, Marche
Contractual		Lombardy	Emilia Romagna, Tuscany, Umbria

Figure 16: Matrix of the Italian's regional healthcare organization

Furthermore, in order to best evaluate performance within the regional health care, a process must be followed that also takes into account external factors and the starting conditions of a given region. For this reason, a system was developed by Mapelli et. al (2007) for cross-regional evaluation, and is a scheme typical of the transformation of resources, material and otherwise, into final results.



Figure 17: Regional performance evaluation method (Mapelli, 2007)

The governance of the health system is influenced, first and foremost, by the stability and continuity of the political majority of the regional government, which favors the constancy of

strategic choices and their implementation over time. A factor that is difficult to quantify, but certainly relevant, is also the history of the Region and the culture of the regional administrative apparatus; further elements that can facilitate government action are the number of health agencies and hospitals present, which represent autonomous decision-making centers with which the Region must continually deal, and the greater or lesser presence of accredited private facilities with which they have contractual relationships.

The components of a governance system are tools and capabilities. The tools are the human and technological resources, the organization, the information system of the Department and the agencies that collaborate with it. The additional resources, which the Region can draw on through taxation, allow greater freedom or can represent a limitation for regional action. Similarly, local availability and the use of state investment funds can facilitate the improvement of health services and the effectiveness of regional action. Capacity refers to the intangible elements: knowledge, professionalism, relationships, authoritative or participatory styles; that make government processes work. It is the ability to have a strategic vision and to implement the objectives, to control the management of the Health Boards, to negotiate objectives and resources with the Boards and private facilities and, finally, the social responsibility to account to stakeholders for the results achieved.

The performance of a governance system can be captured by the results achieved in several areas. First of all, the effectiveness, quality, appropriateness and efficiency of health services provided to the population, together with the ability to innovate and respond to the needs of service users, such as: freedom of choice, satisfaction, waiting lists. Last, but certainly most important, are the final results produced, in terms of improved health status and equal access. Mapelli et al. (2007)⁴² carry out empirical research to be able to compare precisely these regional data. The first results, related to the correlations between variables, give very good response on the connection between governance resources and process results and on the final results of health; trying to summarize the results of the study, the overall performance of regional health services depends very much on the capacity of governance and the regional context, little instead on the available financial resources. For completeness, the figure below shows the entire correlation between macro-areas in the objective evaluation of performance.

⁴² Mapelli et al. 2007. I sistemi di governance dei servizi sanitari regionali. Formez.

	Context	Governance	Management	Process	Results	Performance	Expenditure
Context	1	0,60	0,44	0,64	0,77	0,73	0,49
Governance		1	0,58	0,70	0,66	0,72	0,20
Management			1	0,70	0,46	0,80	0,05
Process				1	0,78	0,89	0,40
Results					1	0,86	0,41
Performance						1	0,27
Expenditure							1

Figure 18: Correlation matrix between macro areas of evaluation (Mapelli et al 2007)

Another insight that stands out is the low correlation between overall spending and the rest of the variables, this result gives a lot of importance in terms of the quality of the organization, which is the real variable that makes a difference in performance. The logical conclusion is that a good management can still prevail even in lack of funds.

In the same research, Mapelli was able to compare all Italian regions following this evaluation standard and organizing the results as an arithmetic mean of the single evaluations of each indicator. The result (Figure 18) rewards the northern regions and, in particular, those with a contractual organizational model, more focused on objectives than on process. As expected, the regions with a bureaucratic model, more static and less inclined to change, despite in some cases presenting a strong governance, are flawed in terms of performance; demonstrating once again that the 1999 health reform presented interesting and useful ideas for improving the regional health system.

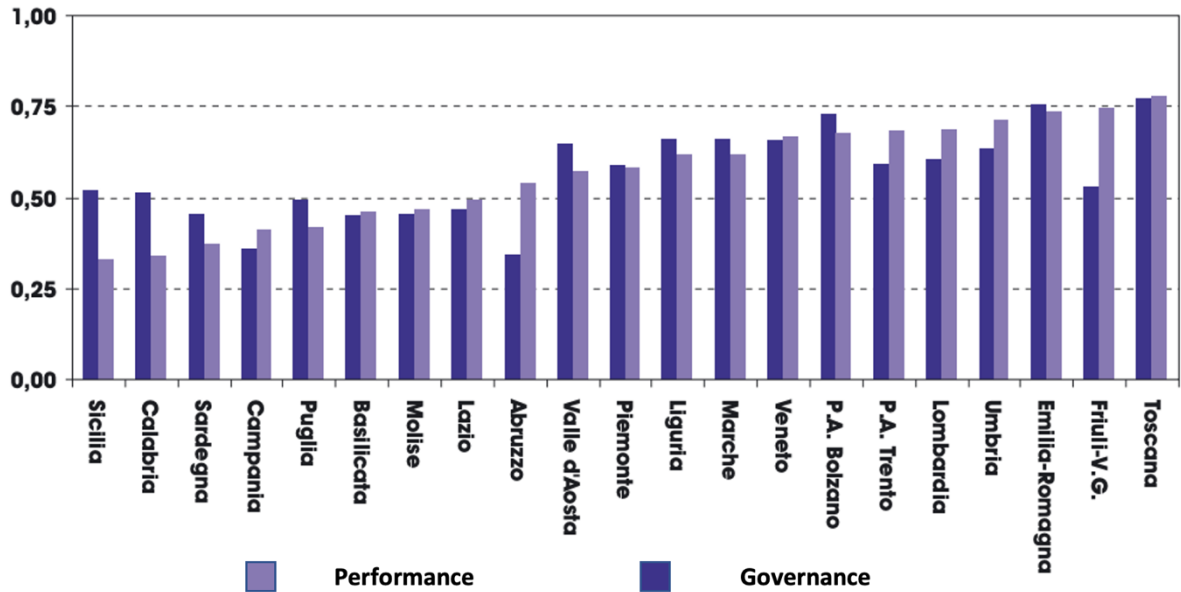


Figure 19: Arithmetic mean of the principal performance indicators of service quality in health care for each region of Italy. (Mapelli et al. 2007)

Another insight that can be gleaned from these results is that the system's best governance capacities do not depend on the institutional structure chosen by the Region for the network of agencies. Among the Regions with integrated systems, in fact, there are Regions with well-structured governance structures in the North and others with poorly structured structures in the South. However, among the Regions with a mixed, but highly integrated system, those with good governance resources prevail over those with fewer resources (Puglia, Basilicata, Calabria). Among those with mixed, but very separate systems, governance capacities appear more scarce (FVG, Lazio, Campania, Sicily).

In order to lay the foundations for a more in-depth study of the current pandemic and the response of the health system, the most important indicators for a regional health system must first be observed and compared in order to have a shared starting point between the different regions.

<i>Region</i>	<i>N° of ASL</i>	<i>Average population per ASL</i>	<i>Doctors per capita</i>	<i>Beds per capita</i>	<i>Intensive care per capita</i>
Abruzzo	4	323485	243	297	8684
Basilicata	2	276627	278	299	9070
Calabria	5	378822	314	337	11012
Campania	7	816020	295	333	8953
Emilia Romagna	8	558015	249	258	8360
FVG	5	241243	218	279	8741
Lazio	10	575570	401	276	8153
Liguria	5	304965	261	266	7586
Lombardy	8	1253450	326	265	9773
Marche	1	1512672	246	289	10361
Molise	1	300516	338	258	7706
Piedmont	12	359268	272	261	10942
South Tyrol	1	532644	220	279	9028
Trentino	1	545425	254	255	13636
Apulia	6	658884	301	319	10714
Sardegna	1	1611621	191	291	9650
Sicily	9	541699	275	304	9485
Tuscany	3	1230852	229	307	8668
Umbria	2	435083	225	269	10877
Valle d'Aosta	1	125034	202	258	12503
Veneto	9	542126	293	279	8682

Figure 20: Local Health Authorities in key data (source: Ministero della salute, 2019)

First of all, analysing the number of Local Health Authorities within the territories, it can be immediately noted that the regions with a low population, such as Molise or Valle d'Aosta, have only one Local Health Authority; curious is the choice of Marche and Sardinia, which, having only one service provider, maintain a centralised model that brings the two highest values based on the number of citizens managed by the authority. Secondly, it can be observed that, in most cases, bureaucratic models are often accompanied by a high number of ASLs. This is due to two factors, firstly, the need to have a well-defined structure certifying the process, and secondly, because they have a geographical distribution with on average larger spaces and a larger population. On the basis of these results, it is possible to further separate the regions that have a centralized governance model, the first group being the small regions that exploit this system for geographical reasons, the second being the cluster of larger regions, such as Veneto or Piedmont, which fully apply the idea of regional government as a "holding"

for the ASL. Another important aspect to consider is the mean and median of the average population sampling per ASL. The arithmetic mean is 624953, but if we look at the median, which is slightly more reliable in a situation where data are few and there are outliers, we can see that it is 541699, which is the figure for Sicily. On the basis of this reasoning, it is easy to see those two of the four regions using the contractual model have very high values when it comes to the average population served by a single Local Health Authority, which are Lombardy and Tuscany.

Going on with the analysis of these macro-areas, the three main indicators are represented on a histogram, ordered from the smallest to the largest, in order to have a more comfortable visual reference than the table representation:

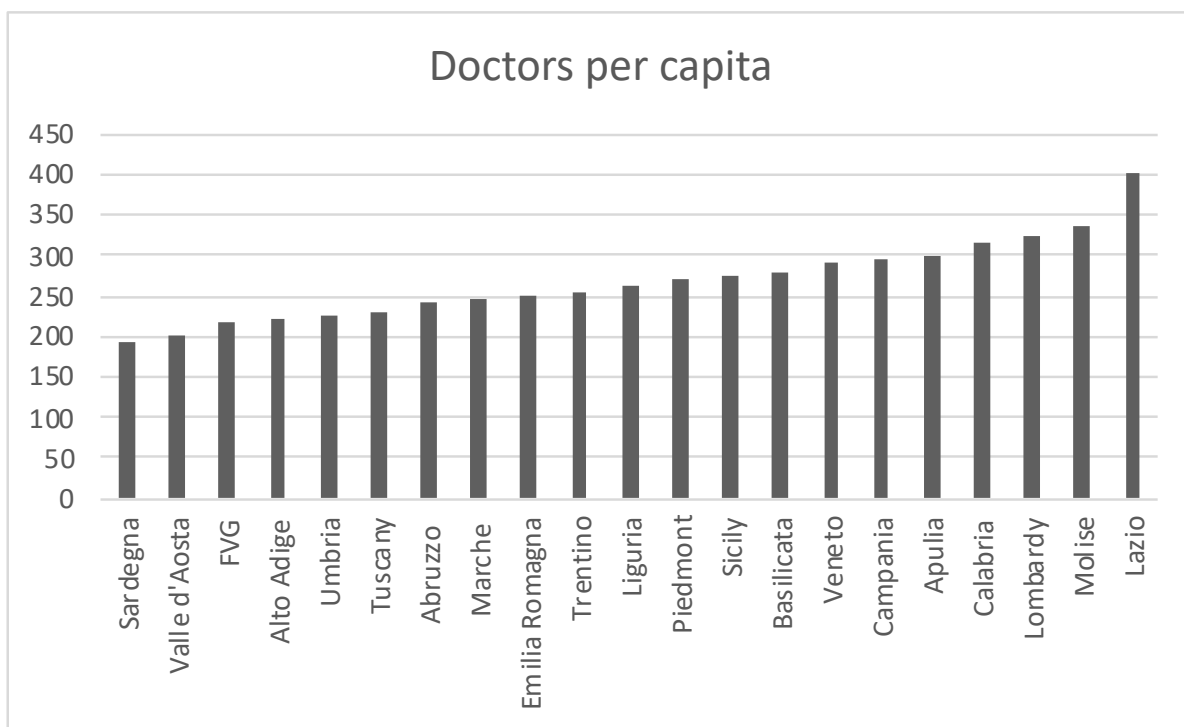


Figure 21: Doctors per capita for every Italian Region, Italian Ministry for Health (2019)

This indicator relates the total number of doctors present on the territory to the population of the region; in this situation the highest value is in Lazio with 401 inhabitants per doctor, while the lowest is in Sardinia with 191. The average and median values are 261 and 268 respectively, which are relatively close to each other and thus indicate an almost perfect symmetry of distribution. A first indication comes from the most populated regions, Campania, Lazio, Veneto and Lombardy in fact present very high values since they have to cover a larger

population and probably manage to exploit certain economies of scale due to the enormous supply of health services they have to provide. Secondly, it should be noted that the regions of southern Italy present higher values on average. There are two possible explanations for this phenomenon: the first one is that with a smaller number of doctors, the hospital structures and doctors are more efficient, or that there is a long-lasting situation of lack of personnel that could sometimes lead to inefficiency or malfunctioning of the system. Being a more developed model in the south of the country, a correlation can be drawn between bureaucratic governance model and index increase. While the institutional structure does not seem to have much impact on this phenomenon.

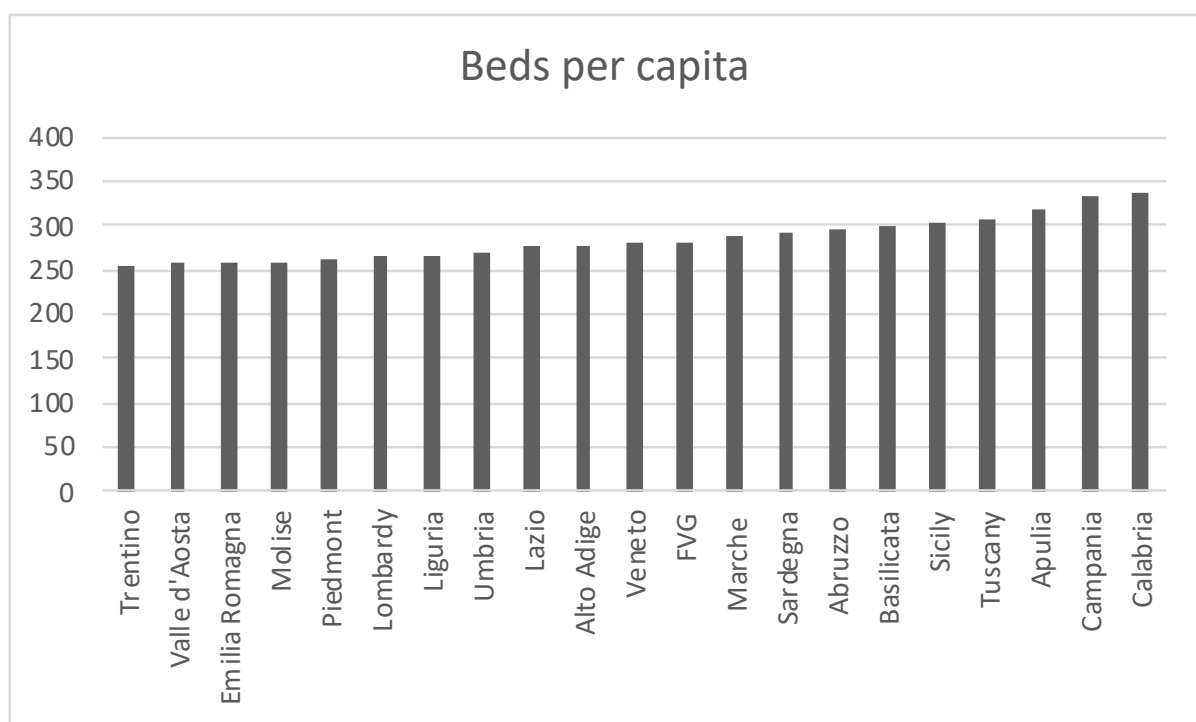


Figure 22: Beds per capita for every Italian Region, Italian Ministry for Health (2019)

The analysis of beds per capita shows that, within the national territory, there are no differences as high as for doctors. The standard deviation within the population is in fact 24 and the difference between the upper and lower limits is 83, represented by Trentino and Calabria respectively. In this case the presence of more beds is certainly to be seen as a positive factor. In contrast to the situation analyzed above, there is a gap between the regions in the south of Italy, which are at a disadvantage compared to those in the north, in this case no longer on average but in their entirety. The outlier in this reasoning is undoubtedly the region of Tuscany, which lags behind the other three regions with contractual governance models and seems to be

affected by the lack of additional beds. As in the analysis of physicians per capita, in this situation the median and the average are practically aligned and are respectively 285 and 279, demonstrating a very slight asymmetry of the population towards the upper extreme.

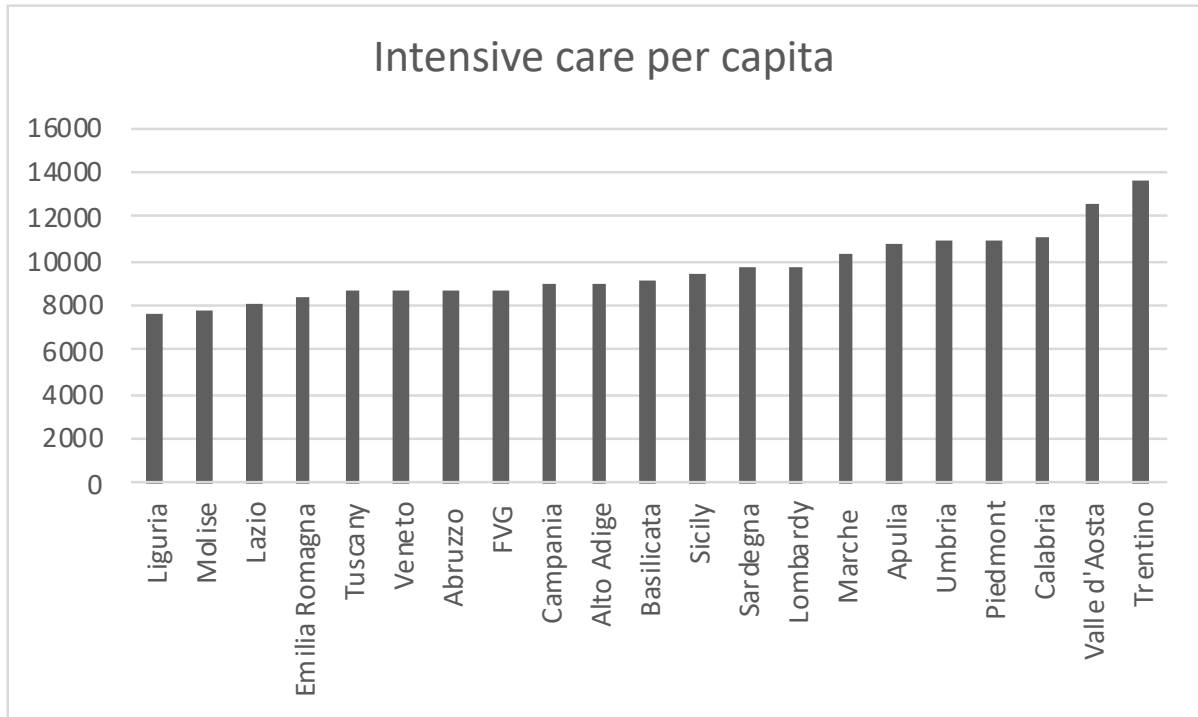


Figure 23: Intensive care per capita for every Italian Region, Italian Ministry for Health (2019)

The analysis of intensive care beds is usually an end in itself as there is never a real risk of sudden filling of them. Unfortunately, however, what was thought to be an unimportant indicator, within the emergency situation that has developed over the last year and a half, has become of central importance once again. In this analysis, it can be seen that the statistical population is very diverse and distant, with a difference between the extremes of 6049 and a standard deviation of 1505. In this case, unlike the two previous analyses, the mean and median are very far apart at 9647 and 9070 respectively, showing an asymmetry of the population towards the lower extreme, fortunately. However, the situation of intensive care does not seem to be related to governance or institutional models but will most likely be linked to the choices that have been made along the historical path of individual regional health systems.

THE ITALIAN HEALTHCARE SYSTEM'S RESPONSE TO THE COVID-19 PANDEMIC

The Ministry of Health in Italy set three main temporal spaces divided by an increase or decrease in the R_t index and subsequent expansion or constriction of the epidemic. The first one, defined as the first wave is located between the discover of the first cases till the beginning of June and is characterized by a nationwide restrictive lockdown and a surge in the number of infections. The second phase, on the other hand, involves a gradual reopening with the number of infections gradually shrinking until the start of the third phase, or second wave of covid, which has October 2020 as its starting point. This phase is characterized by a different regional treatment, and a classification according to the different levels of risk, is divided into three zones: yellow, orange and red.

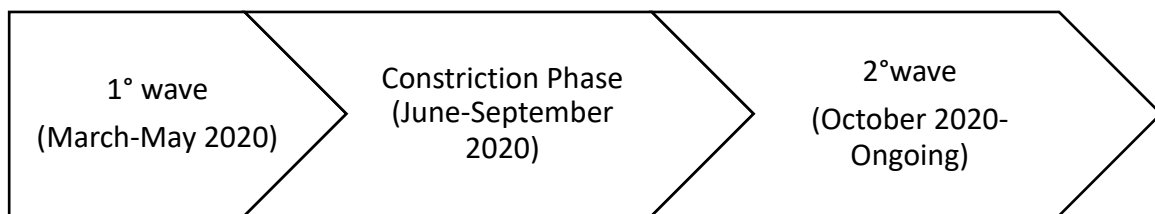


Figure 24: Timeline of the Covid-19 pandemic in Italy.

The lowering of summer infections is mainly due to climatic factors as shown by the study carried out by Mandal and Panwar (2020) which demonstrates that the chance of COVID-19 cases in warmer countries is fewer than in colder countries and that a cold environment may be an additional risk factor for SARS-CoV-2 infection. Thus, the study of the effectiveness of health care choices and index trends during the summer phase is not particularly relevant. The analysis will therefore focus mainly on the two waves that occurred eight months apart, trying to understand which regions performed best in terms of health choices and containment and how these choices impacted on the spread of the epidemic.

Data and methods

To observe the pandemic trend, we use a variable called Baseline reproduction number (R_t), which represents the average number of cases generated by an index case in a population fully susceptible to the disease. This value is represented by positive real numbers and has as reference the value 1, in fact, if the variable takes values less than one it means that the epidemic is waning, on the contrary, if the value is greater than one it is expanding. From that value we can also get two other useful insights: the first is the course of the epidemic in the short term, the second, and the most valuable for our purpose, is the impact of interventions and management throughout time. In Italy, we're used to calculate this variable on a weekly basis, because daily transmissibility can be affected by special events and because in the data collection there are a number of delays: the time between the infectious event and the development of symptoms, the time between the symptoms and the execution of the swab, the time between the execution of the swab and the confirmation of positivity, and the time between the confirmation of positivity and the inclusion in the ISS integrated surveillance system. By calculating this variable weekly, these delays tend to harmonize and reduce the calculation error. For the calculation we start from the estimation of the daily transmissibility $G(t)$, using the Markov Chain Monte Carlo statistical method, which calculates the probability of the occurrence of an event under certain conditions, in this case the probability of contagion.

$$\mathcal{L} = \prod_t^T P(C(t) - I(t); G(t) \sum_s l(s)C(t - s))$$

Where:

- $P(k; \lambda)$ is the density of a Poisson distribution, that is, the probability of observing k events if they occur at an average frequency λ . \mathcal{L} allows us to compare at each time t the number of cases estimated with the renewal equation $G(t) \sum_s l(s)C(t - s)$, with the locally transmitted cases, $C(t) - I(t)$.
- $C(t)$ is the number of symptomatic cases with symptom onset date on day t .
- $I(t)$ is the number of symptomatic cases imported from another Region or from abroad having symptom onset date on day t .
- $l(t)$ is the distribution of the generation time (the time between infection of an index case and infection of the generated cases), approximated by the serial interval (the time between symptom emergence in an index case and symptom emergence in the

generated cases), a gamma distribution with parameters of shape = 1.87 and rate = 0.28, estimated from data of the Lombardy Region⁴³.

To calculate the weekly value of the index therefore it will be sufficient to apply the weekly average of transmissibility, in this way it is possible to arrive at the final result of $R(t)$:

$$R(t) = \frac{1}{7} \sum_{s=0}^6 G_i(t-s)$$

In order to calculate this index, an algorithm provided by the Istituto Superiore della Sanità was used, subsequently implemented in R language. Within which the data obtained from the Civil Protection, which indicated for each single day, and for each region, all the indications of new contagions, were inserted. The algorithm is given in the first appendix.

⁴³ Cereda et al. 2020. The early phase of the COVID-19 outbreak in Lombardy. ArXiv.

Macro perspective: The national response

In view of the evolution of the epidemic, on 30 January 2020 Italy suspended flights to and from China; however, the following day the first two cases of Covid were confirmed in Italy: two Chinese tourists were admitted to the Spallanzani Hospital in Rome. On the same day, the first legislative measure concerning Covid was issued: The Council of Ministers declared a state of health emergency⁴⁴. Once the state of emergency has been declared, the State is entitled to restrict personal freedoms for health reasons, as provided for in Article 16 of the Constitution, derogating from the rules of law (while respecting the general principles of the order) through the power of ordinance. In the same decree, the Council of Ministers decided that, for the implementation of the interventions to be carried out during the state of emergency, orders would be issued by the Head of the Civil Protection Department in derogation of any provision in force; in fact, the Head of the Civil Protection Department took over every decision, on a national scale, concerning the Covid epidemic, thus creating the first organizational response to the ongoing threat.

The first interventions⁴⁵ are aimed at organizing and carrying out:

- Relief and assistance to the population affected by the health emergency.
- The removal of situations of danger to public and private safety.
- The provision of any additional measures to prohibit air, land and sea traffic on the national territory.
- The return of people from countries at risk and assisted repatriation of foreign citizens in the countries of origin exposed to risk.
- To the purchase of medicines, medical devices, individual protection.
- To the requisition of movable, registered and immovable property, to the restoration or enhancement, also with procedures of extreme urgency, of the functionality of public services and infrastructures necessary to overcome the specific emergency and to the adoption of measures aimed at ensuring the continuity of the provision of health care services in the territories concerned, also through interventions of a temporary nature.

⁴⁴ A state of emergency is a legal condition that can be triggered by the occurrence or imminence of exceptional events such as the Covid-19 pandemic, earthquakes or floods. In other words, when it is necessary to act urgently and with extraordinary powers to protect citizens and repair any damage.

⁴⁵ Ordinanza della Presidenza del Consiglio dei Ministri – Dipartimento della Protezione Civile N. 630

In addition, the Scientific Technical Committee is established, initially composed of scientific and political reference figures such as, for example, the Secretary General of the Ministry of Health or the Scientific Director of the National Institute for Infectious Diseases "Lazzaro Spallanzani". This committee can also be integrated in relation to specific needs. Through these measures, the foundations are laid for the organizational resilience that centralizes, for the entire national territory, the management of issues related to the pandemic. As will be seen below, the provisions of this direction will be implemented by each individual regional administration which, with its own ordinances, will confirm what is decided by the national government.

Subsequent ordinances, up to February 21, concern individual measures and situations such as the return of students from abroad or the management of athletes returning from abroad. This day will be crucial with respect to the Italian history of the Covid pandemic: in fact, the so-called "Patient 1" is identified at the Hospital of Codogno (Lombardy) and, in rapid succession, 14 other patients positive to Covid are identified; in the same day the first death of an Italian patient is recorded in Vò Euganeo (Veneto). Also on February 21, an ordinance⁴⁶ was passed to increase the number of medical personnel, particularly dedicated to the performance of the functions of port and airport doctors in the field of international prophylaxis; the attempt is to control and isolate the possible entry of patients from abroad infected with the virus.

On the same day, the Ministry of Health published a circular letter entitled: "COVID-19. Nuove indicazioni e chiarimenti"⁴⁷ where the organizational and strategic foundations are laid in the fight against COVID 19:

- Ensure strict application of infection prevention and control measures (standard, airborne, droplet and contact precautions) in all healthcare facilities, including emergency departments.
- Define a pathway for patients with respiratory symptoms in primary care physicians' and pediatricians' offices, such as the scrupulous and systematic application of the above measures.
- Apply procedures for the assessment, activation and management of the intervention of taking charge and transport of the patient by 118 operators, the operations center will

⁴⁶ Ordinanza della Presidenza del Consiglio dei Ministri – Dipartimento della Protezione Civile N. 637

⁴⁷ This circular supplements and complements Circulars No. 1997 of 22.01.2020 and No. 2302 of 27.01.2020.

contact the reception staff of the Infectious Diseases Unit of the DEA of Level II of reference to agree on the mode of transport and arrival times at that facility. Trying from the organizational point of view, to limit the contacts within the emergency rooms.

- Implement activities to raise awareness among the population, with particular reference to schools.
- General Practitioners and Pediatricians are mandated to equip themselves with personal protective equipment (mask, gloves, goggles, disposable gown), to report the patient to 112/118 or through the organizational paths provided by the individual regions and to report the suspected case to the Infectious Diseases Unit of the DEA of Level II reference.
- Access to ER/DEAs should include an immediate route and a dedicated triage area to avoid contact with other patients. Healthcare facilities are required to hospitalize the patient, where possible in single isolation rooms with negative pressure, with a dedicated bathroom and, if possible, an anteroom. Also calling attention to the need for training of healthcare personnel, which is a very good practice when it comes to operational resilience on the proper methods for donning and doffing PPE.
- In the case of a paucisymptomatic⁴⁸ patient or negative close contact to the test, home care is foreseen and report the case to the Prevention Department of the ASL for active surveillance.
- In the case of a patient found positive to the SARS-COV-2 swab and at the moment asymptomatic, home quarantine is foreseen with active surveillance for 14 days.
- Regions are also required to designate a dedicated facility for the management of the Covid emergency and laboratories to perform molecular diagnosis on clinical respiratory specimens, which will be done only for symptomatic cases, in addition to suspected cases.

On February 23, the Prime Minister, in agreement with the Lombardy Region, arranges for the institution of the first red zones in the concerned municipalities, the lockdown is put in place, which will then be extended to the entire country and can be summarized in the following measures:

- Suspension of events and any form of meeting in public or private places, of the frequency of educational activities, of competition procedures and of the activities of

⁴⁸ Infected patient who has minor symptoms

public offices, except for the provision of essential services and of public utility and finally the closure of all commercial activities.

- Prohibition to travel, both on the national territory and abroad.
- Obligation to communicate to the Department of Prevention of the Health Authority responsible for the territory for individuals who have entered Lombardy from areas at epidemiological risk, as identified by the World Health Organization.
- Application of quarantine measures with active surveillance among individuals who have had close contact with confirmed cases of infectious diffusive disease.

Two days later these measures will be extended⁴⁹ by means of a Prime Ministerial Decree to the Regions of Emilia Romagna, Friuli Venezia Giulia, Veneto, Liguria and Piedmont. However, the seriousness of the situation is not at all perceived in the country; it is enough to think that the secretary of one of the major Italian political parties attends an aperitif with young people on the Navigli and the message is "don't panic", the mayor of Milan relaunches the hashtag #Milanononsiferma, and a similar message is relaunched by the mayor of Bergamo. There is absolutely no perception, in the society, about the gravity of the situation that is about to explode.

ISS is entrusted⁵⁰ with the epidemiological surveillance of SARS-CoV-2 with the obligation of Regions and Autonomous Provinces to feed daily the data platform, the same ISS is entrusted with the microbiological surveillance and the Spallanzani Institute of Rome with the surveillance of clinical characteristics. Late February, the Ministry of Health⁵¹, recognizes that: 5% of patients affected by Covid may present clinical conditions such as to require admission to intensive care with the need for ventilatory assistance. On the basis of this clinical observation, the Circular lays the organizational foundations to which all Regions must adhere, in fact: "It is therefore considered necessary that the Regions prepare an emergency plan for the management of critical patients affected by Covid, which allows to ensure appropriate levels of treatment through an adequate number of intensive care beds. Without prejudice to the fact that each Region must prioritize the identification of one or more facilities to be dedicated to the exclusive management of patients affected by Covid ("COVID Hospital") in

⁴⁹ Decreto attuativo del Presidente del Consiglio dei Ministri of 25.02.2020

⁵⁰ Ordinanza N. 640 of 27.02.2020 of Protezione Civile

⁵¹ Through a circular, entitled: "Guidelines for the care of critical patients affected by Covid-19"

relation to epidemiological dynamics, plans must be prepared for each of the territorial areas that provide for:

- The identification in each hospital facility of isolated stations that allow the observation of ventilated/intensive patients with suspected Covid infection while waiting for the final result of the diagnostic tests performed.
- The creation of distinct intensive care units (with physical separation from other intensive care units in the hospital) for the admission and treatment of patients with Covid. These intensive care units should be created as a priority in hospitals with infectious disease departments and in referral hospitals.
- The creation of protocols that identify the criteria for access to intensive treatment of patients with Covid, their clinical and care management, including aspects of distribution and use of PPE and related staff training.
- The provision to expand the capacity of each hospital through the activation of critical area beds currently not functioning and the process of rescheduling the programmed activities.
- The urgent scheduling of training for healthcare personnel in the use of ventilation systems and the correct adoption of PPE.

This Circular sets the organizational basis to which all Regions and Autonomous Provinces will have to adapt and prepare the fight against Covid according to these provisions; the next day, on the basis of the dramatically increasing numbers of people tested positive, another Circular is issued, again by the Ministry of Health; in which the concepts of the Circular of the previous day are reiterated, but also given precise provisions on an increase in the availability of beds; in fact, the CTS (Technical-Scientific Committee) considers it necessary that in the shortest time possible a model of interregional cooperation coordinated at the national level is activated and commands at the regional level an increase in the availability of beds, in particular 50% of beds in intensive care and 100% of the number of beds in the Operating Unit of Pneumology and Infectious Diseases, including through the local remodeling of hospital activities, redistributing the health personnel assigned to care, providing a "rapid" training path.

On March 8, 2020 is issued a new decree by the Council of Ministers; this decree in fact establishes the national lockdown; in fact, on the entire national territory are suspended conferences, meetings, events and shows, pubs activities, dance schools, museums, suspended

all sporting competitions, educational services for children and all schools of all levels, educational trips; it is recommended, where possible, the DAD⁵²; prohibition to stop in emergency rooms (for carers) and visits to RSA; increased the mode of agile work; it is forbidden for people positive to Covid to leave their homes. In the same decree there are also clear indications of health type, from the disinfection of environments to the recommendation to "fragile" patients to leave their homes. Finally, the indications regarding specifically the obligations of health workers: the public health operator and the territorially competent public health services provide the prescription of the home stay, and therefore also become responsible for the entire tracking of cases. The beginning is from the following day; in fact, the evening of the decree, at 20.45 hours, the derby of Italy between Juventus and Inter is played, without public; it will be the last official sporting event held in Italy until the resumption of until May⁵³.

Concern swept through the financial markets; on March 11, the Milan Stock Exchange closed its session with the worst collapse in its history; in fact, the FTSE MIB index fell dramatically by 16.92%; the other stock exchanges did not fare any better; on March 13, 2020, Wall Street fell by 12%, which was the steepest decline in the 2000s. On March 16, a Circular of the Ministry of Health puts the accent on clinical and organizational issues; in fact, the focus is on scheduled activities in hospitals and outpatient clinics; this circular provides priority for Covid-19 patients by ordering, for programmable pathologies, a postponement and rescheduling; this provision applies throughout the country.

From March 16, 2020 to May 10, 2020, numerous Ordinances, Circulars and legal provisions are prepared by the Head of Civil Protection, the Council of Ministers and the Ministry of Health that modulate and integrate the fight against Covid-19 with technical and organizational measures; for example, recommendations on the proper use of PPE, on the use of electronic and not paper prescriptions, on the management of immunocompromised and oncological patients or on the activities of Gynecology and Obstetrics, with indications on the activity of prevention and control in the Departments of Mental Health and Services of Child Neuropsychiatry⁵⁴, with indications for the doctor in charge, with the creation of monitoring

⁵² Distance learning

⁵³ For the record, Juventus won 2 to 0.

⁵⁴ April 23, 2020

activities, with the activation of the psychological listening service⁵⁵, but organizational measures are also put in place, such as the strengthening of the NHS with the hiring of interns⁵⁶, the establishment of a Specialist Medical Unit of approximately 300 physicians to support regional health facilities⁵⁷ and Nursing Units⁵⁸, with the establishment of the Socio-Health Units available to the Regions.

At the end of March also Europe moves; in fact, the Council and the European Parliament prepare measures to amend the European Regulation in order to give member states more money to fight Covid⁵⁹. Exactly one month later the European Parliament will issue two European Resolutions that will modify again the European Regulation in order to fight against Covid⁶⁰.

On May 19, 2020, Decree Law No. 34 finally lays the groundwork for a true reorganization of the National Health Service; in fact, this decree expressly mentions the need for, and therefore the consequent application of, a reorganization of both territorial assistance and the hospital network. The decree is made up of two main provisions, the first of which regards urgent provisions on territorial assistance and concerns the regions and autonomous provinces that are obliged to adopt plans for the strengthening and reorganization of the assistance network. The health companies, through the districts, must provide for the implementation of activities of integrated home care or equivalent, for patients in isolation also hosted in the facilities identified. In addition, the SSR must provide for the activation of regional operations centers, which perform the functions in conjunction with all services and the emergency-urgency system, including through information tools and telemedicine. The second measure called "Reorganization of the hospital network in relation to the Covid emergency" obliges the regions and the two autonomous provinces to increase inpatient activity in Intensive Care and in areas of high intensity care, making the response to the significant increase in demand for assistance structural in relation to the subsequent phases of management of the epidemiological situation. This structural increase determines an endowment equal to 0.14 beds per thousand inhabitants in intensive care, an additional 4225 beds in semi-intensive area on the national territory that,

⁵⁵ May 6, 2020.

⁵⁶ Decreto-legge n.18 of 17.03.2020

⁵⁷ Ordinanza n. 654 of 20.03.2020 of Protezione Civile

⁵⁸ Ordinance n. 656 of 26.03.2020 of Protezione Civile

⁵⁹ Regulation 2020/460 of the European Parliament and of the Council.

⁶⁰ Regulation 2020/592 and 2020/600 of the European Parliament and of the Council.

for at least 50 percent of the beds, it is expected the possibility of immediate conversion into intensive care. In addition, there is an obligation to consolidate the separation of pathways by making it structural and ensure restructuring with the identification of distinct areas of stay for patients suspected of Covid or potentially contagious, waiting for diagnosis. The Circular also specifies the organizational model and path of the hospital offer. The reorganization of the network of supply Covid should be articulated according to the gradual restoration of the hospital network Hub & Spoke organized by levels of increasing complexity, to ensure the ordinary activity at regime, maintaining as much as possible the elasticity of functions. Furthermore, it is foreseen the integration of additional supply nodes dedicated to maintaining structural support to the epidemic, i.e., facilities of the regional hospital network Hub & Spoke temporarily dedicated to Covid or, where it is not possible to activate them, areas or pavilions specifically dedicated within the hospitals of the Hub & Spoke network, with similar care capacity, with clearly separated paths and spaces.

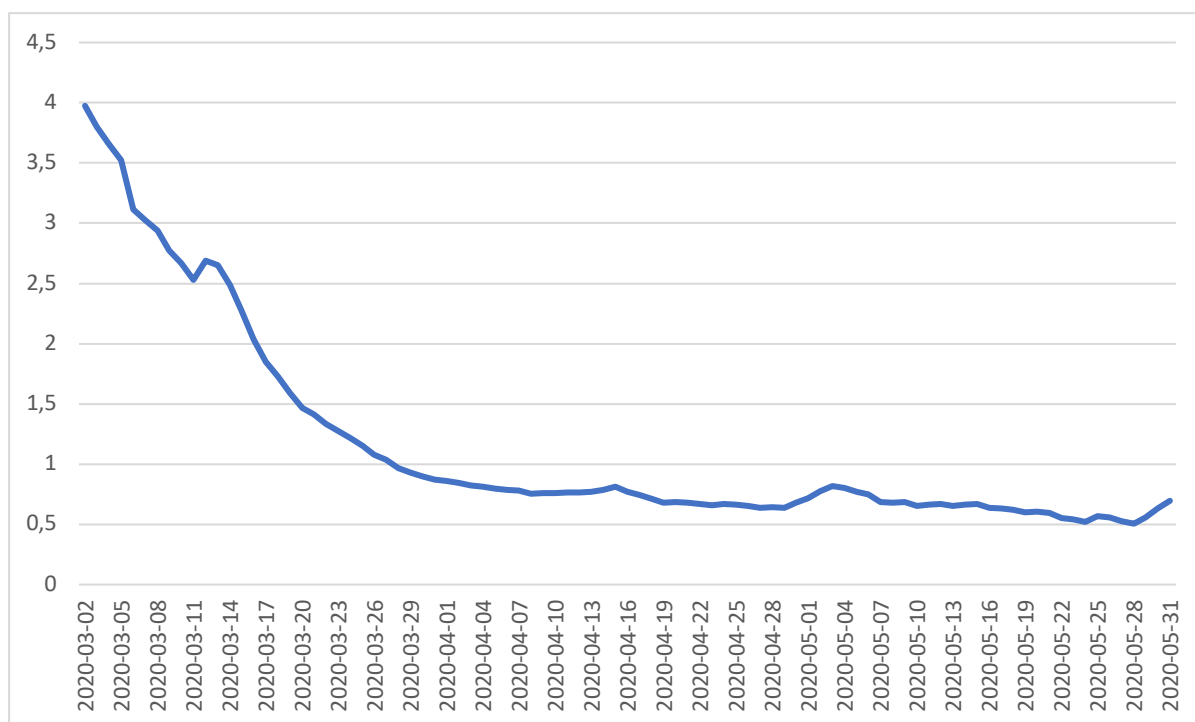


Figure 25: National $R(t)$ index during the first wave of the pandemic.

As can be seen from the graph above, which shows the epidemiological index $R(t)$ on a national scale from the beginning of March to the end of May, the health policies of containment have proved very successful in lowering the number of cases, succeeding in limiting contagions and, consequently, also hospitalizations and the general pressure on the hospital system, thus

allowing the entire sector to reorganize itself in order to prevent possible future similar situations.

In the following period there are other Circulars and other Decrees that address the various issues of the Covid emergency without, however, deepen the more properly organizational aspects; we mention only a few to show that, even in periods of low percentage of infections had not failed the attention to the problem of Pandemic from Covid: On August 11, 2020, the Ministry of Health issued a circular entitled: "Elements of preparedness and response to Covid-19 in the autumn-winter season" in which the possible scenarios of the end of the year 2020 are described with the likely responses to be given depending on the severity of the pandemic. Similar decrees and circulars were published on September 7, 2020 (with particular attention to protocols regarding outbound and return travel, concerning workplaces, schools and universities. On September 24 was issued a detailed circular regarding the opening of schools and again on September 29 a circular that shed light on molecular, antigenic, rapid tests and their correct use for statistical purposes and data collection. Fundamental then, from a general point of view the decree of October 7 that extended the state of health emergency until January 31, 2021.

On October 12, a new Ministry of Health Circular (of no less than 102 pages) entitled: "Prevention and response to Covid-19: strategy evolution and planning in the transition phase for the fall-winter period" was issued. In it is described in detail both the history of the Covid Pandemic in Italy, and the various issues that have been gradually addressed, up to the answers that have been given, the possible scenarios and the answers that will have to be given. It is interesting to report the "Glossary" that introduces terms and concepts that will become familiar and that will "condition" our lives in relation to their variance such as the $R(t)$ index or "the number of net transmissibility reproduction of a pathogen calculated over time in the presence of interventions".

The concept of "yellow", "orange" or "red" region and the consequent measures are introduced with the decree-law of November 3, 2020, entitled: "Further implementing provisions of Decree-Law No. 19 of March 25, 2020". This decree consists of 14 articles and 42 annexes: including all the provisions to cope with the pandemic and adopt a resilient system that knows how to live with the pandemic and adapt the behavior of the population to it. This decree identifies two categories of regulations: one is valid throughout the national territory while

others are valid only on a regional level; a differentiated regime is devised in three bands of contagion risk, according to the 21 parameters listed in the text of a scientific report attached to the new DPCM. According to the DPCM, the measures will be evaluated on a weekly basis, and will have a minimum duration of 15 days: for the effect, if a Region will be classified as red zone, it will remain there for at least two weeks. Each Region will be placed in one of the three bands on the basis of objective criteria. The Minister of Health will be able to adopt ordinances in agreement with the President of the Region in order to provide for the exemption of the application of one or more restrictive measures, even in specific parts of the regional territory.

- Yellow region is the moderate risk level zone, in which only the national limitations are applied.
- Orange zone is the band that includes the Regions at medium-high criticality: on the territories there is the prohibition of any movement, in and out, from the Region (except for proven needs of work, health and urgency), allowed only the movements strictly necessary to ensure the performance of teaching in presence and within the limits in which the same is allowed, with consequent possibility of return to their home or residence. Is also prohibited any movement in a municipality other than that of residence, domicile or home, except for proven needs of work, study, health reasons, situations of necessity or to carry out activities or take advantage of services not suspended and not available in their municipality.
- The Red zone is the most critical zone: there is the prohibition of all movement in and out of the Region, but also within the territory itself, except in cases of necessity and urgency. Lockout for all non-food markets, closure of bars, pubs, restaurants, ice cream parlors, pastry shops, with the exception of catering with home delivery and, until 22.00, the takeaway, but with a ban on consumption on site or in the vicinity. Suspension of sports activities, including those carried out in outdoor sports centers. The school activities remain in presence only for kindergartens, primary and junior high. Public employers limit the presence of staff in workplaces to ensure only those activities that they deem essential and that necessarily require such a presence, also because of emergency management.

This law will remain in place for the duration of the second wave and sets the stage for a dynamic and resilient response, attempting to live with the pandemic and moving beyond the restrictive lockdown concept during Covid's first season.



Figure 26: National $R(t)$ index during the second wave of the pandemic.

The regional trichotomy, as shown in the graph, allows a degree of control over the pandemic trend through the $R(t)$ index, which should remain close to one. It can be said that in this situation, the health policies applied, have allowed a proper balance between situational control and pressure on health structures and personal freedom of the individual. The latter, harshly criticized during the first season of covid precisely because of the great personal limitations put in place, has been accepted differently by the population, probably because of the scale applied regionally and differentiated for each territorial situation.

Meso perspective: Regions and provinces with special statutes

Given the specificities of the national healthcare systems, each region had a fairly high degree of freedom in deciding internally its own organization in response to the covid pandemic. In this chapter we will discuss all the individual regions of which it has been possible to collect information, analyzing them in order of previous health care organization, first of all the bureaucratic regions, then the centralized ones and finally the contractual ones.

In Molise, for the first phase of the epidemic, the Cardarelli Hospital in Campobasso, a level I DEA, has been identified as the Hub for the taking on and management of suspected cases and patients affected by Covid infection. The Veneziale Hospital in Isernia and the San Timoteo Hospital in Termoli, which have the role of Spoke, has been equipped with new intensive care beds. In this region, it was therefore decided that, from the point of view of admissions to intensive care, the epidemic should be taken care of primarily within the regional reference hospital. This is due to two main reasons: the presence of beds dedicated to isolation in the intensive care unit and infectious diseases temporarily separated paths in the emergency phase, and a reference analysis laboratory for carrying out diagnostic tests for the diagnosis of Covid infection. As far as the structured response to the second wave is concerned⁶¹, it was decided not to change the regional *modus operandi* and to continue with the previously developed Hub and Spoke system. The investments and organizational efforts were mainly concentrated on the Hub center, increasing the number of places in intensive care and building a structure adjacent to it for the observation and treatment of covid patients.

As far as Latium is concerned, it is important to take into account the specific features of Italy's largest metropolis, and also the capital, which is the focus of legislative activities that certainly could not afford a scarce response to the pandemic. During the emergency, a crisis unit was immediately set up, and a Coordinating Bed Manager was appointed for the hospital network. At the same time, this figure was also nominated for the Intensive Care Network, which allowed effective and efficient management of the high-intensity care beds. The Fondazione Policlinico Gemelli managed, for public health reasons, a health facility exclusively dedicated to patients suffering from Covid. The strategic location in the metropolitan area, the suitability to guarantee the appropriate confinement, the reception capacity with high volumes of activity were quality elements to the management of the entire network. This Foundation was therefore

⁶¹ DCA n.48 del 14.07.2020. Regione Molise.

identified as a Covid Hub. In addition, the Biomedical Campus, as a university polyclinic, played a decisive role in the Covid network, also in relation to its identification as a level I DEA in the Hospital Emergency network. In Lazio, therefore, a strategy has been chosen whereby two private facilities are at the center of a mixed network that includes both facilities dedicated solely to the treatment of Covid patients and mixed facilities. On a structural level, however, given the high population density, for the second wave the region focused on relieving congestion in the critical areas of the emergency rooms and of medicine and surgery, which were often overcrowded with critical patients requiring intensive care⁶².

In the Abruzzo Region, in order to cope with the emergency phase of the increase in the curve of the SARS CoV-2 infection, the conversion of inpatient operating units or services into Covid wards with low, medium and high intensity of care, semi-intensive therapies (IST) and intensive care units (ICU) of cohorts has been implemented, through the redevelopment of available or disused spaces, and with the simultaneous conversion of many wards. The Hub and Spoke integrated network model envisages the concentration of the most complex cases in a limited number of Hub centres, which, according to the regional programming, are identified in the following level I DEAs acting as Hubs for the Covid network: L'Aquila Hospital, Chieti Hospital, Pescara Hospital, Teramo Hospital and Avezzano Hospital. In addition, an emergency procedure for the construction of a "COVID-19 Hospital Pavilion" has been activated since 7 April 2020⁶³. The Operating Units of Infectious Diseases and Pneumology have been transferred to this new structure dedicated entirely to the management of patients affected by the pandemic. The Covid supply network, activated in the first phase, is redefined, making it not only structural, but also organically integrated with the regional hospital care network, with the simultaneous provision of an adequate logistic network, organised for the rotation and reconversion of equipment and instruments. The flexible reference model is, however, represented both by the definition of structures for the exclusive use and treatment of Covid related pathologies, with the reconversion of hospital pavilions, with the clear separation of pathways and the reconversion of in-patient operating units into Covid wards with medium or high intensity of care, such as in the P.O. of Pescara and Teramo, and by the implementation of hub hospitals, such as the P.O. of Chieti, L'Aquila and Avezzano, with clearly separated organisational paths to guarantee care safety.

⁶² DCA n. U00096 del 21.07.2020. Regione Lazio.

⁶³ DGR n. 334 del 15.06.2020. Regione Abruzzo

In Apulia, on the other hand, six referral hospitals have been identified, one for each ASL (AO Consorziale Policlinico di Bari and "Giovanni XXIII" Paediatric Hospital, AO "OO.RR" of Foggia; "V. Fazzi" Hospital of Lecce; "Perrino" Hospital of Brindisi; "SS. Annunziata" and "Moscati" Hospitals in Taranto and "Vittorio Emanuele II" Hospital in Bisceglie) plus three private nursing homes to support the region's largest population centre, the city of Bari. At the organisational level, it is of fundamental importance that all Covid patients or those suspected of being positive for the virus must be transferred to the reference hospitals only. It is therefore forbidden to admit these patients to different hospitals. At a later stage, however, during the restructuring and resilience plan of the regional health care system, further support from private treatment centers in mixed modalities was envisaged: facilities to be dedicated to Covid patients with intensive or sub-intensive care beds; facilities to be dedicated to Covid patients recovering after the acute phase but not releasable; accredited private facilities to which Operating Units insisting on public hospitals were transferred, for the emergency period only, subsequently entirely dedicated to Covid care, in order to avoid exposing fragile and immunocompromised patients to the aforementioned virus.

In the Calabria Region, in order to cope with the emergency phase of Covid, the orders issued by the President of the Region have commanded the suspension of outpatient activities and admissions except for those with urgent reasons, as well as dialysis. On the other hand, intensive care and infectious diseases beds have been upgraded as far as possible, with the redevelopment of available or disused spaces and the simultaneous conversion of many wards, both at the Hubs and at the Spokes located in the five provinces. Through this operation it was possible to increase the number of beds available in the Intensive Care Unit by more than 65% compared to the initial number of beds before the pandemic. And, with the DPGR no. 18 of 11 March 2020, it was defined the priority activation, for each Reference Area of the Calabria Region (North, Centre, South), of facilities to be dedicated to the management of patients affected by Covid. With the Order of the President of the Region no. 44 of 18 May 2020, the President of the Region ordered the restoration of all ordinary activities (which had already been gradually reactivated), bringing the hospital organisation back into line with the Hub and Spoke model. Therefore, the Covid supply network, activated and hypothesised in the first phase, has been redefined, making it not only structural, but also organically integrated with the regional hospital care network, providing for an adequate logistical network, organised for the rotation and reconversion of equipment and instruments and the adaptation and

restructuring of units in the medical area, which can be used both in the ordinary and in the high-intensity care infectious treatment regimes. The flexible organisational model adopted will make it possible to have a clinical inpatient area, with a higher intensity of care, on the "high care" model, with the distinctive feature of the simultaneous presence, within the same hospital structure, of intensive care activities with an inpatient section equipped for the admission and care of patients requiring bio-containment measures.

As regards the regions of Sicily⁶⁴, Basilicata⁶⁵, and Campania⁶⁶, the only documents at political level are on the distribution of funds to each ASL and the following increase in beds. Organisational action therefore remains private internally within the relevant SSR and is unfortunately not accessible.

The centralized regions organized themselves in this way:

Within the Liguria region, a Hub hospital has been identified, namely the Policlinico San Martino in Genoa and, in addition, the supra-regional Hub hospital Gaslini, an Italian centre of excellence for paediatrics, which has been given the task of managing paediatric cases at national level. In addition, mixed facilities were kept active, one for each ASL, while in Sestri Levante and Albenga it was decided to reserve the entire hospital for the reception of covid patients. This organisation remained structural even during the second covid wave.

Veneto was the second region to be affected by the pandemic, in fact, with DGR n. 344 of 17 March 2020 the "COVID-19 Epidemic Plan: urgent public health interventions" was approved. In the initial phase, an increase in the supply of additional beds has been provided, increasing the capacity of the Hub hospitals and equipping additional intensive and semi-intensive respiratory area beds, considering the presence of the latter to be of fundamental importance in order to allow the correct selection of patients to be assigned to intensive care and infectious diseases. Furthermore, the hospital offer has been remodelled, with the identification of hospitals entirely dedicated to the exclusive management of Covid patients. Thus, maintaining two levels of health care, within each ASL there were both hospitals entirely dedicated to the management of the epidemic and hospitals that continued to provide ordinary services.

⁶⁴ Decreto Assessore Salute Sicilia del 08.07.2020.

⁶⁵ D.G.R. Basilicata n. 437 del 02.07.2020.

⁶⁶ D.G.R. Campania 16 giugno 2020 del 16.06.2020.

In Friuli Venezia Giulia, 116 beds dedicated to the care of Covid patients were made available. More than half of them were made available in hospital centres with a level II DEA (Cattinara and Udine) and 1 IRCCS⁶⁷ dedicated to paediatrics (Burlo Garofolo), thus forming three clear Hub points, the remaining 52 in hospital centres with a level I DEA⁶⁸. This choice was functional in guaranteeing the availability of highly specialised functions (especially for pneumology and infectious diseases), while ensuring the availability of intensive care beds for other pathologies. In this way, in this region, a clear choice of internal division was made within each individual hospital, avoiding the creation of entirely dedicated hospitals but trying to distribute the weight of the pandemic over all the available structures.

In Sardinia, 94 new beds have been assigned, and priority has been given to the identification of facilities to be used for the care of Covid patients (SS Trinità in Cagliari, San Francesco in Nuoro and San Pietro Clinics of the AOU in Sassari), integrating them with the San Martino Hospital in Oristano, due to its barycentric position, and with the Santa Barbara Hospital in Iglesias. The latter solution, in addition to guaranteeing the separate management of any Covid patients, while keeping the other city hospital unconnected, would also make it possible to reduce the number of admissions to the SS Trinità hospital in the event of a deterioration in the epidemiological situation, thereby increasing the supply of Southern Sardinia's beds for Covid.

The ASUR⁶⁹ hospital network, spread throughout the Marche region, played a central role in responding to the need for care during the Covid epidemic. DGR 320/2020 identified hospital facilities exclusively for non-Covid patients (Urbino, Fabriano and Ascoli Piceno and specific operational areas of the Macerata facility), dedicated to guaranteeing the response to "time-dependent" healthcare needs and, in any case, to all those with clinical reasons that cannot be postponed. All the remaining ASUR hospital structures were responsible for guaranteeing the necessary care activities for Covid positive patients. In addition, the largest hospital in the region, located in Ancona, was identified as the hub of the pandemic. The overall organisation of the structure envisages the guarantee of continuity of services for the specialist areas pertaining exclusively to the AOU and the separation of pathways. The rapid spread of the pandemic in the Province of Pesaro-Urbino, where a high incidence/prevalence of the disease

⁶⁷ "Istituto di ricovero e cura a carattere scientifico", scientific institute for hospitalization and care.

⁶⁸ DGR n. 1224 del 07.08.2020

⁶⁹ "Azienda Sanitaria Unica Regionale", Marche's LHA.

was observed (about 40% of the regional case history), led to drastic and unavoidable organisational decisions. In order to deal with the health emergency and guarantee users timely access to treatment, another hospital, the Azienda Ospedaliera Marche Nord, was identified as the Covid structure. During the first phase of the pandemic, 39 intensive care units and 98 sub-intensive medicine units were activated, in addition to the 18 infectious diseases units, for a total of 151 units dedicated to the admission of Covid positive patients.

Trentino adopted a covid hospital, keeping it as the reference Hub (DEA I level of Rovereto), while the DEA II level hospital was strategically kept as a Spoke for the covid function in order to keep the Hub role for the rest of the emergencies. In the remaining hospitals in the province, their functions were maintained, separating covid wards from ordinary ones. No new temporary structures were adopted. South Tyrol, on the other hand, adopted a mixed system: at the beginning of the epidemic, the hospital in the capital, Bolzano, was taken as the reference hospital for covid patients, but later, as the number of cases increased, a mixed system had to be adopted for all the regional hospitals. In addition, two levels of the disease were identified: the acute phase was treated in the intensive care units; as soon as the disease waned and improvements were noted in the patient, they were transferred within the network to Spoke centers.

The Piedmont Region's hospital network for emergencies was defined by DGR 1-600/2014 and DGR 1/924/2015 and provides for an organisation in 6 reference areas, with the identification of level II DEAs playing the role of Hub centres, level I DEAs playing the role of speak centres. In order to deal with the Covid emergency, the Piedmont Region proceeded with the activation of specific system actions: like Lazio, a crisis unit was set up in coordination with the Civil Protection and the Department of Infectious Diseases Emergencies. An epidemiological surveillance system was set up according to national indications. The hospital supply and the containment or mitigation of the epidemic at a territorial level were strengthened in relation to the epidemiological scenarios. During the summer period, an attempt was made to gradually restore the ordinary activities of the Hub & Spoke hospital network, organised according to increasing levels of complexity, while maintaining a high degree of flexibility in the functions: specific supply nodes intended for the care of patients affected by the epidemic were integrated, as well as presidia of the regional Hub & Spoke hospital network entirely dedicated to Covid and specifically dedicated areas within the hospitals of the Hub & Spoke network and additional temporary structures. Of the six areas envisaged by the regional plan for emergency

management, only two have decided to activate actual Covid Hospitals. The Turin area chose the "Amedeo di Savoia" and "San Lorenzo" hospitals in Carmagnola, while the "South-West Piedmont" area chose the Saluzzo Civil Hospital. In addition, in the Piedmont region, the "OGR temporary health facility" in Turin was opened in April, entirely dedicated to the exclusive management of Covid patients.

Having concluded the analysis of regions with centralized organization, we can move on to see the response of contractual ones:

At the onset of the Covid epidemic in Emilia-Romagna, which was one of the first regions to be affected at the same time as Lombardy and Veneto, a plan was drawn up to identify three types of facility to be included in the Covid network: Covid Hub Hospitals equipped with an Infectious Diseases Unit and Intensive Care, Covid Spoke Hospitals equipped with Intensive Care Unit (but not with expertise in infectious diseases or pneumology) in which it would be possible to receive Covid patients in invasive ventilation with separate pathways. And finally, dedicated Covid hospitals with the possible transfer of the necessary competencies, defined as small-medium sized facilities equipped with intensive care or possibly convertible semi-intensive areas and in which non-transferable and non-isolatable activities are not carried out. Analyzing the possible scenarios for the evolution of the epidemic curve, the Emilia-Romagna Region already with DGR 368 of 20/04/2020, has deemed it appropriate to provide for the maintenance of additional equipment aimed at assisting a number of cases related to the permanence of the virus circulation for several months, although in a controlled way or to possible re-emergences of the Coronavirus or similar epidemiological emergencies. In order to follow up on the aforementioned resolution, provision has been made for the creation of intensive care areas through the renovation or completion of hospital wards or prefabricated structures. It is precisely the structures that are at the heart of the organizational restructuring in Emilia Romagna. In fact, measures have been taken to succeed in having a resilient system with structures that, while guaranteeing high standards and durability over time, can be activated in relation to epidemiological observations. The structures would fulfil the tasks of providing acute care for Covid patients, with network use with respect to the regional intensive care units, of receiving from semi-intensive facilities and beds for patients in semi-intensive care to promote the operational efficiency and safety of the regional intensive care units, of representing a "compensation" structure even during the period of slowdown and descent of the epidemic curve to allow the hospital structures to partially and gradually recover their

ordinary functions of responding to surgical needs not only for services that cannot be postponed. And lastly, and this should not be underestimated since it is the only region to have considered this, it should be a center available to the national emergency network. In addition, the hospital emergency-urgency structures have been identified to be kept operational also during epidemic emergencies, in relation to the safety characteristics of the structures themselves and the functions envisaged for the relative hospital.

From a structural point of view, in addition to maintaining the measures taken during the first wave, two types of structures have been provided for the future in relation to the Covid emergency network: Covid reference structures at which the entire diagnostic pathway in the first aid is foreseen, up to the possible admission of cases, and other structures at which the pathway for the evaluation of suspects is foreseen, as well as their stay pending the outcome of the test and possible transfer.

Since the last week of February, the Azienda Regionale dell'Emergenza Urgenza Lombarda (Lombardy Regional Emergency Service) has recorded a huge increase in emergency calls, as it was the first region affected by the epidemic. In view of the ever-increasing number of patients, it was initially planned to identify totally Covid hospitals to support the network of regional infectious disease units, which were immediately fully involved. For this purpose, the Lodi, Crema and Seriate hospitals were identified as reference points for the areas in which clusters of patients with Covid symptoms were detected in the very first few days and which were therefore already naturally and directly affected by a higher prevalence of patients with this pathology. The escalation of the epidemic was such that by 28 February it was decided that the above mentioned hospitals were not sufficient to deal with the emergency and other large hospitals were identified where entire wards could be dedicated to Covid patients. The Papa Giovanni XXIII Hospital in Bergamo was instructed to reserve first one and then two towers for this purpose, the IRCCS Policlinico in Milan was instructed to dedicate a Covid pavilion, as were the ASST Spedali Civili in Brescia and the IRCCS San Matteo in Pavia. Immediately, the main accredited private facilities in Lombardy, such as Ospedale San Raffaele and Poliambulanza in Brescia, also responded massively to the need for hospitalisation caused by the pandemic emergency. A plan to expand the range of microbiological diagnostics was launched immediately, evaluating the equipment and its ability to increase testing and involving other facilities in the network, bringing the regional diagnostic capacity from 2,000 swabs/day (at the beginning of March) to around 13,000 swabs/day by mid-April. Regional Council Resolution No. 2906 of 8 March 2020 approved a profound remodeling of inpatient

hospitalization and the radical suspension of outpatient activities, with the exception of non-deferrable services, in order to recover medical and nursing resources to strengthen the inpatient and emergency departments, increase the number of beds available in public and private accredited and contracted facilities, and allow for an adequate level of health and social care services, including for patients not affected by Covid, in compliance with safety criteria. In addition, a 500 bed ICU facility was set up at Milano Fiere, followed by the activation of the National Alpine Association's Field Hospital at the Bergamo Fair, the most affected city in Italy. A further two temporary structures, also equipped with intensive care beds, were subsequently activated at the Crema and Cremona Hospitals.

The reorganization led to the identification throughout the Region of:

- 3 hospital facilities dedicated to major trauma
- 4 facilities for non-urgent and urgent neurosurgery operations
- 10 facilities for the Stroke network
- 13 facilities for the STEMI⁷⁰ network
- 5 Facilities for Cardiac and Vascular Emergencies
- 2 facilities for orthopedic emergencies
- 2 facilities for oncological emergencies
- 5 facilities for the maternal and neonatal network
- 1 Neonatal Intensive Care Unit COVID
- 1 Pediatric Unit

In order to structure the response, the Lombardy region has also provided for the structuring of a plan that foresees activatable levels (from 1 to 4) of ICUs upon reaching more than 70% filling on several consecutive days.

In order to maintain the flexibility of the functions as much as possible, the Region of Tuscany has set up a maxi emergency hospital operations centre which, by adopting an information platform, monitors the capacity of intensive and non-intensive beds, their occupation, the availability of personnel and technologies for expansion in the event of an increase in the demand for hospitalisation and controls the alert indicators for the activation of maxi emergency responses, including transfers between hospitals and the diversion of the 118

⁷⁰ ST elevation myocardial infarction

service, ensuring the rotation and distribution of equipment and instruments according to an organised logistic network. In addition, an organisational model is envisaged which, on the one hand, allows operating units that are not involved in ICUs to take charge in the acute phase of complex cases characterised by respiratory insufficiency, guaranteeing valid support to intensive care units for patient management, without prejudice to the taking charge of patients requiring invasive support by ICUs. Lastly, again with a view to improving availability for the critical area, it was decided to adapt, with regard to plant arrangements and the possibility of isolating and separating pathways the recovery room beds at the hospitals included in the emergency response network in such a way as to allow them to be used in normal conditions to support the operating block, thus improving the efficiency of use of the rooms and enhancing patient safety and organisational appropriateness for the Critical Area, and to convert them, if necessary, very quickly into intensive care beds in maxi-emergency situations in which the remaining response capacity is committed. Therefore, a re-modulation of the hospital supply is envisaged, based on the choice of defining a quota of hospitals in the network as a potential response to the epidemic, but without identifying dedicated hospitals, because in Tuscany it was considered preferable to prepare a model that would allow greater flexibility, and therefore a quota of hospitals was identified in which the possibility of creating mixed Covid non-Covid pathways could be envisaged, and which could ensure all the necessary levels of care intensity.

In Umbria, the Media Valle del Tevere hospital in the province of Perugia has been temporarily reconverted due to the geo-location of the facility, which is situated on the main Umbrian road between the two regional hubs of Perugia and Terni. Secondly, the hospitals of Perugia (level II DEA), Terni (level II DEA), Città di Castello (level I DEA) and Foligno (level I DEA) were partially and temporarily reconverted. The Regional Emergency Plan was developed on 3 levels, in relation to the number of positive cases requiring hospitalisation and the flow of patients: This differentiation was necessary in order to guarantee the separate management of Covid patients with respect to those suffering from other pathologies, with particular regard to time-dependent pathologies and surgical emergencies requiring acute hospitalisation.

The levels of reorganisation of the regional Hospitals, envisage progressive measures for organising patient flows, identifying: level II DEAs as the reference point for the management of emergencies aimed at the admission of serious cases in Infectious Diseases and Intensive Care; level I DEAs and basic hospitals divided into two types: o those to be allocated to the coronavirus emergency, reconfiguring them for this situation, to accommodate cases of admission with suspected Covid infection, cancelling all in-patient surgical and medical

activities and out-patient activities for out-patients, while safeguarding the activities of single services. Or those to be allocated to the management of acute and sub-acute medical and surgical pathologies, to also accommodate medical pathologies of high care intensity (including in Intensive Care) being transferred from the Hospital Authorities.

Comparison between regions

In order to make an effective comparison between regional health systems, we must first take into account a fundamental aspect that has impacted our country, namely the difference in inter-regional infections and hospitalisations. To do this, two key indicators must be taken into account, namely the $R(t)$ index and the number of daily bed occupancy. The first one is used to understand the spread of the pandemic within each individual region, while the latter is used to compare the actual burden that each regional health system has had to bear.

The index $R(t)$ as explained above represents the growth of the epidemic within the territory of reference, in other words it can define how many people are infected by each positive person. It is easy to see how this index if exceeds the value of one unit the epidemic is in a expansion phase. In the table below, which shows the index during the first wave, we can see four distinct colors: dark red when the epidemic is growing exponentially, with values greater than two, light red when it is in a slightly expansive phase, light green when it is in slight contraction and finally dark green when the value drops below 0.5. Indicating a near halving of infections. Another important point to make before reading the table is the starting number of infected, to give an example, Lazio and Lombardy, during the first week, have two very similar $R(t)$ indices, but the situation within the two regions is totally different: the starting situation in fact provided 2 positive persons in Lazio against 166 in Lombardy; despite the similar index, however, at the end of the first week, Lazio had 4 positive patients against 1077 of the other. Therefore, this index should not be read with regard to the current situation of the positives, but with an eye to the future situation, taking into account the situational gravity. In this direction it is appropriate to point out a severe starting position within the regions of Lombardy, Piedmont, Emilia Romagna and Marche, which were the four Italian regions that reached 1000 infected in the first 3 weeks of the pandemic. The last note to make is that, the reference day shown at the top of the table represents the index for the previous week, so March 9 represents the index for the previous week, i.e., the one from 2 to 8 of the same month.

	09 Mar	16 Mar	23 Mar	30 Mar	06 Apr	13 Apr	20 Apr	27 Apr	04 May	11 May	18 May	25 May	01 Jun
Abruzzo	4.17	2.99	1.78	1.22	0.83	0.93	0.93	0.56	0.62	0.64	0.78	0.43	0.61
Basilicata	2.79	3.39	2.33	1.37	0.65	0.52	0.74	0.72	1.50	0.71	0.43	0.70	0.25
Calabria	4.68	2.96	1.77	1.26	0.74	0.71	0.82	0.44	0.42	0.78	0.77	0.32	0.41
Campania	2.61	2.31	1.57	1.51	0.98	0.66	0.64	0.58	0.58	0.70	0.83	0.72	0.71
Emilia Romagna	2.00	2.02	1.63	1.00	0.80	0.79	0.80	0.78	0.68	0.53	0.57	0.69	0.64
FVG	3.68	2.01	1.57	1.04	0.92	0.73	0.70	0.71	0.53	0.62	0.82	0.82	0.55
Lazio	3.05	2.55	1.78	1.21	0.86	0.90	0.78	0.78	0.77	0.68	0.83	0.59	0.57
Liguria	3.52	2.39	1.71	1.08	0.98	0.84	0.95	0.97	0.72	0.60	0.81	0.78	0.67
Lombardy	2.46	1.71	1.30	0.90	0.79	0.90	0.85	0.84	0.77	0.83	0.71	0.78	0.75
Marche	2.84	1.93	1.25	0.89	0.85	0.76	0.64	0.67	0.72	0.77	0.61	0.39	0.42
Molise	1.32	2.57	1.87	1.41	1.06	0.54	0.66	0.64	1.29	2.86	0.51	0.39	0.22
South Tyrol	7.33	2.62	1.44	1.20	0.83	0.90	0.58	0.43	0.40	0.54	0.50	0.60	0.66
Trentino	5.34	2.50	1.66	1.07	1.05	0.90	0.75	0.84	0.57	0.21	0.79	0.82	0.33
Piedmont	2.82	2.82	1.66	1.16	1.09	1.07	0.97	0.81	0.65	0.55	0.65	0.64	0.65
Apulia	3.64	2.72	1.82	1.26	0.91	0.84	0.92	0.61	0.58	0.69	0.54	0.79	0.48
Sardegna	4.48	3.18	1.62	1.15	0.87	0.71	0.58	0.55	0.55	0.70	0.48	0.32	1.00
Sicily	2.85	2.32	2.35	1.15	0.75	0.77	0.89	0.79	0.56	0.55	0.62	0.50	0.47
Tuscany	3.35	2.40	1.55	1.22	0.83	0.91	0.74	0.65	0.56	0.51	0.73	0.58	0.48
Umbria	3.04	2.93	1.77	0.94	0.52	0.28	0.45	0.79	0.66	0.90	0.67	0.47	0.33
Valle d'Aosta	3.73	3.89	1.33	1.11	0.87	0.71	0.85	0.34	0.54	0.74	0.63	0.62	0.97
Veneto	2.38	2.01	1.48	1.05	0.95	0.82	0.83	0.63	0.55	0.49	0.53	0.49	0.46

Figure 27: Weekly regional $R(t)$ during the first wave.

As can be seen, the situation throughout the territory is initially very serious, with the pandemic expanding without any particular territorial distinctions. Once a consistent number of cases has been reached and restrictive measures have been applied, it can be seen that the epidemic starts to slow down its growth towards the middle of March and then begins to contract at the end of the month. The first regions to succeed in reversing the trend were those most affected initially, due to the speech made earlier on the number of positive totals. Piedmont is a different situation: compared to regions such as Umbria or Marche, it reverses the trend three weeks later, indicating a difficult epidemiological situation and, given the relatively similar starting point, a probable additional pressure on the healthcare structure.

With regard instead to the situation of transition to the summer phase of the pandemic, the case of Umbria is certainly noteworthy, which was able, two weeks before the other virtuous regions, to halve the number of newly infected showing the quality of regional policies implemented and the seriousness with which citizens have interpreted the regulations. Along the same lines are the two autonomous provinces, Veneto and Valle d'Aosta, which began a very rapid contraction of the index between the end of May and the beginning of April. The other regions, however, have begun a phase of return of the cases, but in a slower manner, and all of them managed to present a much more comforting epidemiological picture by the beginning of June.

	11 Oct	25 Oct	08 Nov	22 Nov	06 Dec	20 Dec	03 Jan	17 Jan	31 Jan	14 Feb	28 Feb	14 Mar	28 Mar	11 Apr	25 Apr	09 May
Abruzzo	1.72	1.65	1.29	1.05	0.75	0.75	1.04	1.02	1.16	1.14	1.05	0.92	0.89	0.87	0.85	0.89
Basilicata	1.08	1.61	1.54	1.12	0.72	0.84	1.06	0.92	0.87	1.20	1.18	1.06	0.98	1.14	0.98	0.84
Calabria	1.52	1.77	1.38	1.14	0.77	0.90	1.12	1.07	0.89	0.85	1.04	1.20	1.14	1.10	0.99	0.84
Campania	1.51	1.61	1.30	0.93	0.71	0.77	0.96	1.05	1.10	1.09	1.20	1.07	0.88	0.97	1.00	0.85
Emilia Romagna	1.57	1.68	1.37	1.08	0.86	0.94	1.06	0.92	0.90	1.05	1.28	1.10	0.86	0.77	0.88	0.85
FVG	1.56	1.63	1.30	1.17	0.99	0.95	0.91	1.06	0.86	0.80	1.22	1.28	0.90	0.69	0.77	0.68
Lazio	1.36	1.71	1.25	1.01	0.81	0.89	1.07	0.94	0.90	0.95	1.13	1.15	1.02	0.88	0.91	0.86
Liguria	1.59	1.56	1.15	0.81	0.69	0.92	1.05	0.98	0.99	1.01	1.06	1.01	1.14	0.92	0.86	0.76
Lombardy	1.86	1.89	1.29	0.91	0.65	0.85	0.95	0.99	0.95	1.08	1.31	1.12	0.93	0.78	0.90	0.84
Marche	1.62	1.81	1.29	0.92	0.89	1.00	1.11	0.98	0.93	1.00	1.24	1.08	0.87	0.79	0.89	0.90
Molise	1.75	1.64	1.27	1.13	0.84	0.88	0.90	1.11	1.09	1.11	1.00	0.86	0.77	0.95	0.99	0.79
South Tyrol	1.56	1.73	1.45	0.91	0.72	0.82	0.99	1.38	1.24	0.99	0.74	0.71	0.87	0.82	0.90	1.02
Trentino	1.15	1.72	1.23	0.94	1.01	0.97	0.96	1.04	1.00	1.05	1.14	0.96	0.85	0.74	0.89	0.85
Piedmont	1.75	1.81	1.34	0.94	0.69	0.76	0.98	0.96	0.98	0.99	1.29	1.23	1.00	0.80	0.85	0.85
Apulia	1.47	1.51	1.34	1.15	1.03	0.88	0.97	1.02	0.95	0.94	1.10	1.18	1.09	0.92	0.93	0.79
Sardegna	1.30	1.36	1.22	1.07	0.92	0.92	0.92	0.98	0.87	0.72	0.88	1.15	1.46	1.18	0.88	0.65
Sicily	1.45	1.48	1.30	1.11	0.88	0.86	1.16	1.17	0.75	0.78	0.96	1.11	1.15	1.17	0.95	0.83
Tuscany	1.75	1.69	1.23	0.89	0.64	0.80	0.93	0.98	1.11	1.13	1.22	1.09	1.04	0.92	0.89	0.85
Umbria	1.84	1.64	1.20	0.82	0.71	0.86	1.10	1.09	1.16	1.05	0.88	0.92	0.90	0.86	0.91	0.94
Valle d'Aosta	2.19	1.77	1.12	0.89	0.57	0.81	1.03	0.91	0.68	0.97	1.15	1.55	1.40	0.95	0.91	0.80
Veneto	1.46	1.63	1.37	1.03	1.02	1.06	0.96	0.69	0.70	0.88	1.25	1.23	0.99	0.78	0.94	0.79

Figure 28: Bi-weekly regional $R(t)$ index during the second wave.

During the second wave, the $R(t)$ index is certainly much more reliable since the starting point of contagions between regions, as a percentage of the territorial population, is very similar. As mentioned earlier, the index is used by the government to define the "color" of a region and, consequently, the rules to which it must conform. For ease of reading and due to the long duration of the second season of the epidemic, a bi-weekly average is reported, as in the previous table, values are reported with different colors based on whether or not the index value 1 is exceeded.

On the whole, out of 33 weeks of observation, the region that had the lowest index of one for the most times was Umbria 20 times, on the other hand Calabria was the region where the pandemic was in an expansive phase for the most weeks, keeping the index below one only in 13 occasions. On average, however, the path of the various regions is very similar, with an expansive phase until December, and then contract and begin the expansion after the Christmas holidays, stabilizing throughout the territory on April 25, a historical date that probably, to our country, brings much luck.

In order to get a better picture of the relative pressure that each region had to bear, an index was calculated which provides the average daily bed occupancy, normalized for the population of each region, thus finding the per capita bed occupancy comparable for each region. This figure, to make it easier to understand, has been multiplied by 100.000, thereby finding the daily regional bed occupancy per 100.000 inhabitants: thus, allowing comparison both between regions and between waves and it can be summarized in the table below.

Average number of bed occupancy per day (per 100.000 inhabitants)		
	First wave	Second wave
<i>Abruzzo</i>	15	41
<i>Basilicata</i>	5	22
<i>Calabria</i>	4	17
<i>Campania</i>	6	28
<i>Emilia Romagna</i>	37	54
<i>FVG</i>	8	41
<i>Lazio</i>	15	46
<i>Liguria</i>	33	49
<i>Lombardy</i>	60	50
<i>Marche</i>	28	37
<i>Molise</i>	5	21
<i>Piedmont</i>	41	70
<i>South Tyrol</i>	18	41
<i>Trentino</i>	25	45
<i>Apulia</i>	7	38
<i>Sardegna</i>	4	25
<i>Sicily</i>	5	25
<i>Tuscany</i>	13	34
<i>Umbria</i>	8	39
<i>Valle d'Aosta</i>	38	51
<i>Veneto</i>	15	35

Figure 29: Average number of bed occupancy per day.

A first observation certainly gives an idea of how the regional health system, with the exception of Lombardy, was put under much greater pressure during the second phase of the epidemic. The difference between the two timeframes is that the first one caught the health system by requiring resilience at a situational and structural level, while for the second one resilience was systemic, allowing each organization to better prepare for the response to the outbreak.

Placing the results on a histogram and sorting them in descending order, it can be seen that the north-west regions, during the first wave, were those most under pressure. The region most affected was Lombardy, since before it was discovered, the pandemic had probably already

proliferated within the region and so in the adjacent territories. One figure that is certainly surprising is that of Veneto, which shares with Lombardy the first local covid-positive patients. In fact, the Veneto health administration managed to contain the virus by tracking and screening all infected persons, thus managing to limit the pressure on the health system. The other parts of Italy were fortunately less affected. If we look at the distribution of the first wave, we can see that the north-eastern and central regions are around the median. The southern areas, on the other hand, found themselves with much less hospital pressure, which gave them time to organize their planning for what was expected to be a second wave after the summer.

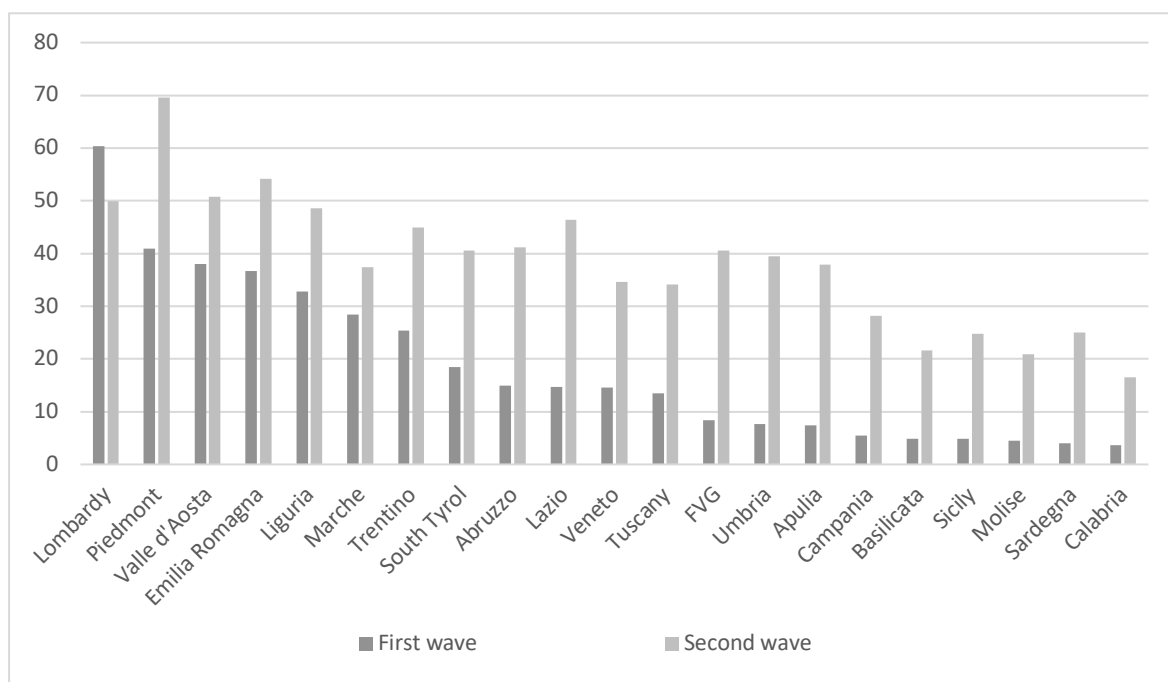


Figure 30: Daily bed occupancy due to covid per 100000 inhabitants, source: Protezione Civile, ISTAT.

The same geographical considerations can be made for the second wave, with the north-west of the country bearing the brunt of the pressure, followed by the north-east, the center and finally the south. What has changed compared to before is certainly the greater presence of covid patients in hospitals and the region most affected, which becomes Piedmont followed by Emilia Romagna and Valle d'Aosta. Lombardy, for its part, suffers even less impact on beds than in the previous year. There does not seem to be any other particular correlation on hospital pressure, clearly at this juncture the organizational structure of the regional system does not impact on bed occupancy.

Still from the point of view of beds availability, an interesting fact is the percentage increase of intensive care and how much, the regions, have managed to reach the goal set by the government for 0.14 per 1000 inhabitants.

	POP.	IC BEDS BEFORE COVID	IC BEDS AT 23/05	IC BED PROGR- AMMED	DELTA
ABRUZZO	1293941	149	185	181	4
BASILICATA	553254	61	88	77	11
CALABRIA	1894110	172	172	265	-93
CAMPANIA	5712143	638	638	800	-162
EMILIA ROMAGNA	4464119	534	760	625	135
FVG	1206216	138	175	169	6
LATIUM	5755700	706	943	806	137
LIGURIA	1524826	201	228	213	15
LOMBARDY	10027602	1026	1416	1404	12
MARCHE	1512672	146	210	212	-2
MOLISE	300516	39	39	42	-3
PIDEMONT	4311217	394	628	604	24
SOUTH TYROL	532644	59	100	75	25
TRENTINO	545425	40	90	76	14
APULIA	3953305	369	586	553	33
SARDINIA	1611621	167	216	226	-10
SICILY	4875290	514	834	683	151
TUSCANY	3692555	426	562	517	45
UMBRIA	870165	80	116	122	-6
VALLE D'AOSTA	125034	10	30	18	12
VENETO	4879133	562	1000	683	317

Figure 31: Regional ICUs bed situation in relation to the DL 34/2020.

The only two regions to deviate, and not by a small margin, from the number of beds in relation to the resident population are Calabria and Campania. Worthy of note, however, are the virtuous cases of Veneto and Sicily, which have been able not only to provide a large number of beds equipped to treat critical patients, but also to exceed, even by many units, the minimum number required by law. The situation is, however, on the whole excellent; three other regions are below the threshold, but with a practically negligible number.

After a brief introduction on the development of the pandemic within each region, we can move on to an analysis of the specific organisation of health systems: classifying each individual intervention and taking into account whether centres dedicated solely to the treatment of covid were introduced, whether these centres were created ex novo or whether hospital centres were readapted solely for this function; secondly, another regional organisational distinction is whether a mixed system of hospitalisation was implemented, keeping the entire system open to the battle against the epidemic.

	COVID HOSPITAL	MIXED HOSPITAL	COVID HUB	NEW STRUCTURE	EMERGENCY PLAN
MOLISE		X	X	X	
LAZIO	X	X	X		X
ABRUZZO	X	X	X	X	
CAMPANIA			N/A		
SICILY			N/A		
APULIA		X	X		
CALABRIA		X	X		
LIGURIA		X	X		
VENETO	X		X		X
FVG		X	X		
SOUTH TYROL		X	X		
BASILICATA			N/A		
SARDEGNA		X	X		
MARCHE	X	X	X		
PIEDMONT	X	X	X	X	X
VALLE D'AOSTA		X	X		
TRENTINO	X	X	X		
EMILIA ROMAGNA		X	X	X	X
TUSCANY		X	X		X
LOMBARDY	X		X	X	X
UMBRIA	X	X	X		X

The table above represents the regions in order of organisational structure: regions with a bureaucratic structure are represented first, followed by those with a centralised management and finally those with a contractual organisation. Covid hospitals are defined as regions that have referred severe covid patients to a single hospital, up to the maximum capacity of the hospital, and that have kept open one or more centers solely dedicated to the care of those patients. Mixed hospitals, on the other hand, define regions that have kept open one or more hospitals with separate pathways for covid and non covid patients. Clearly there is no

exclusivity between the first two columns as a region may have adopted both solutions to fight the pandemic. Covid Hub, however, defines the regions that have indicated a reference center that, within the Hub and Spoke model adopted by the health system, would perform the first function by acting as a guide to other facilities. After careful observation, there are clear trends in hospital reorganisation, with centralised regions preferring a mixed system, thus favouring flexibility in organisation and service delivery. All the centralised regions have in fact provided for the presence of a central reference hub in a sort of organisational continuity with the initial model. In fact, as a first approach, all the other regions have structured, within each Local Health Authority, a reference hospital to act as a Hub, choosing in some cases a mixed system (Trentino, Liguria, Valle d'Aosta, Friuli Venezia Giulia) while in other cases Hubs dedicated solely to the pandemic (Piedmont, Veneto, Marche, Sardinia). The regions with a bureaucratic organization, on the other hand, have preferred the identification of reference hospitals within the region, excluding access to covid patients to other hospitals, with the clear exception of Lazio, which has adopted a policy of mixed Hub and Spoke with the two private centers acting as leaders. Finally, the contracting regions have managed to ensure a very efficient reorganizational policy, with targeted and regionalized choices and, above all, a clear and well-defined emergency plan, a mixed system is identified that proposes the individual specificities of each AO, effectively relaunching the concept of high specialization and supply of individual facilities. It should be emphasized that both Lombardy and Emilia Romagna foresee the creation of temporary health facilities to be made available to the rest of the regions in the worst-case scenario.

Once all the specific data and the regional epidemiological trends have been compared, a confront can be made on the efficiency of the ongoing provision of other health services. In this regard, we report two matrix that relate the impact of each individual region to two other variables, in the first case we have the variation in the volume of planned hospitalizations, while in the second the volumes of outpatient specialist services. On the abscissa axis, instead, we find the number of infected per 100,000 inhabitants. In both cases the efficiency calculated refers to the first wave, with data collection from March to June of last year. The two tables differentiate the four areas, separated by the two medians of the variables taken into consideration. In general, one can speak of good relative performance when the region taken into consideration is above the median of the volumes supplied. The macro-areas on the right and on the left, on the other hand, increase or decrease the evaluation of the overall performance, regions such as Lombardy or Valle D'Aosta, which have had very high data on

the infected, are more "justified" in having a lower performance, in the event that there has been one.

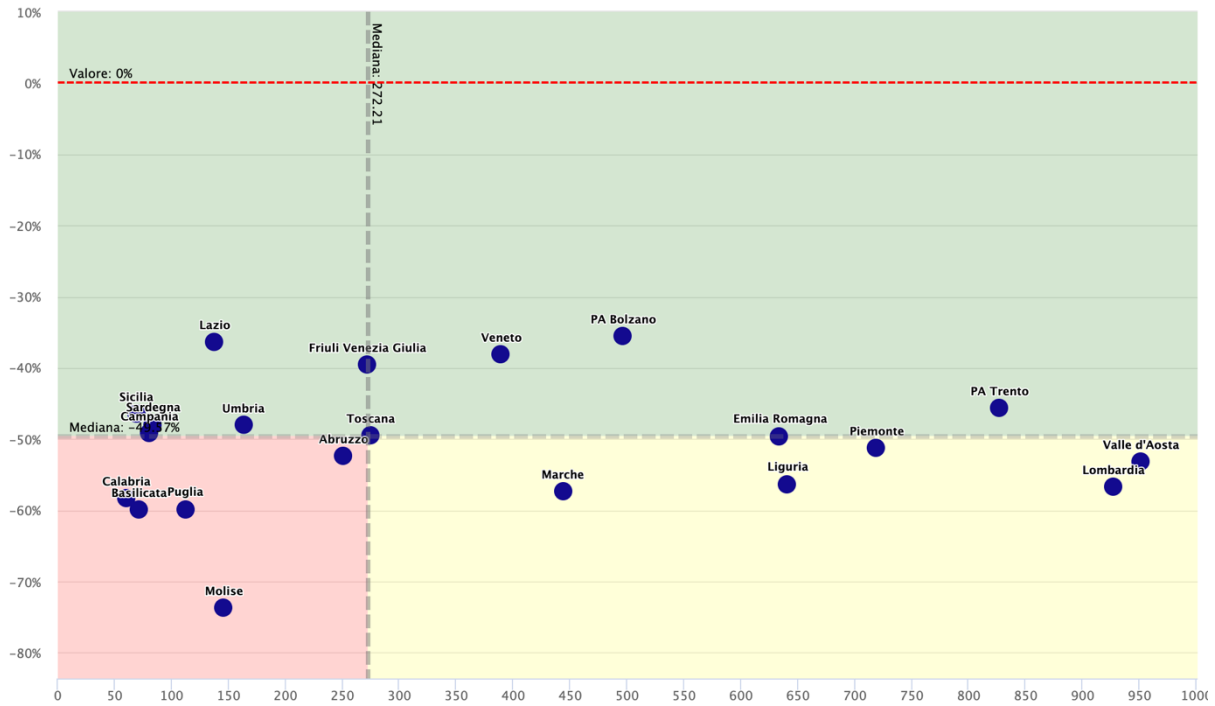


Figure 32: Change in volumes for planned admissions for March-June 2020 compared to the prior year. AGENAS

This matrix helps us understand how the various regions were able to deliver effective service during the pandemic, at the hospital level. In fact, by counting planned hospitalizations, it is possible to observe how the various regional health systems managed to provide continuity of service beyond the pandemic situation. As can be seen, in the case of scheduled hospitalizations, the most virtuous regions were those with a centralized organization, and especially those in the northeast, which could already boast of a very advanced healthcare system, and in addition had on their side a limited number of infections. Even Lazio has recorded a good performance, but that depends more on intrinsic regional specificities or on the ability of management than on the organizational model. In fact, other regions with a bureaucratic model have not performed as well as they should, especially in relation to the unbearable pressure on the healthcare system. The organization instead during the epidemic, reflects these data with the regions that have adopted a system of mixed hospitals (covid/non covid) as the FVG or the autonomous province of Bolzano to lead the way. Certainly, even the Veneto system of organizing a Covid hospital for each ASL, keeping the others free, has given

positive indications. In its own way, even the autonomous province of Trento, with a mixed system, but with the most serious patients addressed in a single hospital DEA I has given its fruits, keeping freer the central hospital of the region, it can be observed that, among the regions that have an incidence of cases higher than 600 per 100000 inhabitants, has been the best. The regions of the northeast, for their part, have not been able to remain at the standards of the other regions, and this result is partially justified by the enormous pressure they have had to suffer within the pandemic, not even remotely comparable to the rest of Italy.

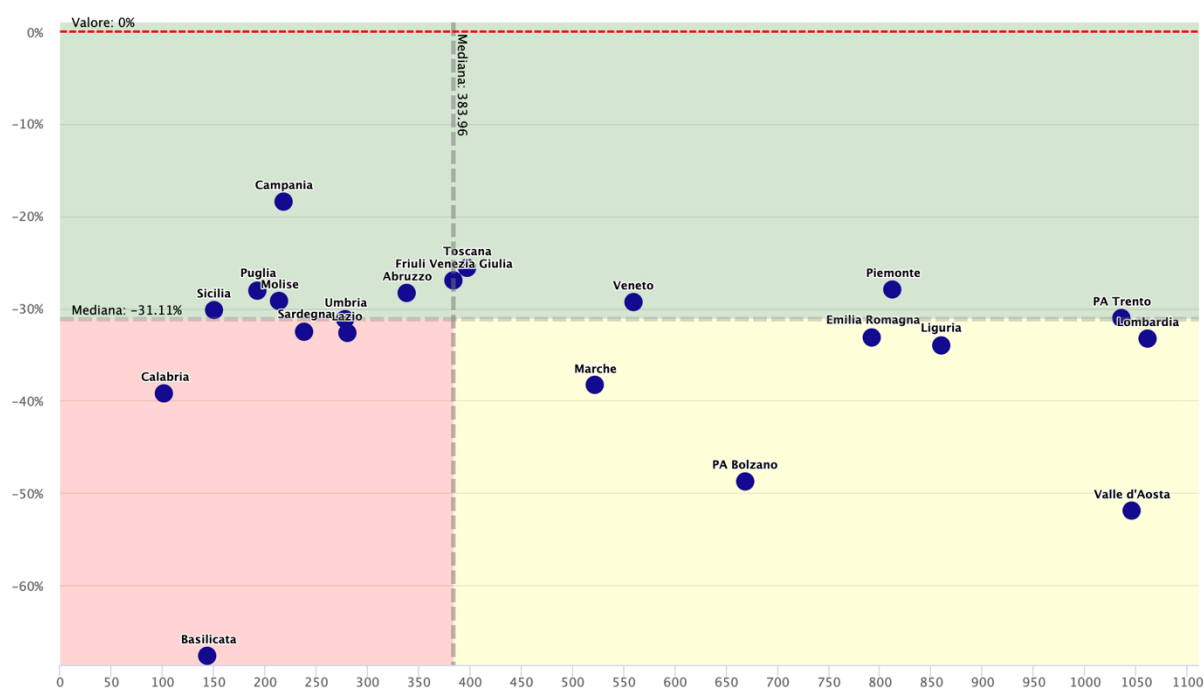


Figure 33: Change in volumes for ambulatory specialty services for March-June 2020 compared to the prior year. AGENAS

The second matrix proposes the specialist outpatient visits offered, both hospital and non-hospital. This figure represents the various territorial services and, with respect to the previous one, succeeds in giving a judgment not only from the hospital point of view but also of the resilience of all those specialist physicians who offer services other than operations or hospitalization, thus managing to avoid the impact of the number of available beds, which instead had a slight incidence in the previous matrix. At this juncture, the various regions do not differ much from the median, with the negative exception of Basilicata, South Tyrol and Valle d'Aosta, and the positive exception of Campania. In this sense, there does not seem to be any correlation between the variation in the volumes offered and the various organizational models, both from the point of view of the strict hospital organization during the pandemic and the model adopted from the regional point of view. Nor do they depend on the number of

physicians present on the territory, since Campania, despite being fourth last in this special classification, presents the least negative variation. In conclusion, therefore, it can be said that the volumes of service provided depend on the situational number of patients in need and on the specific regional situations.

CONCLUSIONS

The pandemic certainly tested the resilience attributes of the healthcare system, initially, from an operational standpoint, with healthcare personnel finding themselves having to respond to an unknown disease without having the necessary tools and knowledge in what seemed like a David versus Goliath struggle. Even from a structural point of view, the moment of resilience occurred almost immediately, with the regions of Lombardy and Veneto leading the way, with rapid and targeted measures, from patient isolation to contact tracing systems to the management of a completely revamped and separate triage system. From a systemic perspective, however, the moment of resilience is to be found at the end of the first wave and the beginning of the second. In a first moment, in fact, it was wanted to make systemic the process of resilience started in March, implementing and making structural all the changes made. The national regulatory response, with the lockdown imposed at the beginning of March, was certainly appropriate to give the entire system room to reorganize and prepare for the second wave in the best possible conditions. In a second moment, fundamental was the passage to the trichotomy of the regions, dividing them according to the $R(t)$ index and the specific health response capacity; placing at the center of management the absorptive capacity of each individual regional system and thus making the characteristics of a resilient system capable of anticipating, learning, monitoring and finally responding to external agents.

From a regional point of view, the greatest burden of this pandemic has been borne by the regions of the northwest, along with Emilia Romagna, with the pandemic fortunately not proliferating in the same way in other regions where healthcare, during flu periods, already struggles to respond adequately. Certainly, from an organizational point of view, the regions applying the contractual organizational model proved to be faster and more resilient, first of all, they all applied a strategic plan that was then made public, and they were also able to increase the capacity of available beds practically immediately, as shown in Lombardy, which after one week had already increased the number of intensive care beds by 20% compared to the original capacity. The application of a concerted model, in Tuscany and Emilia-Romagna, demonstrates how the sharing of objectives with health personnel in the field, makes the response efficient and targeted to the result, giving excellent performance from the point of view of the quality of the response, certainly, it turns out to be a little slower than a slightly different model such as Lombardy, but in the long run is still very valid. The centralized regions, however, proved up to the challenge, with the particularities of Veneto, which did a

terrific job of tracking and containing the epidemic in the first wave, and Piedmont, which, despite the huge load on the regional health system in the second wave, still had 27% of the total beds available at the peak of intensive care filling. The bureaucratic model, with the exception of Lazio instead, seems to suffer a little from the resistance of the procedural certification and the cumbersomeness of the decisions, the comparison with other systems is however complicated given the difference in the impact of the pandemic in the territories of reference and the starting point of the regional health system that for the amount of available productive resources is certainly lower than the corresponding ones. Certainly, it can still be affirmed that the alignment with the organizational reform of the Health System that took place in 1999 brings only benefits to the regional administrations that, as demonstrated above, perform better under the contractual models, with the exception of those regions with a small population and, therefore, with ease of management by a single central entity, such as Trentino, South Tyrol and Valle d'Aosta.

From an organizational point of view within the pandemic resilience, the best strategy for small regions is to free the central hospital from the greater specific weight of the covid inpatients, diverting it, as Trentino has done, to the second regional hospital in terms of size and equipment, thus allowing the continuity of health service delivery. Valle d'Aosta and Molise, that instead have individualized in the central hospital the Hub covid, have in fact underperformed in comparison to the province cited previously, having one greater loss in the disbursement of the normal service like demonstrated in the previous chapter.

The regions of medium size, with a population exceeding one million inhabitants, have as their leader Friuli Venezia Giulia, which demonstrates how a mixed strategy, with each hospital involved and as a reference Hub the DEA II hospitals performs at its best. Also Abruzzo, which despite the lower availability of productive factors while using the same strategy as FVG, with the addition of a dedicated structure overperforming the Marche, which instead adopted a strategy with covid referral hospitals, and hospitals that did not treat this type of patient, who underperformed in the overall situation, going in both indicators of continuity of service delivery below the national median. For high-populated regions, on the other hand, a double reasoning must be made. First of all, the different impact of the pandemic and how it has been treated at the epidemiological level, with the case of Veneto which, as mentioned above, with a system of a dedicated hospital for each ASL and a strategy of research and isolation of contacts with positives, shows the best way to respond to the situation that has arisen. The other

regions have responded in different ways, those who, like Piedmont, have faced the pandemic with a mixed strategy, with the simultaneous presence of dedicated hospitals, special temporary structures and a different system for each ASL, certainly demonstrates managerial resilience but, given the great interregional differentiation, gives a response that is difficult to quantify in a cause-effect relationship. The Lombard internal organization, on the other hand, demonstrates great decision-making rapidity, especially in the first wave, but as mentioned above, a comparison is difficult both in terms of regional population and in terms of the difference in impact on the healthcare system. From a purely organizational point of view, they were certainly successful in being able to make available beds in intensive care in a very short time, certifying how a separate system, with the search for a public-private partnership, can certainly be effective. The last major region that gave important organizational indications was Lazio, which, thanks to a mixed institutional model, was able to address the command of operations to private centers which offered a high-end service, guaranteeing excellent management of the epidemic and a very well-prepared referral Hub, probably providing what was one of the best hospital responses to the pandemic for high-population regions, with a mixed Hub and Spoke system that proved to be very competent and resilient.

To conclude, the response of our system has certainly been effective, guaranteeing in every moment of the pandemic adequate care to every citizen who needed it; the quality of the response has come both from a political point of view, first with the excellent choice of the government to impose a lockdown to limit contagions and give time to the structures to organize themselves, and later with the dynamic regional trichotomy. From the hospital point of view, the regions were able to increase the availability of intensive care beds, which in the case of Lombardy, Marche, Piedmont, Umbria, Trentino and South Tyrol would not initially have been sufficient. Probably, it would have been possible to improve the continuity of the health service, which in the best of cases (South Tyrol and Lazio) recorded a -35% in volumes against a national median of halving the supply, but this figure is also in part due to the lesser need for ordinary care on the part of the population which, staying at home, certainly had fewer traumatic incidents. Comparing our situation, however, with dramatic realities such as that of the United States, where health policies have certainly been less restrictive, we can once again be thankful for having a state health system available, accessible to all and which, even in an extreme situation such as this, has responded efficiently.

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Appendix 1: The algorithm in R for calculating the index $R(t)$

```
rm(list=ls())
graphics.off()
library(EpiEstim)

## parametri dell'intervallo seriale stimati da dati di contact tracing lombardi
shape.stimato <- 1.87
rate.stimato <- 0.28

## massimo numero di giorni dell'intervallo seriale
N <- 300

## definisco la distribuzione dell'intervallo seriale
intervallo.seriale <- dgamma(0:N, shape=shape.stimato, rate=rate.stimato)

## normalizzo la distribuzione dell'intervallo seriale in modo che la somma faccia 1
SI <- (intervallo.seriale/sum(intervallo.seriale))

## leggo la curva epidemica da un file con 3 colonne separate da spazi
curva.epidemica <- read.table("curva_epidemica_Italia_anon_2020-12-02")
curva.epidemica[,1] <- as.Date(curva.epidemica[,1])
names(curva.epidemica) <- c("dates", "local", "imported") ## assegno i nomi richiesti dal
pacchetto EpiEstim

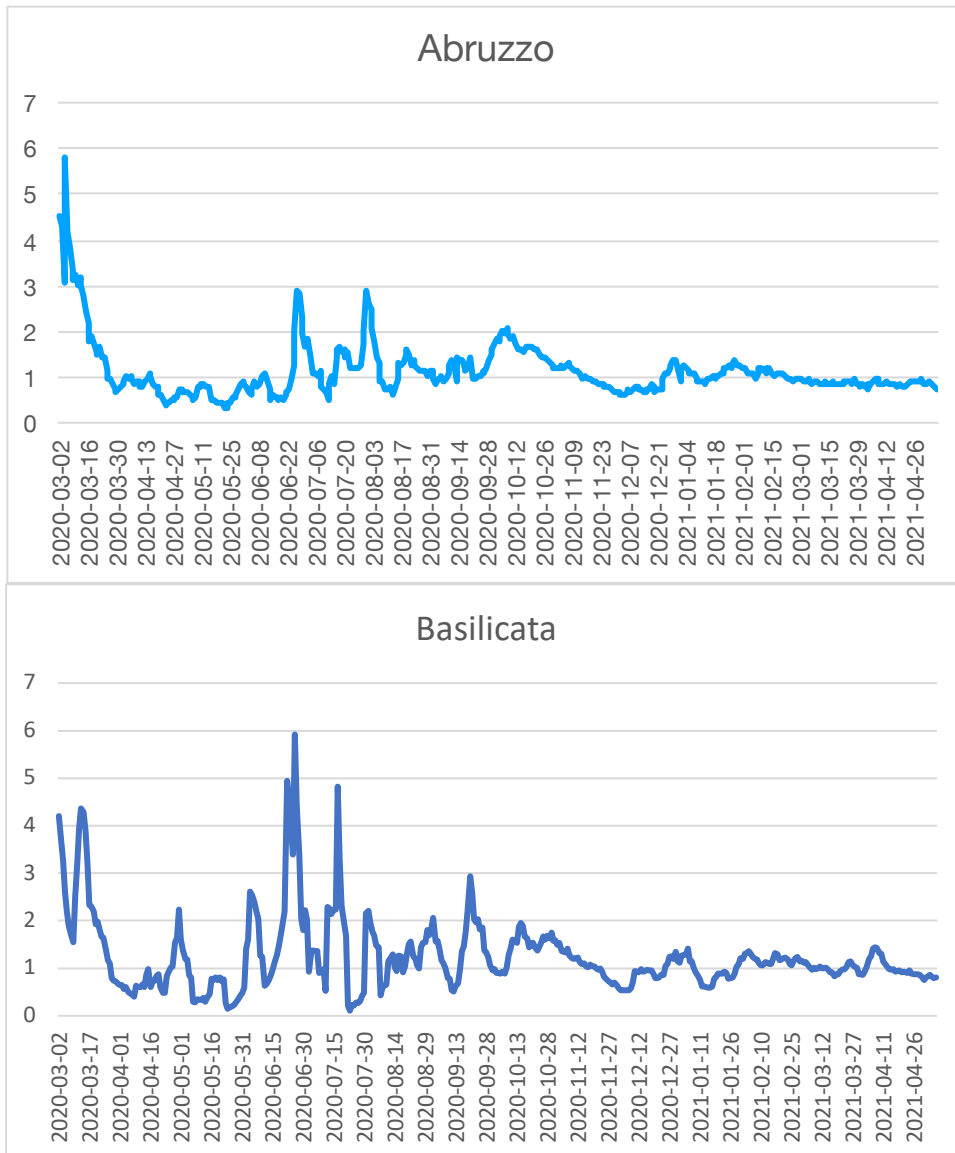
## calcolo la stima di R applicando la funzione estimate_R del pacchetto EpiEstim
stima <- estimate_R(incid=curva.epidemica, method="non_parametric_si", config =
make_config(list(si_distr = SI, n1=10000, mcmc_control=make_mcmc_control(thin=1,
burnin=1000000))))

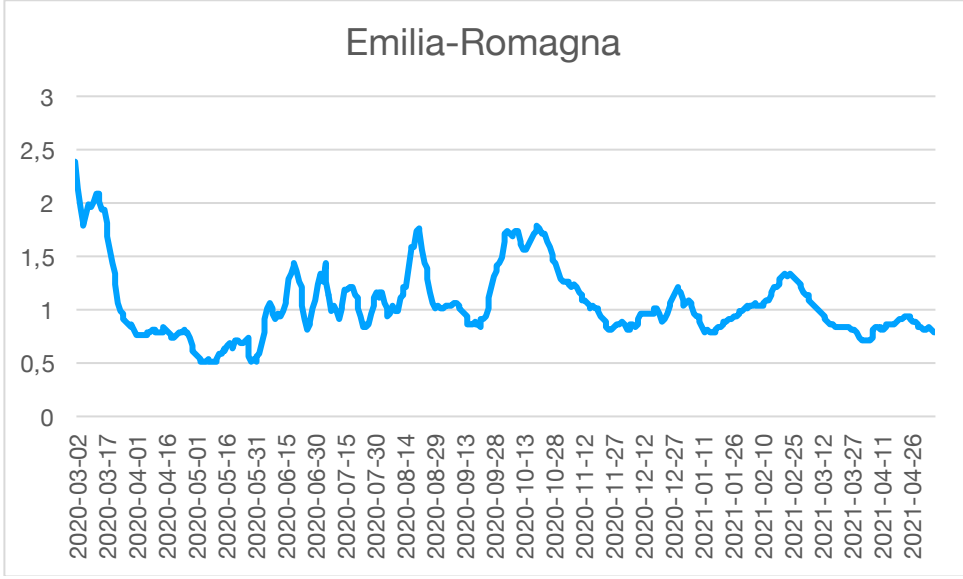
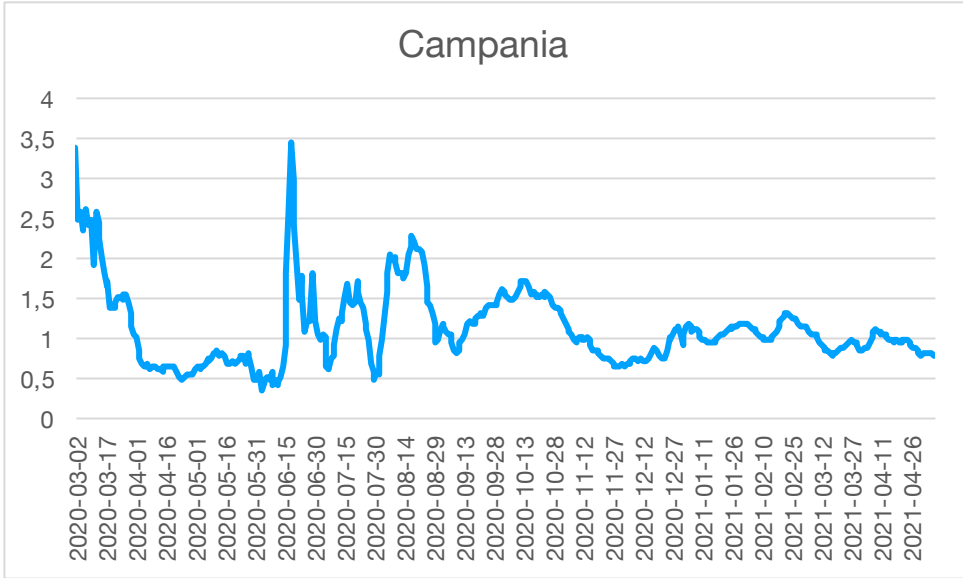
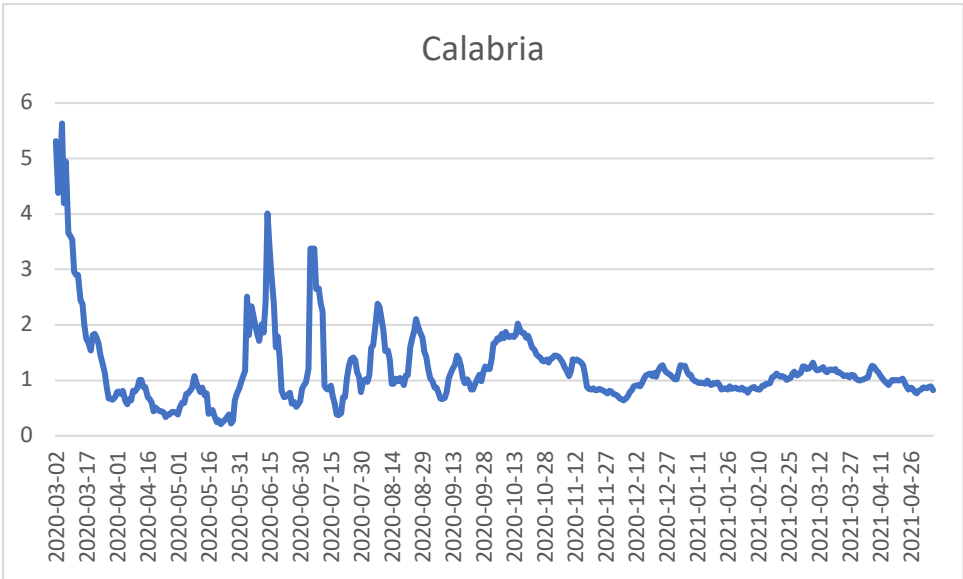
## estraggo i risultati di interesse
R.medio <- stima$R$`Mean(R)` ## valore medio
R.lowerCI <- stima$R$`Quantile.0.025(R)` ## estremo inferiore dell'intervallo di confidenza
R.upperCI <- stima$R$`Quantile.0.975(R)` ## estremo superiore dell'intervallo di confidenza

## estraggo le date di riferimento per la stima di R
## la data rappresenta il giorno centrale intorno a cui e' calcolata la media mobile di Rt (con
finestra di ampiezza pari a una settimana)
sel.date <- stima$R[, "t_end"]
date <- curva.epidemica[sel.date,1]

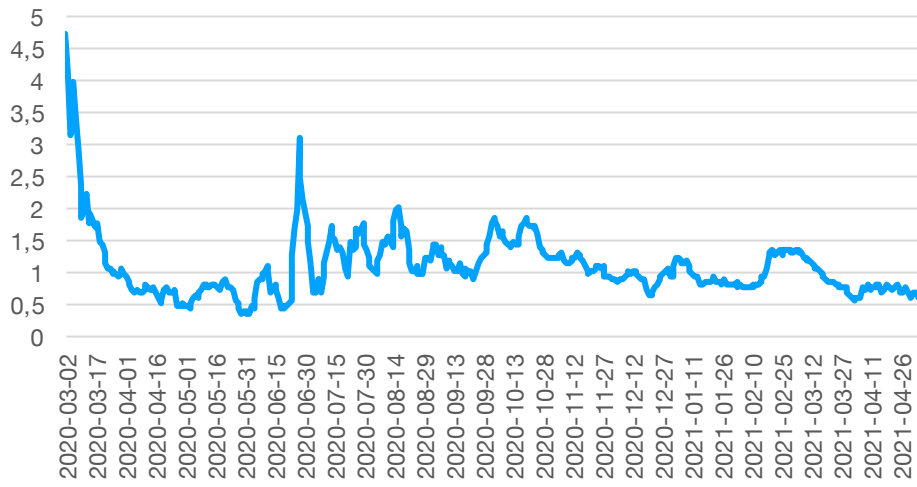
## visualizzazione grafica dei risultati
par(mar=c(7,5,1,1))
plot(R.upperCI, type='l', lwd=2, col='gray', axes=FALSE, ylim=c(0, max(R.upperCI)),
ylab=expression(R[t]), xlab="")
lines(R.medio, type='l', lwd=3, col='gray20')
lines(R.lowerCI, type='l', lwd=2, col='gray')
axis(1, at=1:length(R.medio), label=date, las=2)
axis(2, las=2)
```

Appendix 2: Graphical representation of the R(t) index for each Italian region

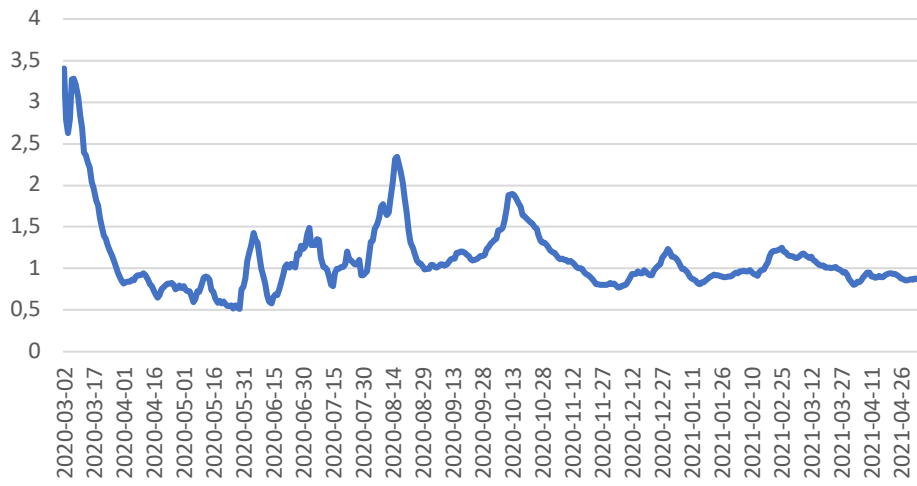




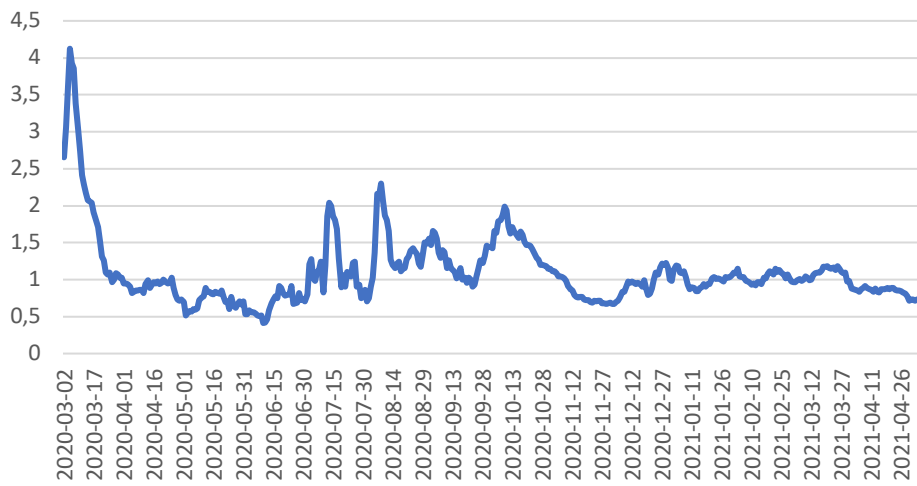
Friuli Venezia Giulia

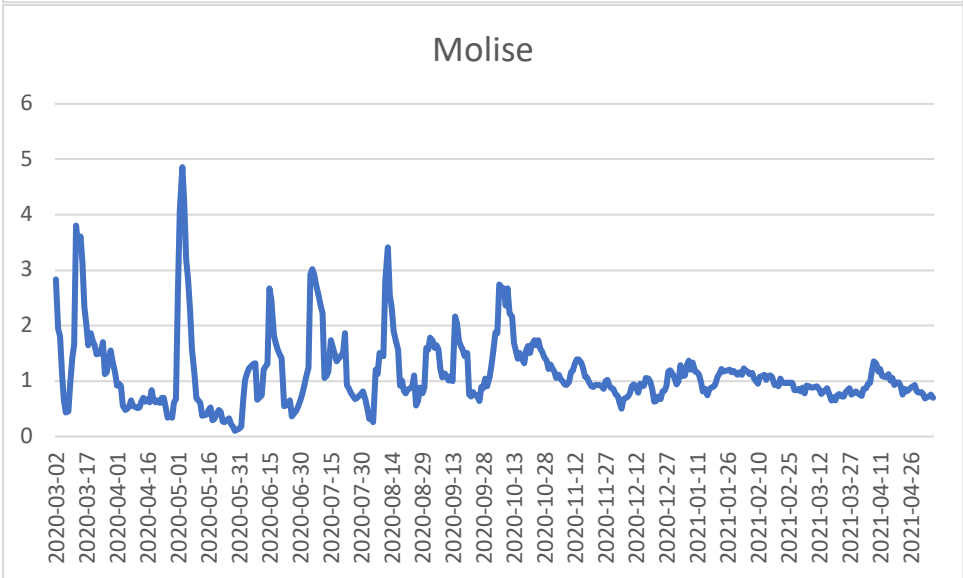
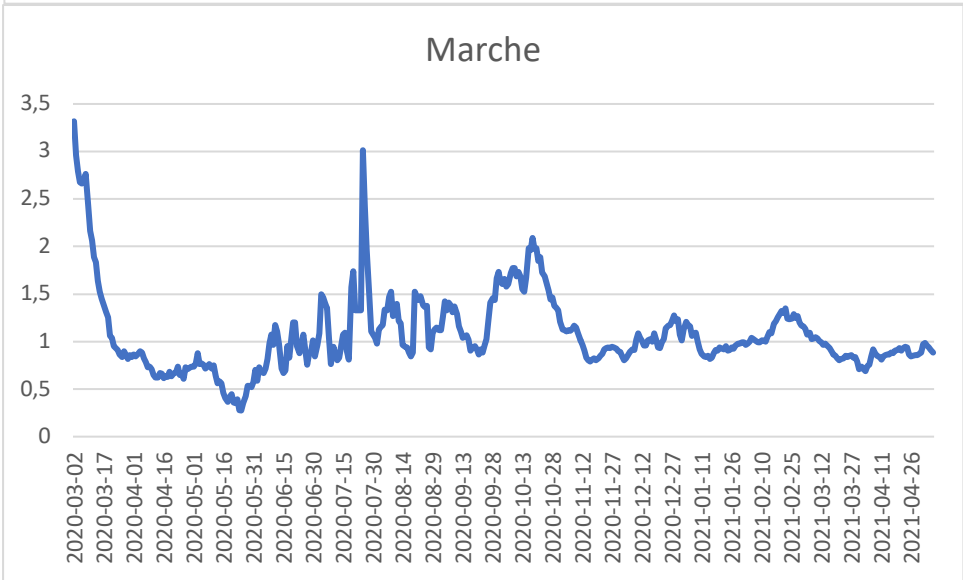
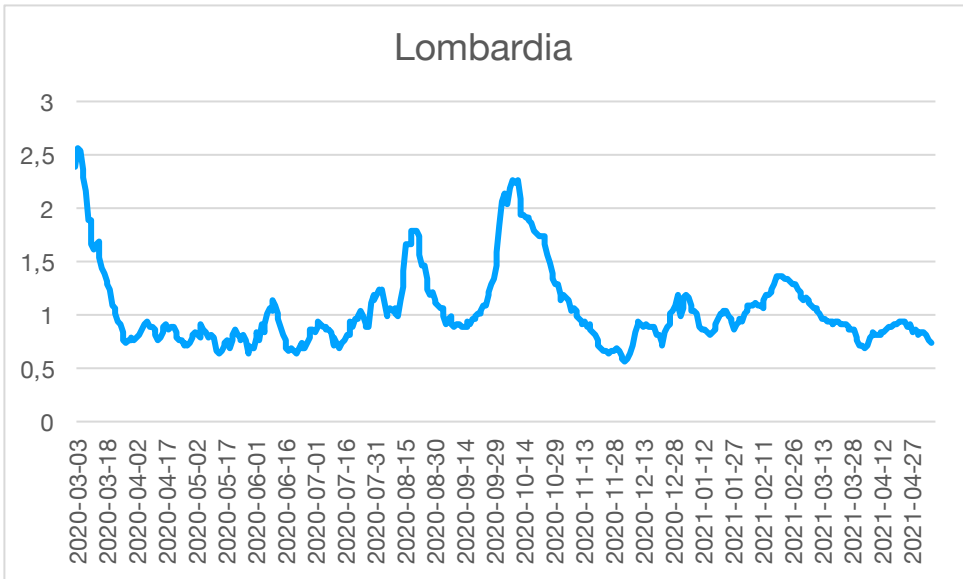


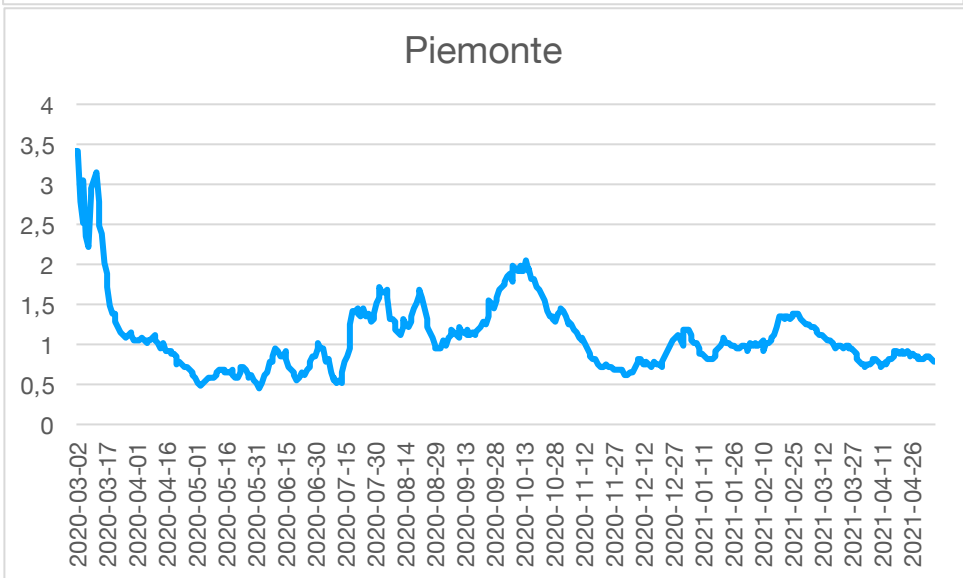
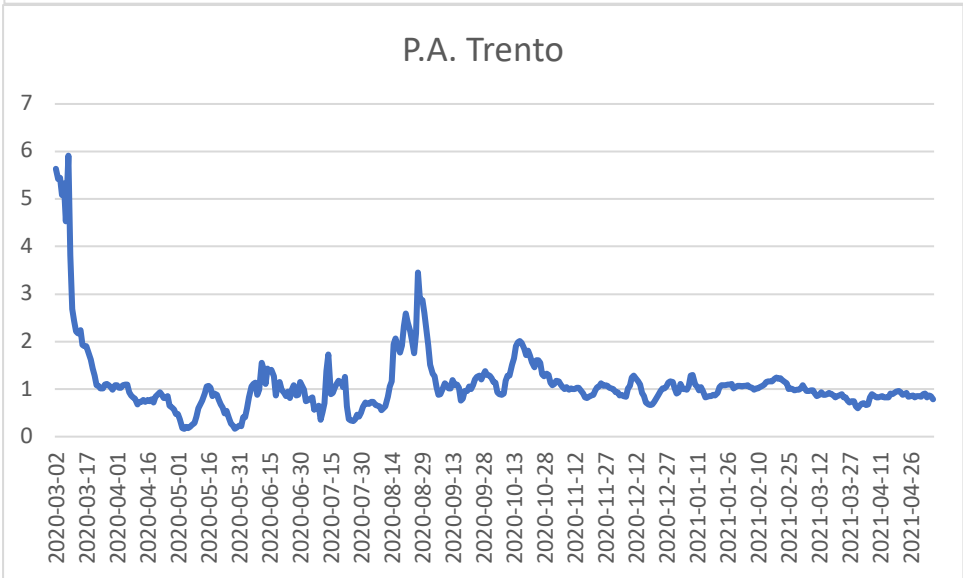
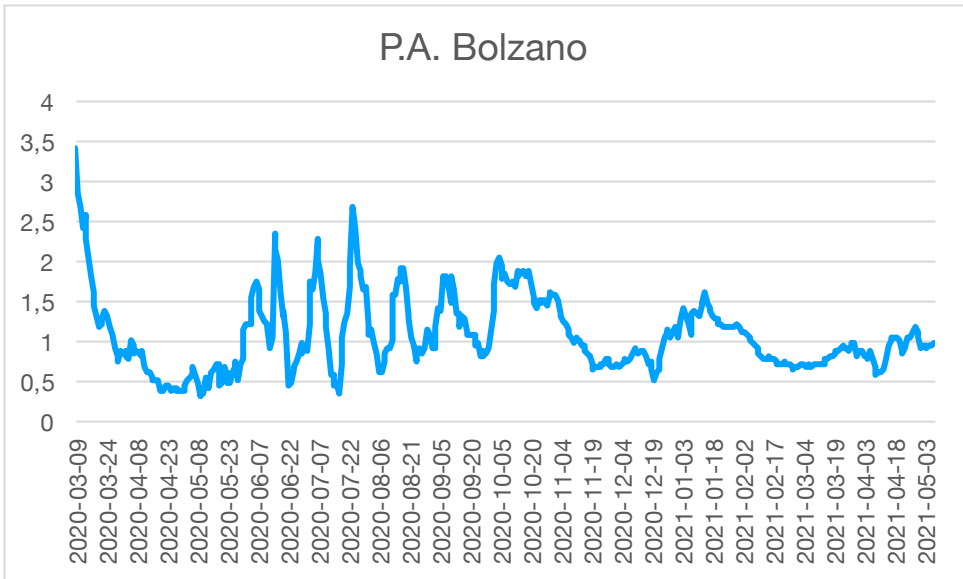
Lazio

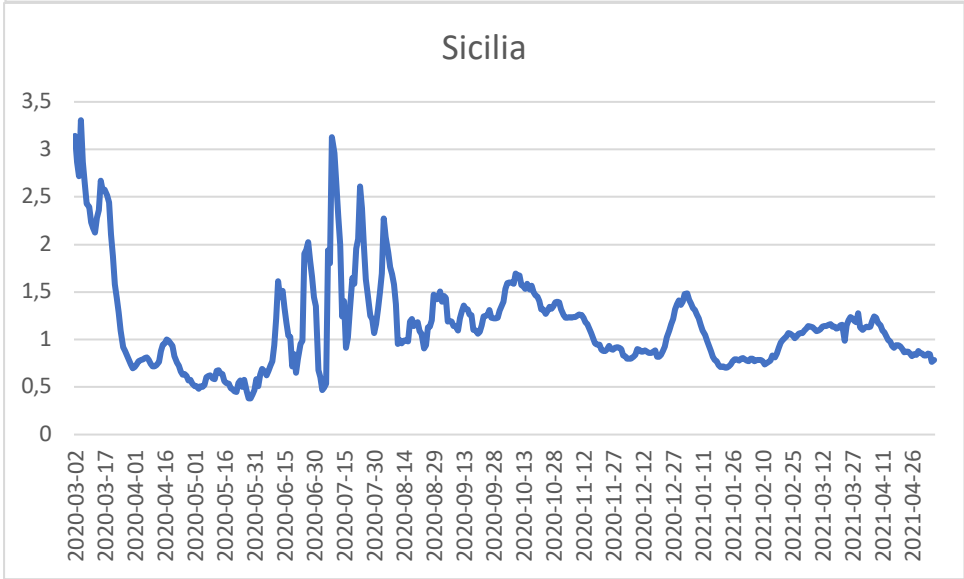
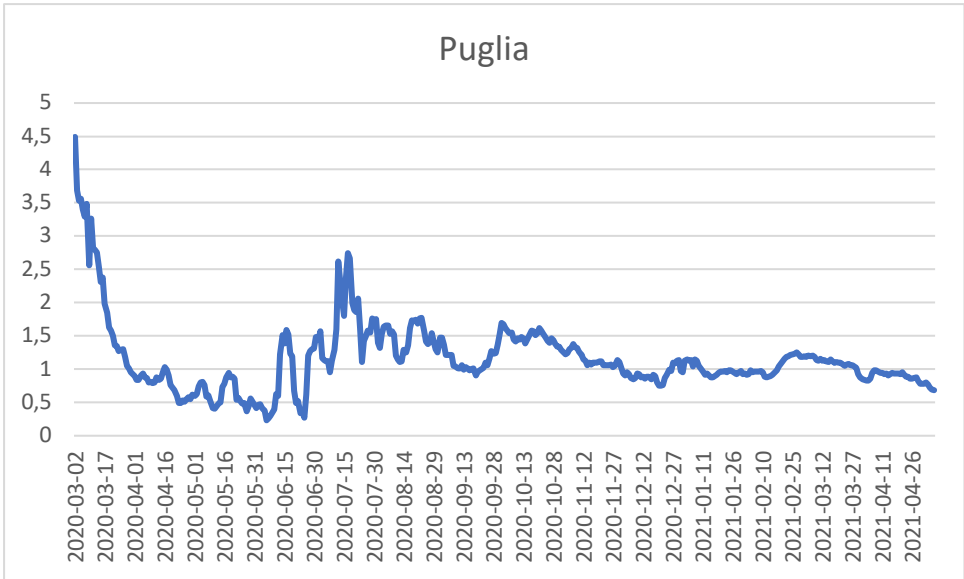


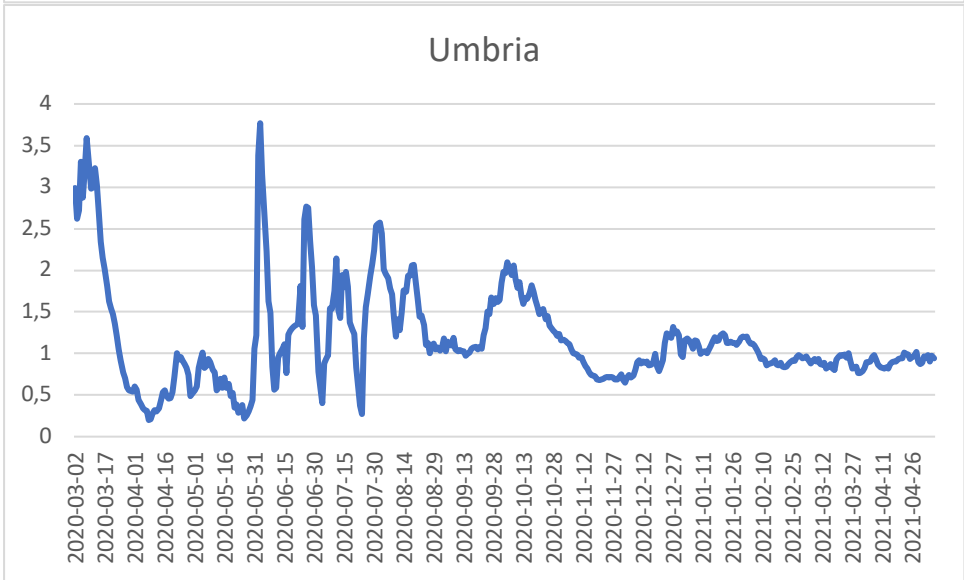
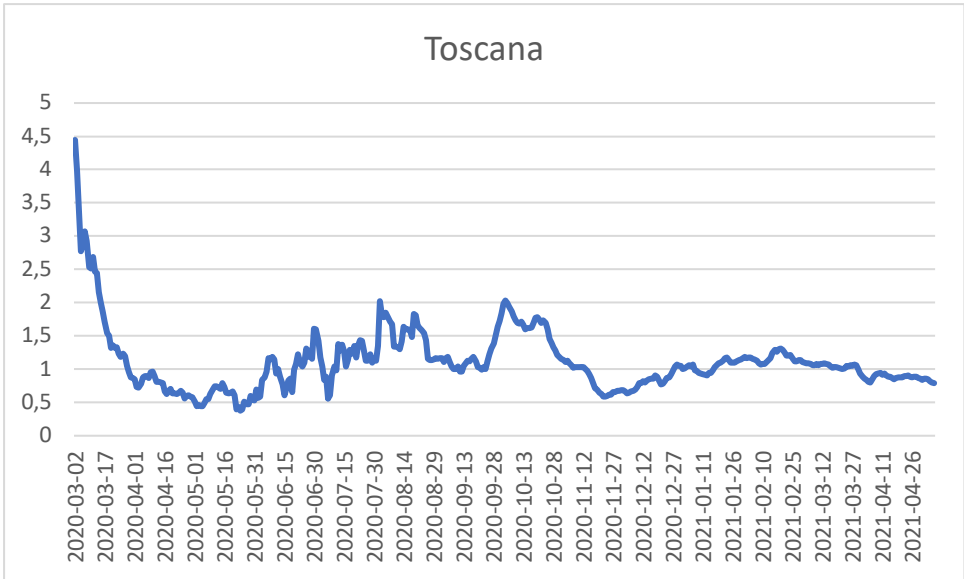
Liguria

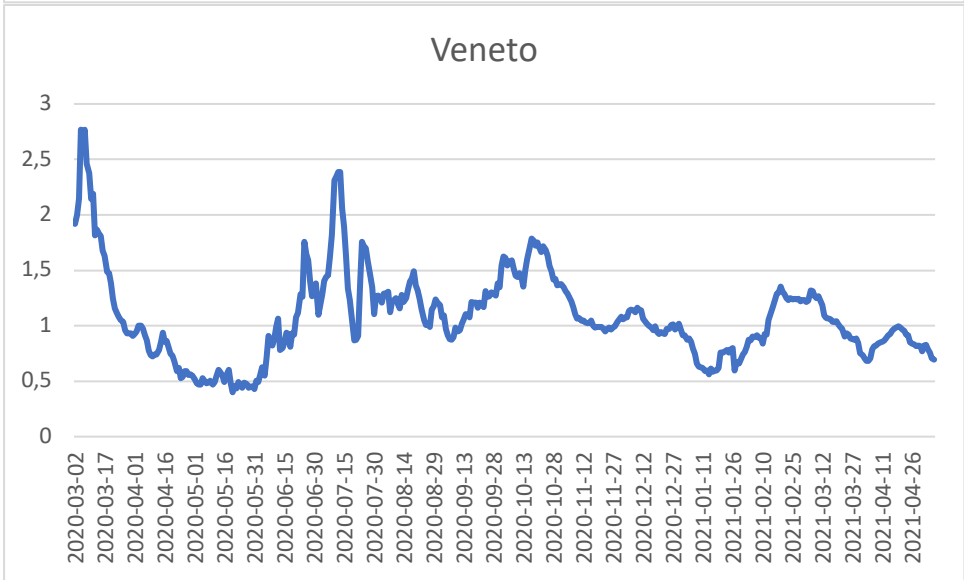
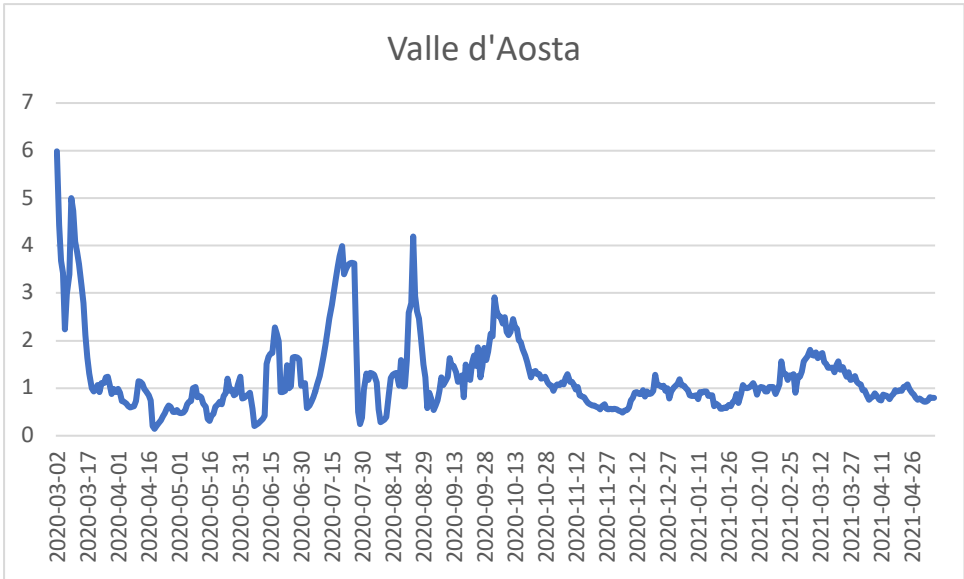












SUMMARY

Resilience is defined as a measure of the amount of change a system can experience while maintaining the same controls on structure and function. It can be divided into three macro-areas: situated resilience, which refer to a micro-level between people and their surrounding work environment, structural resilience: represents the processes of restructuring and reforming socio- technical resources and situated practices, meso-level and at the end we can find the systemic resilience that represents the fundamental reconfiguration and reform of the processes that design, produce, constitute and circulate the sociotechnical resources that underpin safety. In this situation we are looking at the macro level of an organization. Furthermore, we can identify four resilience potentials that are: anticipating, monitoring, responding, learning. These potentials are proposed to support the success of the resilience process that occur in the work environment is essential to guarantee the maintenance of good performance. These four potentials should not be considered individually but should be taken into account in their totality and interdependence. In the practice, the United Nations proposed in 2015 a framework, so called the Sendai framework for disaster risk reduction (SFDRR), which defines a series of priorities and actions to be taken in the context of risk management and following disastrous events, such as the occurrence of natural catastrophes or epidemics. Into practice and the goals to be achieved, the UN foresees four macro areas of intervention which are:

1. Understanding disaster risk
2. Strengthening disaster risk governance to manage disaster risk
3. Investing in disaster risk reduction for resilience
4. Enhancing disaster preparedness for effective response and to “Build Back Better” in recovery, rehabilitation and reconstruction.

All this can be analyzed over the course of history through an analysis of recent pandemics: the largest and most infamous is HIV, the evolution in time of this disease shows us two mainly things: the possibility of living with a virus where you can't defeat it, secondly it shows how there is a strong connection between medicine and society, and where society fails to redeem itself, the fight against certain diseases by the healthcare systems, also has as its goal a social improvement. Another pandemic that certainly deserves attention is that of SARS, which occurred in China in 2003 for two main reasons: the first because it is very reminiscent from the medical point of view of Covid, the second because it is needed in the same country, thus managing to help project China's healthcare system into a more resilient model capable of

responding to the covid epidemic more effectively than other nations. The last epidemic that deserves to be mentioned and that can teach us something is the Ebola epidemic, both because it has activated certain WHO mechanisms and because it has affected the Old Continent in a certain way. What matter most, anyway, is that in the wake of the outbreak, researchers from the Harvard Global Health Institute and the London School of Hygiene & Tropical Medicine formed a research panel, in which they seek to provide the international community with guidelines for improving health resilience to better prepare for any subsequent crises. This group of researchers came up with conclusion and ten recommendations on four different topic areas which are the prevention and the response of major disease outbreak, the reorganization of the global research and governance reform for the coordination of global medical activities. These recommendations are extremely relevant given the situation we are experiencing with Covid and was not followed by the WHO and the global government.

The outbreak of Covid takes as its possible starting point the Huanan Seafood Wholesale Market in Wuhan, which was closed on January 1, 2020. Subsequently, the entire city of Wuhan was placed under lockdown, and by the end of January, already 30 provinces in China had activated the first level of public health emergency mechanism. Chinese experience in managing airborne diseases, as demonstrated in the previous subchapter discussing the SARS outbreak, has certainly helped: the habit of using masks, social distancing, and self-isolation were immediately adopted by the population with informational help from civil society organizations. China was able to have a decrease in cases as early as the end of February, demonstrating how a rapid response and immediate restrictive measures were able to reverse the trend of ongoing infections.

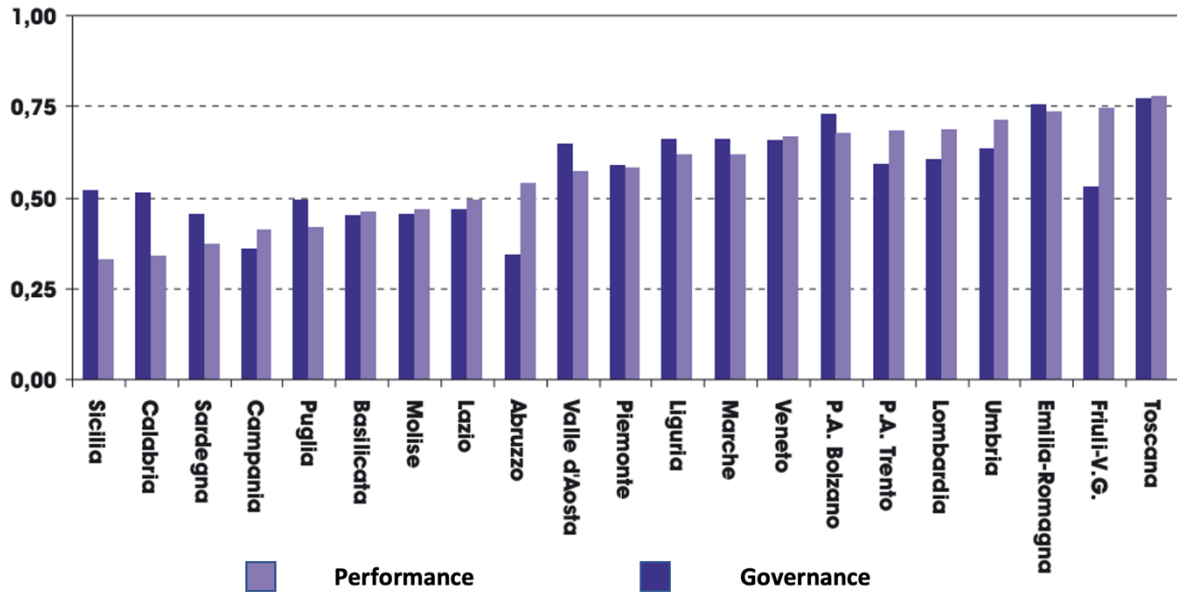
The European Union began having the first cases of covid in late January. The first one, was traced to France on January 24, with a clear link to a trip to China. First, the EU focused on limiting contagions, first closing several national borders and imposing temporary restrictions on non-essential travel within the union. Secondly, the engage in the provision of medical equipment with two specific actions. The third programmatic point concerns the promotion and research of vaccines. Lastly, the union is also focused on combating misinformation through transparency and immediacy of communication, engaged economically in supporting business and work and facilitating the return of European citizens who were abroad at the time the pandemic broke out.

In order to address the discussion of our country's response to the epidemic, it is necessary to briefly understand how our healthcare system is composed. First of all, it is made up of three levels of government, two of governance and one of service delivery: the highest

point belongs to the state, which legislates and gives the key indications, then the health competence passes to the region, which approves its own health policies through the council, and finally the service provider can be the ASL or the AO. Furthermore, we can divide our healthcare system into two main structures, one organizational and one institutional. Institutional organization depends on the type of relationship between ASL and AO. There are three types: Separate, where the AO is separate from the ASL and is the sole provider of the service; Integrated, where the AO is practically non-existent and the ASL directly controls the hospitals; and finally, a mixed system with both models. From the organizational point of view, however, the three main models are the bureaucratic model, where procedural certification is rewarded, typical of the public system; the centralized model, where the ASL acts as the system's holding company, setting goals and spending ceilings to be met by the various ASLs. Finally, the last model is the contractual one, the most advanced which provides for equilibrium of its components and decisional participation between region and sanitary company. The region is the pivot of the process, controlling and monitoring the results, leaving the right degree of freedom of action and self-regulation to the health sector. We can report an interesting matrix which divides all the regions into the organizational and institutional models in which they operate:

<i>Institutional structure</i> <i>Type of governance</i>	Integrated	Separated	Mixed
Bureaucratic	Abruzzo, Molise		Campania, Sicily, Calabria, Apulia, Lazio
Centralized	Veneto, Trentino, Alto Adige, Valle d'Aosta		Basilicata, Sardinia, Piedmont, Liguria, FVG, Marche
Contractual		Lombardy	Emilia Romagna, Tuscany, Umbria

Going to analyze what the situation was before the pandemic, the results that come to light in a study conducted by Mapelli that evaluates regional performance are as follows:



As can be seen, the best performances come from the regions with a contractual organization, and in general from the center-north of the country. Other indicators such as the number of physicians per capita or the number of beds per capita also follow the same trend.

To observe the pandemic development, we use a variable called Baseline reproduction number (R_t), which represents the average number of cases generated by an index case in a population fully susceptible to the disease. This value is represented by positive real numbers and has as reference the value 1, in fact, if the variable takes values less than one it means that the epidemic is waning, on the contrary, if the value is greater than one it is expanding. From that value we can also get two other useful insights: the first is the course of the epidemic in the short term, the second, and the most valuable for our purpose, is the impact of interventions and management throughout time.

The Italian history of the Covid-19 pandemic starts on February 21: the so-called "Patient 0" is identified at the Hospital of Codogno (Lombardy) and, in rapid succession, 14 other patients positive to Covid 19 are identified; in the same day the first death of an Italian patient is recorded in Vò Euganeo (Veneto). Also on February 21, an ordinance was passed to increase the number of medical personnel, particularly dedicated to the performance of the functions of port and airport doctors in the field of international prophylaxis; the attempt is to control and isolate the possible entry of patients from abroad infected with the virus.

On the same day, the Ministry of Health published a circular letter entitled: "COVID-19. Nuove indicazioni e chiarimenti" where the organizational and strategic foundations are laid in the fight against COVID 19:

- Ensure strict application of infection prevention and control measures (standard, airborne, droplet and contact precautions) in all healthcare facilities, including emergency departments.
- Define a pathway for patients with respiratory symptoms in primary care physicians' and pediatricians' offices, such as the scrupulous and systematic application of the above measures.
- Apply procedures for the assessment, activation and management of the intervention of taking charge and transport of the patient by 118 operators, the operations center will contact the reception staff of the Infectious Diseases Unit of the DEA of Level II of reference to agree on the mode of transport and arrival times at that facility. Trying from the organizational point of view, to limit the contacts within the emergency rooms.
- Implement activities to raise awareness among the population, with particular reference to schools.
- General Practitioners and Pediatricians are mandated to equip themselves with personal protective equipment (mask, gloves, goggles, disposable gown), to report the patient to 112/118 or through the organizational paths provided by the individual regions and to report the suspected case to the Infectious Diseases Unit of the DEA of Level II reference.
- Access to ER/DEAs should include an immediate route and a dedicated triage area to avoid contact with other patients. Healthcare facilities are required to hospitalize the patient, where possible in single isolation rooms with negative pressure, with a dedicated bathroom and, if possible, an anteroom. Also calling attention to the need for training of healthcare personnel, which is a very good practice when it comes to operational resilience on the proper methods for donning and doffing PPE
- In the case of a paucisymptomatic⁷¹ patient or negative close contact to the test, home care is foreseen and report the case to the Prevention Department of the ASL for active surveillance.
- In the case of a patient found positive to the SARS-COV-2 swab and at the moment asymptomatic, home quarantine is foreseen with active surveillance for 14 days.
- Regions are also required to designate a dedicated facility for the management of the COVID-19 emergency and laboratories to perform molecular diagnosis on clinical

⁷¹ Infected patient who has minor symptoms

respiratory specimens, which will be done only for symptomatic cases, in addition to suspected cases.

ISS is entrusted with the epidemiological surveillance of SARS-CoV-2 with the obligation of Regions and Autonomous Provinces to feed daily the data platform, the same ISS is entrusted with the microbiological surveillance and the Spallanzani Institute of Rome with the surveillance of clinical characteristics. On March 8, 2020 is issued a new decree by the Council of Ministers; this decree in fact establishes the national lockdown; in fact, on the entire national territory are suspended conferences, meetings, events and shows, pubs activities, dance schools, museums, suspended all sporting competitions, educational services for children and all schools of all levels, educational trips; it is recommended, where possible, the DAD; prohibition to stop in emergency rooms (for carers) and visits to RSA; increased the mode of agile work; it is forbidden for people positive to Covid-19 to leave their homes. In the same decree there are also clear indications of health type, from the disinfection of environments to the recommendation to "fragile" patients to leave their homes. Finally, the indications regarding specifically the obligations of health workers: the public health operator and the territorially competent public health services provide the prescription of the home stay, and therefore also become responsible for the entire tracking of cases. This situation will persist until the beginning of the summer season, where the decrease in cases will lead to a gradual decrease in restrictive measures.

On October 12, a new Ministry of Health Circular (of no less than 102 pages) entitled: "Prevention and response to Covid-19: strategy evolution and planning in the transition phase for the fall-winter period" was issued. In it is described in detail both the history of the Covid-19 Pandemic in Italy, and the various issues that have been gradually addressed, up to the answers that have been given, the possible scenarios and the answers that will have to be given.

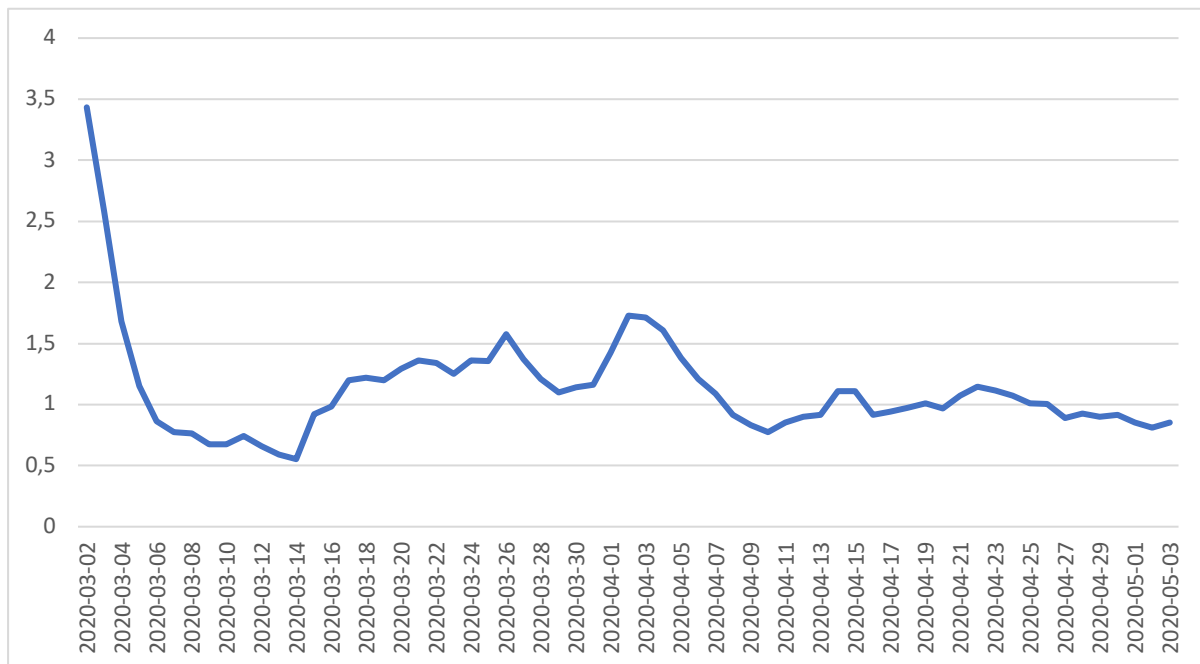
The beginning of the second wave will bring to the attention of the population the concept of diversified zones within the Italian peninsula. This concept, of "yellow", "orange" or "red" region, and the consequent measures are introduced with the decree-law of November 3, 2020, entitled: "Further implementing provisions of Decree-Law No. 19 of March 25, 2020". This decree consists of 14 articles and 42 annexes: in it there are all the provisions to cope with the pandemic and adopt a resilient system that knows how to live with the epidemic and adapt the behavior of the population to it. This decree identifies two categories of regulations: one is valid throughout the national territory while others are valid only on a regional level; a differentiated regime is devised in three bands of contagion risk, according to the 21 parameters

listed in the text of a scientific report attached to the new DPCM. According to the this, the measures will be evaluated on a weekly basis, and will have a minimum duration of 15 days: for the effect, if a Region will be classified as red zone, it will remain there for at least two weeks. Each Region will be placed in one of the three bands on the basis of objective criteria. The Minister of Health will be able to adopt ordinances in agreement with the President of the Region in order to provide for the exemption of the application of one or more restrictive measures, even in specific parts of the regional territory.

- Yellow region is the moderate risk level zone, in which only the national limitations are applied.
- Orange zone is the band that includes the Regions at medium-high criticality: on the territories there is the prohibition of any movement, in and out, from the Region (except for proven needs of work, health and urgency), allowed only the movements strictly necessary to ensure the performance of teaching in presence and within the limits in which the same is allowed, with consequent possibility of return to their home or residence. Is also prohibited any movement in a municipality other than that of residence, domicile or home, except for proven needs of work, study, health reasons, situations of necessity or to carry out activities or take advantage of services not suspended and not available in their municipality.
- The Red zone is the most critical zone: there is the prohibition of all movement in and out of the Region, but also within the territory itself, except in cases of necessity and urgency. Lockout for all non-food markets, closure of bars, pubs, restaurants, ice cream parlors, pastry shops, with the exception of catering with home delivery and, until 22.00, the takeaway, but with a ban on consumption on site or in the vicinity. Suspension of sports activities, including those carried out in outdoor sports centers. The school activities remain in presence only for kindergartens, primary and junior high. Public employers limit the presence of staff in workplaces to ensure only those activities that they deem essential and that necessarily require such a presence, also because of emergency management.

This law will remain in place for the duration of the second wave and sets the stage for a dynamic and resilient response, attempting to live with the pandemic and moving beyond the restrictive lockdown concept during Covid's first season. The results of the two different

legislations at the national level can be observed in the graph below, which shows the trend of the $R(t)$ index at the national level:



As can be seen, the two different strategies clearly had two different goals, during the first wave the aim was a drastic decrease of cases, while in the second wave the goal was to be able to live with the pandemic while keeping the index below the fundamental indicator of 1. It is possible to affirm that in both cases the choices and the measures adopted have at least led to the desired goals.

At regional level, various strategies have been implemented, which derive from the organizational form of the healthcare system of reference and from the specific choices of the management in question. The results can be summarized in the table below. Covid hospitals are defined as regions that have referred severe covid patients to a single hospital, up to the maximum capacity of the hospital, and that have kept open one or more centers solely dedicated to the care of those patients. Mixed hospitals, on the other hand, define regions that have kept open one or more hospitals with separate pathways for covid and non covid patients. Clearly there is no exclusivity between the first two columns as a region may have adopted both solutions to fight the pandemic. Covid Hub, however, defines the regions that have indicated a reference center that, within the Hub and Spoke model adopted by the health system, would perform the first function by acting as a guide to other facilities.

	COVID HOSPITAL	MIXED HOSPITAL	COVID HUB	NEW STRUCTURE	EMERGENCY PLAN
MOLISE		X	X	X	
LAZIO	X	X	X		X
ABRUZZO	X	X	X	X	
CAMPANIA			N/A		
SICILY			N/A		
APULIA		X	X		
CALABRIA		X	X		
LIGURIA		X	X		
VENETO	X				X
FVG		X	X		
SOUTH TYROL		X	X		
BASILICATA			N/A		
SARDEGNA		X	X		
MARCHE	X	X	X		
PIEDMONT	X	X	X	X	X
VALLE D'AOSTA		X	X		
TRENTINO	X	X	X		
EMILIA ROMAGNA		X	X	X	X
TUSCANY		X	X		X
LOMBARDY	X		X	X	X
UMBRIA	X	X	X		X

After careful observation, there are clear trends in hospital reorganisation, with centralised regions preferring a mixed system, thus favouring flexibility in organisation and service delivery. All the centralised regions have in fact provided for the presence of a central reference hub in a sort of organisational continuity with the initial model. In fact, as a first approach, all the other regions have structured, within each Local Health Authority, a reference hospital to act as a Hub, choosing in some cases a mixed system (Trentino, Liguria, Valle d'Aosta, Friuli Venezia Giulia) while in other cases Hubs dedicated solely to the pandemic (Piedmont, Veneto, Marche, Sardinia). The regions with a bureaucratic organization, on the other hand, have preferred the identification of reference hospitals within the region, excluding access to covid patients to other hospitals, with the clear exception of Lazio, which has adopted a policy of mixed Hub and Spoke with the two private centers acting as leaders. Finally, the contracting regions have managed to ensure a very efficient reorganizational policy, with targeted and regionalized choices and, above all, a clear and well-defined emergency plan, a mixed system is identified that proposes the individual specificities of each AO, effectively relaunching the concept of high specialization and supply of individual facilities. It should be

emphasized that both Lombardy and Emilia Romagna foresee the creation of temporary health facilities to be made available to the rest of the regions in the worst-case scenario.

Once all the specific data and the regional epidemiological trends have been compared, a confront can be made on the efficiency of the ongoing provision of other health services. In this regard, we report two matrix that relate the impact of each individual region to two other variables, in the first case we have the variation in the volume of planned hospitalizations, while in the second the volumes of outpatient specialist services. On the abscissa axis, instead, we find the number of infected per 100,000 inhabitants. In both cases the efficiency calculated refers to the first wave, with data collection from March to June of last year. The two tables differentiate the four areas, separated by the two medians of the variables taken into consideration. In general, one can speak of good relative performance when the region taken into consideration is above the median of the volumes supplied. The macro-areas on the right and on the left, on the other hand, increase or decrease the evaluation of the overall performance, regions such as Lombardy or Valle D'Aosta, which have had very high data on the infected, are more "justified" in having a lower performance, in the event that there has been one.

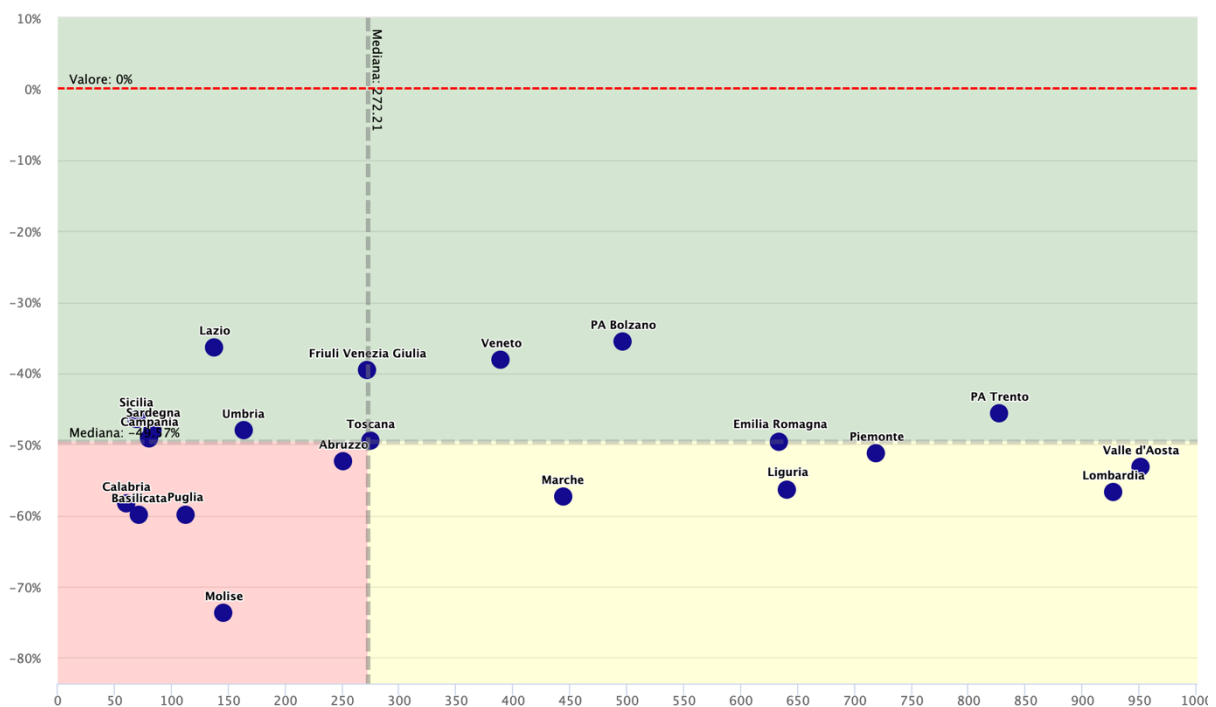


Figure 34: Change in volumes for planned admissions for March-June 2020 compared to the prior year. AGENAS

This matrix helps us understand how the various regions were able to deliver effective service during the pandemic, at the hospital level. In fact, by counting planned hospitalizations, it is possible to observe how the various regional health systems managed to provide continuity of service beyond the pandemic situation. As can be seen, in the case of scheduled hospitalizations, the most virtuous regions were those with a centralized organization, and especially those in the northeast, which could already boast of a very advanced healthcare system, and in addition had on their side a limited number of infections. Even Lazio has recorded a good performance, but that depends more on intrinsic regional specificities or on the ability of management than on the organizational model. In fact, other regions with a bureaucratic model have not performed as well as they should, especially in relation to the unbearable pressure on the healthcare system. The organization instead during the epidemic, reflects these data with the regions that have adopted a system of mixed hospitals (covid/non covid) as the FVG or the autonomous province of Bolzano to lead the way. Certainly, even the Veneto system of organizing a Covid hospital for each ASL, keeping the others free, has given positive indications. In its own way, even the autonomous province of Trento, with a mixed system, but with the most serious patients addressed in a single hospital DEA I has given its fruits, keeping freer the central hospital of the region, it can be observed that, among the regions that have an incidence of cases higher than 600 per 100000 inhabitants, has been the best. The regions of the northeast, for their part, have not been able to remain at the standards of the other regions, and this result is partially justified by the enormous pressure they have had to suffer within the pandemic, not even remotely comparable to the rest of Italy.

The pandemic certainly tested the resilience attributes of the healthcare system, initially, from an operational standpoint, with healthcare personnel finding themselves having to respond to an unknown disease without having the necessary tools and knowledge. Even from a structural point of view, the moment of resilience occurred almost immediately, with the regions of Lombardy and Veneto leading the way, with rapid and targeted measures, from patient isolation to contact tracing systems to the management of a completely revamped and separate triage system. From a systemic perspective, however, the moment of resilience is to be found at the end of the first wave and the beginning of the second. In a first moment, in fact, it was wanted to make systemic the process of resilience started in March, implementing and making structural all the changes made. The national regulatory response, with the lockdown imposed at the beginning of March, was certainly appropriate to give the entire system room to reorganize and prepare for the second wave in the best possible conditions. In a second moment, fundamental was the passage to the trichotomy of the regions, dividing them

according to the $R(t)$ index and the specific health response capacity; placing at the center of management the absorptive capacity of each individual regional system and thus making the characteristics of a resilient system capable of anticipating, learning, monitoring and finally responding to external agents. From a regional point of view, the greatest burden of this pandemic has been borne by the regions of the northwest, along with Emilia Romagna, with the pandemic fortunately not proliferating in the same way in other regions where healthcare, during flu periods, already struggles to respond adequately. Certainly, from an organizational point of view, the regions applying the contractual organizational model proved to be faster and more resilient, first of all, they all applied a strategic plan that was then made public, and they were also able to increase the capacity of available beds practically immediately, as shown in Lombardy, which after one week had already increased the number of intensive care beds by 20% compared to the original capacity. The application of a concerted model, in Tuscany and Emilia-Romagna, demonstrates how the sharing of objectives with health personnel in the field, makes the response efficient and targeted to the result, giving excellent performance from the point of view of the quality of the response, certainly, it turns out to be a little slower than a slightly different model such as Lombardy, but in the long run is still very valid. The centralized regions, however, proved up to the challenge, with the particularities of Veneto, which did a terrific job of tracking and containing the epidemic in the first wave, and Piedmont, which, despite the huge load on the regional health system in the second wave, still had 27% of the total beds available at the peak of intensive care filling. The bureaucratic model, with the exception of Lazio instead, seems to suffer a little from the resistance of the procedural certification and the cumbersomeness of the decisions, the comparison with other systems is however complicated given the difference in the impact of the pandemic in the territories of reference and the starting point of the regional health system that for the amount of available productive resources is certainly lower than the corresponding ones. Certainly, it can still be affirmed that the alignment with the organizational reform of the Health System that took place in 1999 brings only benefits to the regional administrations that, as demonstrated above, perform better under the contractual models, with the exception of those regions with a small population and, therefore, with ease of management by a single central entity, such as Trentino, South Tyrol and Valle d'Aosta. From an organizational point of view within the pandemic resilience, the best strategy for small regions is to free the central hospital from the greater specific weight of the covid inpatients, diverting it, as Trentino has done, to the second regional hospital in terms of size and equipment, thus allowing the continuity of health service delivery. Valle d'Aosta and Molise, that instead have individualized in the central hospital the Hub covid,

have in fact underperformed in comparison to the province cited previously, having one greater loss in the disbursement of the normal service like demonstrated in the previous chapter. The regions of medium size, with a population exceeding one million inhabitants, have as their leader Friuli Venezia Giulia, which demonstrates how a mixed strategy, with each hospital involved and as a reference Hub the DEA II hospitals performs at its best. Also Abruzzo, which despite the lower availability of productive factors while using the same strategy as FVG, with the addition of a dedicated structure overperforming the Marche, which instead adopted a strategy with covid referral hospitals, and hospitals that did not treat this type of patient, who underperformed in the overall situation, going in both indicators of continuity of service delivery below the national median. For high-populated regions, on the other hand, a double reasoning must be made. First of all, the different impact of the pandemic and how it has been treated at the epidemiological level, with the case of Veneto which, as mentioned above, with a system of a dedicated hospital for each ASL and a strategy of research and isolation of contacts with positives, shows the best way to respond to the situation that has arisen. The other regions have responded in different ways, those who, like Piedmont, have faced the pandemic with a mixed strategy, with the simultaneous presence of dedicated hospitals, special temporary structures and a different system for each ASL, certainly demonstrates managerial resilience but, given the great interregional differentiation, gives a response that is difficult to quantify in a cause-effect relationship. The Lombard internal organization, on the other hand, demonstrates great decision-making rapidity, especially in the first wave, but as mentioned above, a comparison is difficult both in terms of regional population and in terms of the difference in impact on the healthcare system. From a purely organizational point of view, they were certainly successful in being able to make available beds in intensive care in a very short time, certifying how a separate system, with the search for a public-private partnership, can certainly be effective. The last major region that gave important organizational indications was Lazio, which, thanks to a mixed institutional model, was able to address the command of operations to private centers which offered a high-end service, guaranteeing excellent management of the epidemic and a very well-prepared referral Hub, probably providing what was one of the best hospital responses to the pandemic for high-population regions, with a mixed Hub and Spoke system that proved to be very competent and resilient. To conclude, the response of our system has certainly been effective, guaranteeing in every moment of the pandemic adequate care to every citizen who needed it; the quality of the response has come both from a political point of view, first with the excellent choice of the government to impose a lockdown to limit contagions and give time to the structures to organize themselves, and later with the dynamic

regional trichotomy. From the hospital point of view, the regions were able to increase the availability of intensive care beds, which in the case of Lombardy, Marche, Piedmont, Umbria, Trentino and South Tyrol would not initially have been sufficient. Probably, it would have been possible to improve the continuity of the health service, which in the best of cases (South Tyrol and Lazio) recorded a -35% in volumes against a national median of halving the supply, but this figure is also in part due to the lesser need for ordinary care on the part of the population which, staying at home, certainly had fewer traumatic incidents. Comparing our situation, however, with dramatic realities such as that of the United States, where health policies have certainly been less restrictive, we can once again be thankful for having a state health system available, accessible to all and which, even in an extreme situation such as this, has responded efficiently.