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The rise of multi-sided platforms in healthcare: insights from telemedicine companies

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Authors: **Luca Bastianelli**
Stefano Martinelli

Student ID: 10755087
10583074

Advisor: Emanuele Lettieri
Co-advisor: Alessandro Carrera
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Abstract

The recent pandemic has exposed structural weaknesses and criticalities of the Italian national healthcare system (SSN), as inefficiencies and serious burden to face emergency situations that require high degree of flexibility in services provision. Contextually, remarkable steps forward have been made in the digital health sector, in particular multisided platforms, that are products or services where multiple groups of customers are get together through a platform that internalizes indirect network externalities, are becoming increasingly widespread. The aim of this research is to investigate a relevant example of multisided platform in the Italian healthcare sector, namely telemedicine. Telemedicine solutions are indeed a highly relevant and timely phenomenon that can be studied through the lens of multisided platforms. Consequently, the present study explores the business models of organizations providing telemedicine solutions in Italy, to understand potential benefits, limitations, and future developments in terms of profitability and scalability. Through an empirical analysis based on the collection of information on companies' websites, official documentation, and direct interviews with nine telemedicine organizations, it emerged that telemedicine could actually make an impactful contribution to cope with the fragilities that affect the national healthcare system. Nevertheless, a significant limitation that impedes these companies to leverage on a business model like the one of other multisided platforms has to be found in the issue of health-related data management, that are known to be particularly sensitive. Indeed, the usage of data could unlock new revenue streams, enhancing the profitability of the business model and raising network externalities on the platform, always respecting General Data Protection Regulation (GDPR) rules. Finally, the telemedicine business model proved to be sustainable and scalable in the next future; however, in order to make it fully succeed also in the long term, an improved data management regulatory is required, government aid is needed, and digital divide issues must be overcome.

Key words: telemedicine, multisided platforms, telemedicine business model, healthcare, healthcare data management.

Abstract in italiano

La recente pandemia ha puntato i riflettori su alcune debolezze strutturali e criticità del Servizio Sanitario Nazionale (SSN), come inefficienze e altri ostacoli nel fronteggiare situazioni di emergenza che richiedono alti gradi di flessibilità nell'erogazione di servizi. Contestualmente, importanti passi avanti sono stati fatti nel settore digitale sanitario, in particolare piattaforme a più parti, che sono prodotti o servizi dove gruppi multipli di clienti sono raggruppati attraverso una piattaforma che internalizza esternalità di network indirette, stanno diventando sempre più diffuse. Lo scopo di questa ricerca è di indagare un esempio rilevante di piattaforme a più parti nel settore sanitario italiano. Le soluzioni di telemedicina sono infatti un fenomeno molto importante e recente che può essere studiato attraverso le lenti di queste piattaforme. Di conseguenza, questa ricerca esplora il business model delle organizzazioni che erogano telemedicina in Italia per capirne potenziali benefits, limiti, e futuri sviluppi in termini di scalabilità e profittabilità attraverso un'analisi empirica basata sulla raccolta di informazioni dai web site delle aziende, documentazione ufficiale, ed interviste dirette con nove realtà di telemedicina, è emerso che la telemedicina potrebbe portare un significativo impatto per fronteggiare le fragilità che interessano il sistema sanitario nazionale. Ciò nonostante, un limite significativo che impedisce a queste aziende di fare leva su un business model come altre piattaforme a più parti risiede nella gestione di dati sanitari, conosciuti per essere particolarmente sensibili. Infatti, l'uso dei dati potrebbe sbloccare nuovi flussi di cassa, incrementando la profittabilità del business model e aumentando le esternalità della piattaforma. Infine, il business model della telemedicina ha dimostrato di essere sostenibile e scalabile nel prossimo futuro; comunque, per avere successo nel lungo termine, è richiesta una migliore regolamentazione sulla gestione dati, sono necessari aiuti governativi e devono essere risolti problemi di digital divide.

Parole chiave: telemedicina, piattaforme a più parti, modello di business di telemedicina, sanità, gestione dati sanitari.

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1 Executive Summary

The current historical period, characterized also by the COVID-19 pandemic, has highlighted various criticalities of the national healthcare system. At the same time, the diffusion of digital technologies and applications based on a multisided platform business model has become widespread. It is worth elaborating on an example of digital technology in healthcare based on the multisided platform model: telemedicine.

In particular, the focus of the thesis is to map the current situation of the telemedicine market in Italy with all the related stakeholders, the common characteristic of the business model, and finally hypothetical future developments of a market with high potentiality but not fully exploited.

To deepen the core topic of this study, it has been studied the overall picture of digital health in all its features. Thus, clarifying the contextual and theoretical background, the literature review, encompasses the concept of digital platforms, and finally carries out an empirical analysis of telemedicine as a consequence of literature review.

1.1. The theoretical and contextual background

For an introductory overview, useful to probe the thematic, the Italian national health system (NHS) in its structure and organization has been summarized. Then an excursus about digital health has been done. In fact, during the last decade, digital healthcare has seen the introduction of high technology such as artificial intelligence, cloud computing, and robotic process automation, which together with significant investments made by companies and government institutions have brought traditional healthcare to a superior level of quality, efficiency, and effectiveness which results are no longer negligible. The main frame for Italian telemedicine has been provided by the "National guidelines for the delivery of services in telemedicine" published in October 2020, which give definitions and rules about this sector. Telemedicine encompasses a series of services namely tele-monitoring, tele-visit, tele-consulting, tele-reporting, tele-assistance, and all of them have a primary objective to deliver health services without the physical patient presence, but through data exchanging. Thorough research has been developed to understand the actual telemedicine governance in terms of future national plans and investments, whose extraordinary available budget makes the sector truly attractive for hundreds of companies in search of the best business model to be on

the market and obtain income from public tenders. Finally, in this first part of the research, multisided platforms have been investigated because of their inherent relationship with the telemedicine sector, which is a primary and practical example of a digital platform. As a matter of fact, telemedicine could be a native example of a digital platform in healthcare, hence the results of a non-systematic literature review have been reported to describe the common business model elements of multisided platforms that could be useful to identify those of telemedicine, in case of similarities and differences.

1.2. Literature analysis

In order to get an exhaustive overview of the theoretical knowledge of digital platforms in healthcare, a systematic literature analysis has been carried out. The former consists of an unbiased and always replicable top-down process. The first step involves identifying the right keywords about the topic of the research to pick the right set of articles dealing with multisided platform topics. The eligible papers have been fully read and analyzed from the point of view of their business model. The principal information of business model cases has been systematized to have a schematic folder of key material. From this analysis, it turns out that there are no relevant Italian digital platform cases in the literature, while outside the Italian border the topic is way deepened. Moreover, valuable, and precious information about the core elements that distinguish multisided platforms in healthcare with respect to the normal multisided platforms have emerged.

1.3. Empirical analysis

Since telemedicine can be considered an interesting and timely case of multi-sided platforms operating in this country, an empirical analysis of operating telemedicine companies is needed to find out the current status for the purposes of this research, even because of the lack of theoretical contents in the Italian landscape.

The empirical analysis consists in collecting general knowledge and insights from the official website of the companies and the official companies' documentation. In this phase, the objective is mapping comprehensively the telemedicine Italian market to see which actors made up the competition and meanwhile start to shed light on the data fitting properly the principal business model blocks and other worthwhile types of information understood from the literature analysis. A satisfactory result has been achieved both in terms of the number of realities and in terms of insights. Again, in this empirical study, the essential information has been systematized to have a schematic approach to the analysis for identifying

differences, similarities, core elements, value proposition, and other key elements of this sector.

After having explored the topic from an analytical point of view and denoting not being fully familiar with healthcare multisided platforms, the current research applies a methodological approach to gather further information about telemedicine organizations in Italy and their business model. From this point ahead the subject of investigation switches definitely from multisided platform to telemedicine, assuming an empirical and pragmatic approach. Indeed, the main firms that offer telemedicine services in Italy are analyzed, identifying the principal characteristic of their business model which could be the first national approach to the business model of multisided platforms.

1.4. Research methodology

The research methodology selected is qualitative, more specifically a multiple-case study is conducted, in which different companies are interviewed. The interview, which is structured by taking as input the evidence emerging from the literature review and the empirical context analysis, has the aim of investigating more deeply and directly the features of Italian organizations offering telemedicine solutions, through the first-hand testimonies of people who hold senior positions in the companies.

The interview is made up of 11 demands which cover parts about a general introduction of the company, empirical parts, and important business model elements such as revenue stream, customers, key resources, etc.

In order to collect as much as possible information, an interview request has been sent to all the companies previously identified as telemedicine providers. Nevertheless, not all the companies granted the interview, but just nine over nearly forty. For the success of this phase significant support has been provided by the "Osservatorio Sanit Digitale" of "Politecnico di Milano", indeed, it is recognized at the national level as a reference point in the field of telemedicine.

1.5. Findings

The relevant findings resulting from each interview are reported, highlighting the main differences between these companies. The aim is to apply critical analysis to all the information gathered by the interviews in combination with the empirical analysis that has been previously done. As result, the overall picture of telemedicine organizations in Italy is depicted, in terms of telemedicine services offered and

relationships with the users of the platforms, obstacles encountered, benefits generated, and their business model. A detailed investigation, through the usage of graphs, is therefore provided about their key customers, revenue streams, key resources, and policies in terms of user-data management. Moreover, considerations about the history of those companies and the effects that the COVID-19 pandemic has brought on their business are reported. Finally, hypothetical future developments in the telemedicine sector have been registered to highlight the convergence of most of the companies about the progress that might occur within the national border.

1.6. Discussion

A discussion of those findings is subsequently carried out, deriving valuable insights about the future of this market and the trends that may characterize the telemedicine sector, taking into account also what emerged from the literature review. The state of emergency has for sure spotlighted the incredible benefits of telemedicine, offering the prospect of a positive future for this discipline. However, some circumstances need to be verified so that telemedicine companies can profitably succeed. Through the academic insights coming from the literature review, it has been possible to spot all the possible features that make telemedicine similar to a multisided platform and features that still block telemedicine as a simple application for delivering healthcare services without unlocking all the potential which might generate large benefits from pain relievers and gain creators. This research thus contributes to delineating the margins of telemedicine, which could end up being the first application of a multisided platform in healthcare in Italy. The study, indeed, can be exploited to understand which are the weaknesses and strengths of a sector and contemporarily the boundaries of a market heavily regulated by legislation and influenced by different actors.

1.7. Conclusion

The work ends with a conclusion about the limitations faced during the study and suggestions for future research based on the cues that emerged. The main limitations which challenge the potentiality of the current research can be associated with the premature market of telemedicine as well as the more general business model of multisided platforms in healthcare.

A further limitation can be found in the empirical analysis since there was no possibility to interview all the Italian telemedicine realities. Thus, a more complete

analysis and consequent results might be generated if all the possible information would be collected.

Finally, to further enhance the overall results obtained, it would be worth introducing new points of view of different stakeholders in the telemedicine ecosystem. In this way, since the different users of a multisided platform are fundamental for the benefits of the whole platform environment, it would be possible to know how it produces or could potentially produce value not strictly limited to remote healthcare delivery.

2 Introduction and Contextual and Theoretical Background

2.1. Organization of Italian national healthcare system (SSN)

The Italian national healthcare system, called Servizio Sanitario Nazionale (SSN), has a communitarian and equalitarian connotation, considering the healthcare a public interest. This system is not completely financed by public funds, but it is made up by a mixed participation of public intervention and private autonomy. Specifically, the percentage of private expenses or out-of-pocket expenses is around 25% respect to the total health expense composition [1]. The governance starts hierarchically from the minister of health which assigns annually the financial resources to each regional ASL (azienda sanitaria locale) based on a lending capital parameter to assure minimum level of assistance (LEA) that each region must guarantee over its territory. Then each ASL has fully autonomy in organizing its subsystem in terms of how many and which health facilities they need, as well as acting as a supervisor. The sublevel of ASL is made up by different agents. There are the AOs (aziende ospedaliere) which are autonomous entities able to deliver health services in parallel at ASL. Pharmacies which enable the purchasing of pharma for citizens. Private healthcare providers which perform private health services. Moreover, there are other stakeholders around the whole system that highlight the complexity of the health sector, whose governance is therefore cumbersome.

The main public entities of the healthcare system are aziende sanitarie locali (ASL), aziende ospedaliera (AO), aziende ospedaliero universitarie, and Istituti di ricerca e cura a carattere scientifico. The ASL are responsible for managing an integrated system which comprehends different services delivered by doctors and healthcare facilities. Instead, the main private entities of the healthcare system are accredited private hospitals, IRCCS (Istituto di ricovero e cura a carattere scientifico), private Policlinics directly managed by universities and classified hospitals [2].

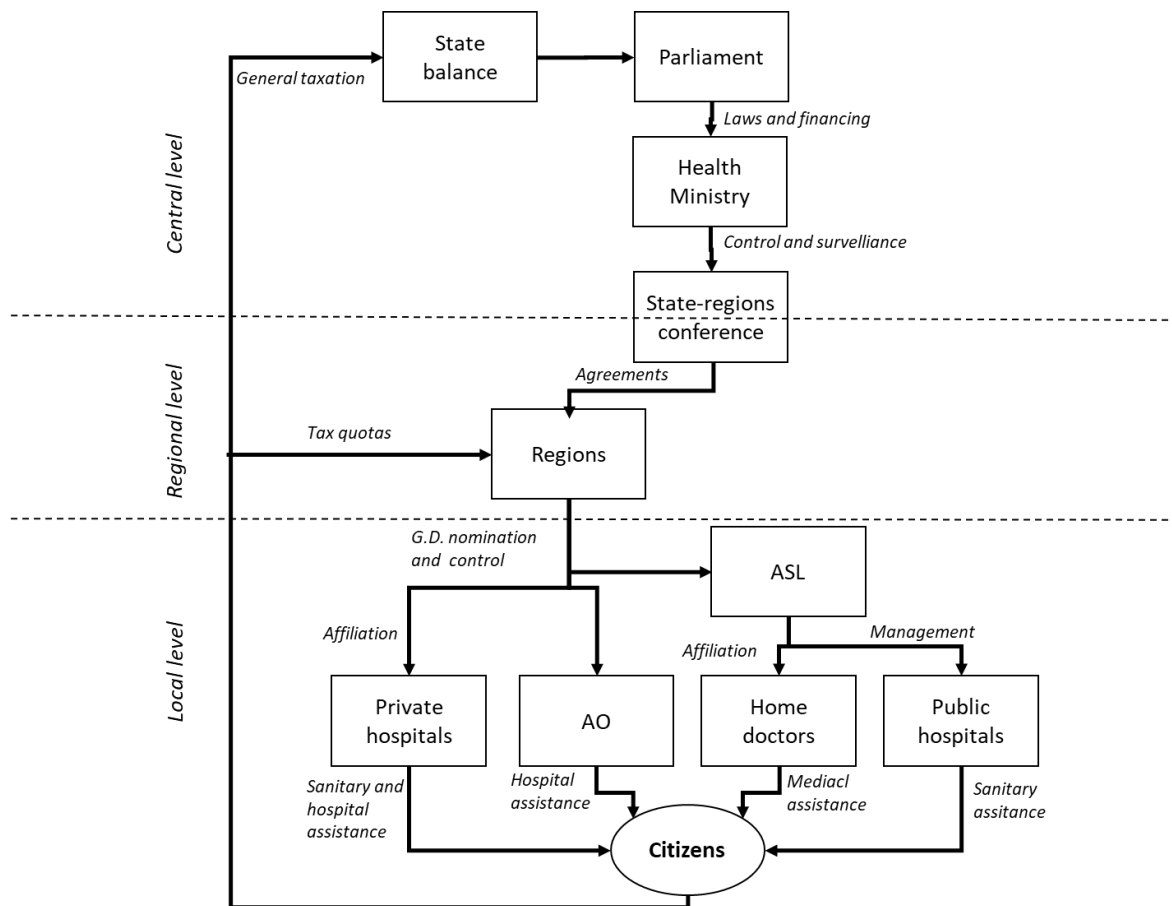


Figure 1: Structure of Italian national healthcare system

2.2. Multisided Platforms

The focus of this thesis is intended to be on multisided platforms, with particular emphasis on the Italian scenario. Hence, a theoretical overview of the concept of multisided platforms is given in this chapter. It refers basically to platform as an interface enabling and orchestrating interactions between two (two-sided platform) or more (multi-sided platform) distinct sides, capturing value from it. It acts therefore as an intermediary that manages the economic transaction between two or more mutually dependent groups of users, connecting them. In so doing, it creates values by reducing operational and transaction costs or giving new benefits to the groups [3]. As the aforementioned features suggest, this type of business model is regarded as an “asset light” one, since the key resources of these businesses (namely the distinct group of customers) are external and not owned by the

companies themselves. This allows them to have a leaner cost structure with respect to the traditional companies, ensuring a competitive advantage in terms of flexibility and favouring a natural attitude toward innovation. Another necessary characteristic that businesses must have to be classified as two- or multi-sided platforms is that positive cross-side network effects between the different groups must be present. Cross-side network externalities arise when one side of the platform benefits from the growth in terms of attractiveness of the other side, for instance an increased number of users [4]. So, there is a mutual gain between the two groups. In this context, the platform provider acts as an intermediary that internalizes these externalities. A key challenge for this kind of organizations is represented by the necessity and difficulty of having the two group of users on board of the platform at the same time, and to reach the so-called “critical mass” required to make the business take off [5]. Regarding the revenue structure, there should be usually a money-side that pays in order to be on the platform and a subsidize-side that earns being present on the platform.

After having clarified the concept of multisided platform, a classification of the different typologies in terms of what kind of connection the intermediary facilitates is covered. A transaction two-sided platform or market enables a direct transaction related to a product or a service between the two groups. Several examples are present in real life, from Uber to Airbnb. Instead, an orthogonal or nontransaction platform is about an indirect relation among the sides, since its business consists in providing its product or service to one group and selling the access to this side to the other one. A classic example of the latter category is represented by the websites’ advertising model, in which the visitors and final users access the service for free or at a low price, being subsidized by the advertisers on the other side. Indeed, advertising companies are charged by the platform provider, constituting the main revenue stream for it, since it allows them to access final users who represent their targets [6].

*Transaction
Two-Sided Markets*



Figure 2: Two-sided transactional platform

*Nontransaction
Two-Sided Markets*

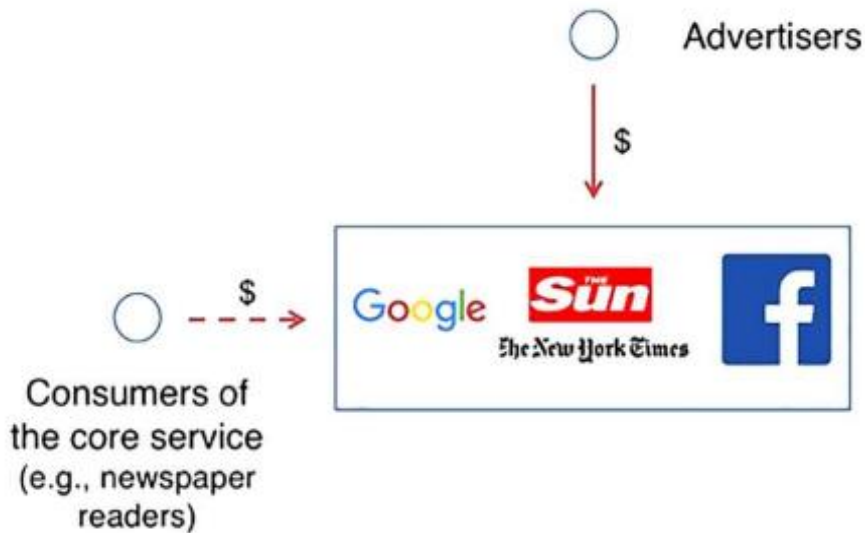


Figure 3: Two-sided non transactional platform

Regarding value capture, a recent study by Trabucchi, Buganza and Pellizzoni explains how big data have a key role for the platform business model. As a matter of fact, there are three strategies that multisided platforms can leverage to gain revenue from big data: enhanced advertising, e-ethnography and data trading. Enhanced advertising consists in using customer data to boost standard advertising, helping advertisers in making it more customized and targeted for customers. So basically, clients are seen both as a target and as a source by the other side of the platform (advertisers). This strategy is pursued for instance by Runtastic, providing very personalized and contextualized advertising messages and links to advertising partners “that make ads look like the answer to users’ needs” [6].

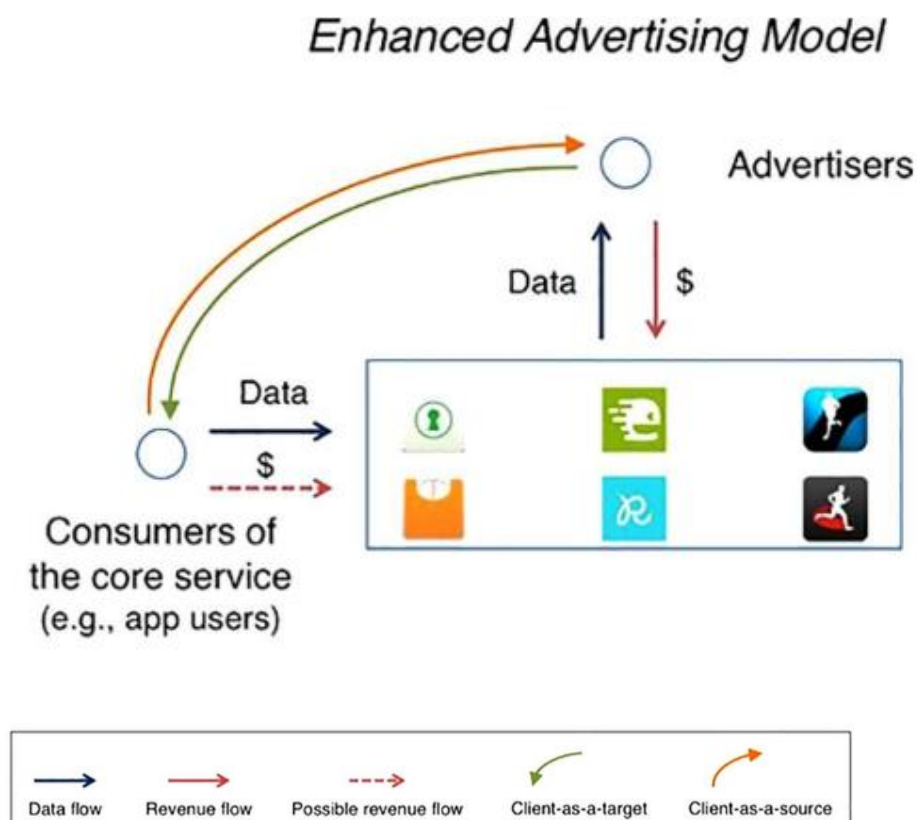


Figure 4: Enhanced advertising strategy

E-ethnography is a strategy used by the provider of the platform to enhance its products and services exploiting the customer data collected through the platform itself. Indeed, user-generated data represent a key resource for companies, providing insights about the way clients interact with their offerings. Therefore, by analysing those data, companies can internally investigate areas for improvement

and strengthen their relationship with customers. In this strategy, the client has clearly the role of a source and the use of data generated by him is internal. A company that adopted this strategy is Nike, that collected a large set of valuable user data through the training app “Nike +”, getting useful insights on how their customers used Nike shoes [6].

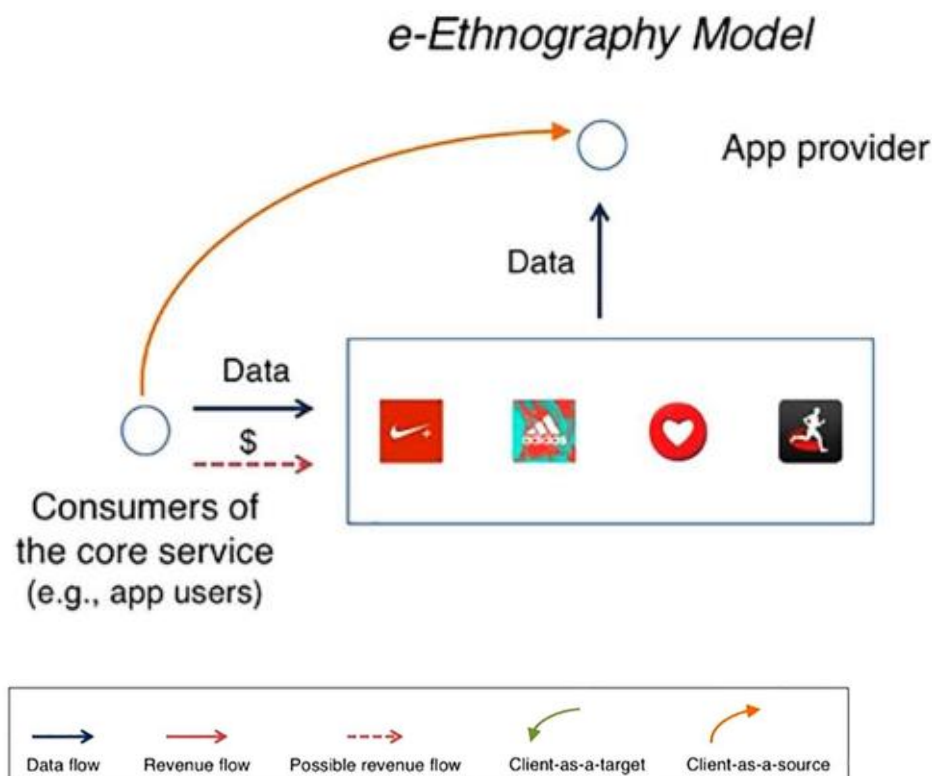


Figure 5: e-Ethnography strategy

The last strategy for generating revenue from user data is to directly sell them to third parties, namely data trading. Third parties are usually other companies that use those data to provide their solutions or organizations doing research. In this perspective, client is seen as a source and the data itself represents a revenue-generating asset for the platform. An example is Strava, a platform that offers GPS tracking service for cycling, running, walking and swimming sport activities and puts in contact users for sharing their progress. Indeed, the company has sold their user-generated data to different departments of transportation in US and UK, that exploited those data to provide civic support, for instance by identifying where bike lanes are needed [6].

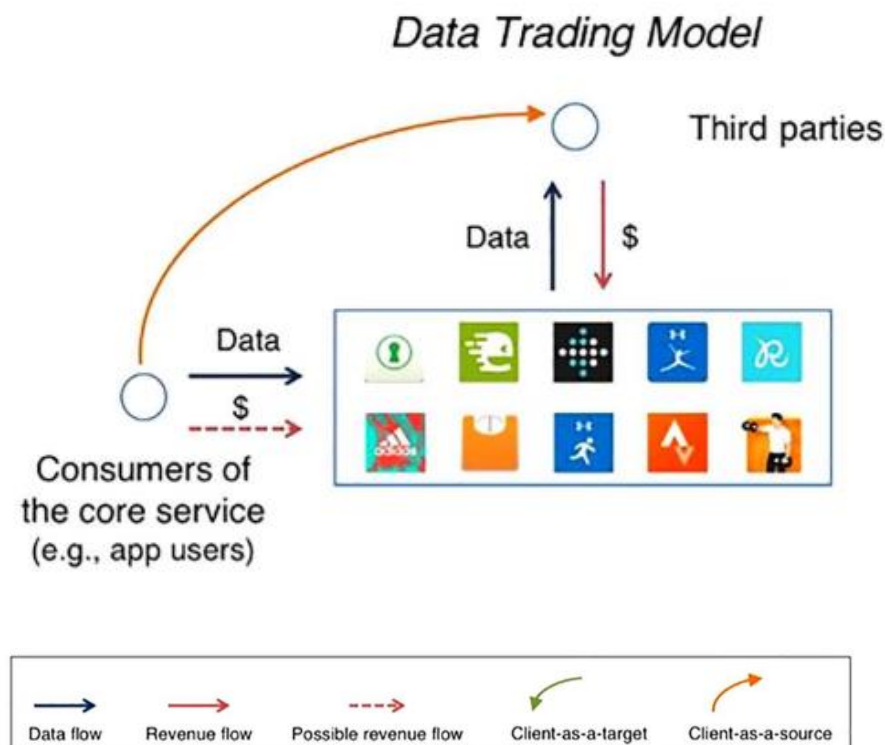


Figure 6: Data trading strategy

2.3. Digital health

2.3.1. Historical background

Technology developments especially in Information and Communication Technologies (ICT) strongly influenced and transformed also medicine, starting from the second half of the 20th century [7]. The first technological innovations such as ultrasound imaging techniques (1956), DNA sequencing techniques (1977) and artificial organs transplantation (1982) definitely paved the way for the advent of developed information and communication technologies in the years ahead [8].

Entering the end of the 1980s and 1990s, the healthcare sector was affected by the wave of digital communication, also thanks to many professional associations appeared with the aim of improving health services in attempt to favour the transition towards more technology-driven healthcare methods [8].

The maturation phase occurred since the 2000s, because of the maturity and diffusion reached by world-wide-web and telecommunications that allowed the average patient to have access to the internet and easily become an interconnected user. Consequently, the world of medicine became more accessible by patients and new terms have been coined, such as mHealth (mobile health), eHealth (electronic health), and Personalized Health. These years saw also the origin of digital therapeutics, namely the therapies that rely on digital technologies in order to heal and manage illnesses in a predictive manner. In this regard, one of the forerunners is represented by WellDoc, founded in 2005. In the same period, the use of wearable devices in the healthcare field began to gain a foothold, with the innovation of wireless fitness tools able to monitor vitals introduced by the American company Fitbit in 2007 [8]. This represented a crucial transition for digital health, that with the commercialisation of such devices started to look toward a wider audience.

In the last decade, the concept and implementation of digital healthcare have generally been integrated into the traditional health, as a mean to enhance its efficiency and potential cutting costs and increasing quality. A decisive role has been played by the recent advancements made in different technologies, such as artificial intelligence, machine learning, cloud computing and robotic process automation. This progress allows healthcare to provide a customized service to patients, adapting to their different needs. A significant push was also made by companies and government institutions, that occurs especially in the form of investments. Indeed, in the period between 2014 and 2020 investments in digital health rose from \$4.1 bln to \$9.4 bln [8]. In particular, an important branch of digital health turns out to be telemedicine, that will be deepened in the next section with reference to the Italian scenario.

2.3.2. Telemedicine

A major contribution to the framing of telemedicine discipline in Italy is provided by the “National guidelines for the delivery of services in telemedicine” published in October 2020, that gives precise definitions and practices about this branch of digital health. Below are presented the main passages.

As defined by these guidelines, “Telemedicine represents an innovative approach to healthcare practice enabling the provision of remote services using digital devices, internet, software and telecommunication networks”.

Hence, telemedicine allows the patient’s home to become a place of health assistance, by making the treatments accessible through a secure data and

documentation exchange between patients and healthcare professionals. Consequently, telemedicine brings clear advantages in terms of cost and process time for patients within the context of prevention, diagnosis, therapeutics and monitoring of clinical parameters. Moreover, it makes the daily doctors activities smoother, also facilitating the exchange of information between professionals. Instead, some of the barriers that can impede or hurdle the growing of telemedicine are the availability and capability of usage of the needed technology and the data handling about the privacy matter.

Telemedicine services can already be extremely useful for the following healthcare aims:

- medical emergencies, exploiting electronic transmissions in order to exchange clinical information and establish contacts in videocalls with rescuers;
- control of diseases of particular importance for the national health service because of the severity of the clinical course, diffusion among the population and/or economic effort;
- accessibility to diagnostic services and continuity of care;
- remote control and monitoring;
- medical certification.

Within the Italian legislation all the types of telemedicine services have already clear definitions. "Televisita" (tele-visit) is a medical activity in which doctors interact with their patients in real time and from distance, even through a care giver support. However, it is limited to the control of patients whose diagnosis has already been formulated during a visit in presence. It is payable under one of the following circumstances:

- a medical service concerning PAI/PDTA ("Individualized Care Plan" and "Diagnostic Therapeutic Assistance Pathway");
- follow up from a known pathology;
- control, confirmation or modification of a therapy;
- verification of a medical outcome exam;
- assessment of a clinical state for a medical prescription [9].

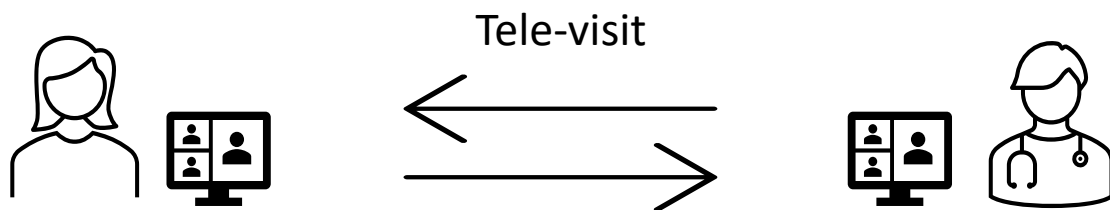


Figure 7: Tele-visit

“Teleconsulto medico” (tele-consulting) is a medical activity in which the doctor interacts with one or more colleagues to dialogue upon a medical situation based on the sharing of clinical data from distance. The aim of tele-consulting is to share the clinical state of a patient in order to get a second view or opinions of it [9].

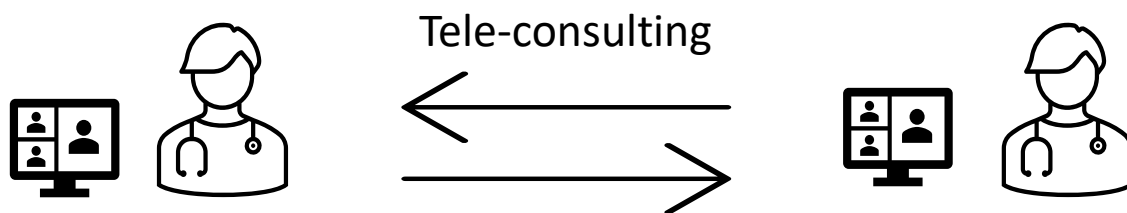


Figure 8: Tele-consulting

“Teleconsulenza medico-sanitaria” (tele-consultation) is a healthcare activity that is performed by two or more people who have different responsibilities respect to the specific case. It consists of a support request during the development of health activities in which the consulted doctor provides insights for the decision making or for the correct execution of medical assistance toward the patient [9].

“Telemonitoraggio” (tele-monitoring) permits the collection and transmission of vital and clinic parameters from distance in a steady and customized way, through sensors that interact with the patient. The patient needs to be connected continuously allowing the detection of data with more frequency and accuracy. Tele-monitoring allows, at the same time, a more frequent and uniform detection of parameters than it was possible previously and a reduced need for patients to perform follow-ups at the clinic in person [9].

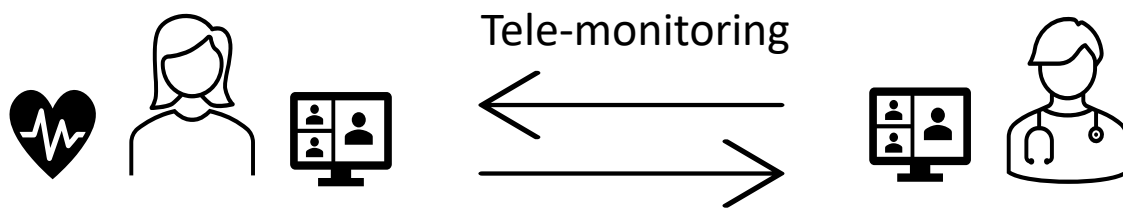


Figure 9: Tele-monitoring

“Teleriabilitazione” (tele-assistance) o “Teleassistenza da parte di professioni sanitarie (infermiere/fisioterapista/logopedista/ecc)” is a remote interaction between the professional and the patient/caregiver through a videocall. The aim of tele-assistance is to facilitate the correct execution of care activities. Indeed, it is a healthcare activity pertaining to healthcare professionals, it can have multidisciplinary features and it can require collaboration from caregivers, family members and teachers. Tele-assistance activities are complementary to other health services, rehabilitation, prevention, or assistance. This type of service can be delivered in any place from the school, university, house to workplace and health structures [9].

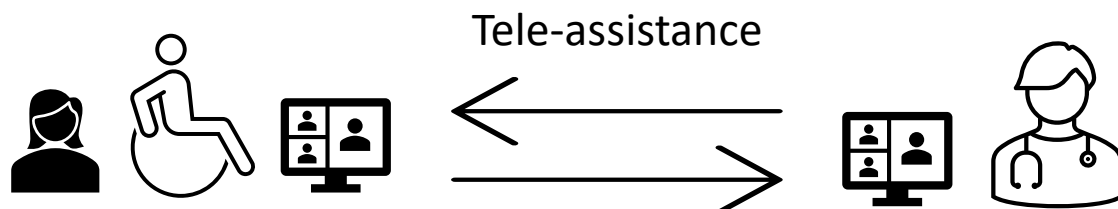


Figure 10: Tele-assistance

“Telerefertazione” (tele-reporting) is a report from a doctor who has subjected a patient to a clinical or instrumental examination and that is written and transmitted through digital and telecommunication systems. “Telereferto” can be released after the traditional execution in presence of the clinical or instrumental examination or at a distance from the site where the examination is performed [9].

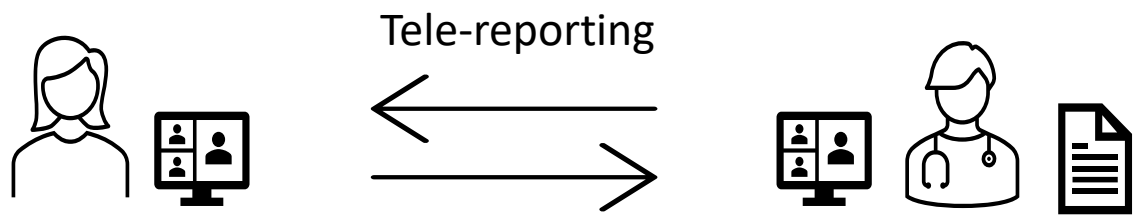


Figure 11: Tele-reporting

The objective of telemedicine is to deliver health services without the physical patient presence, but through the data exchange (images, document, video, medical report) making these medical services equivalent to traditional services. Its benefits are among others cure access equity, higher assistance quality and the patient handling by home. However, there are application limits due to the lack of quantitatively significant previous experiences of utilization of such systems. Indeed, the provision of telemedicine services is not recommended with:

- patients with acute pathologies or exacerbations of chronic diseases in progress;
- patients with chronic diseases and frailties or with disabilities that make “stay at home” imprudent [9].

2.3.3. Telemedicine Governance

A relevant stimulus to the development of telemedicine in Italy has been given by the European funds allocated by the “Next Generation EU” project, the recovery plan laid down by the European Union to support the member states in repairing the social and economic damage caused by the coronavirus pandemic. It basically consists in a financial instrument of 750 billions of euro, the largest ever package funded by the EU [10]. The “PNRR” (Piano Nazionale di Ripresa e Resilienza) fits in this context, as the program developed by the Italian Government to define the objectives, reform and investments planned to be undertaken thanks to the “Next Generation EU” funds. The PNRR of Italy was definitively approved on 13 July 2021, made up of the following six thematic areas of intervention (“missions”):

1. digitalization, innovation, competitiveness, culture and tourism;
2. green revolution and ecological transition;
3. infrastructure for sustainable mobility;

4. education and research;
5. inclusion and cohesion;
6. health [11].

The area of interest of this thesis is limited to the sixth mission, which is structured in two sub-missions, for a total of €15,63 billion allocated:

1. proximity networks, structures and telemedicine for local health care;
2. innovation, research and digitalization of the national health service [12].

Mission 6 has as its object the sector hit in the front line by the pandemic, highlighting the need for an equal and uniform access to healthcare. The emergency has put the spotlight on the critical issues on which the Italian health system rests its roots, such as:

- significant territorial disparities in the provision of medical services;
- inadequate integration between hospital services, territorial services and social services;
- high waiting times for certain services.

Furthermore, the need for an appropriate exploitation of the most advanced technologies emerged dramatically, along with the urgency of high digital expertise and new processes for the provision of health care.

Reform and investments proposed in this area have just the purpose of addressing these issues, strengthening the prevention and care capacity of the national health system (ensuring primary and intermediate care throughout the territory) and encouraging the diffusion of innovative technologies and digital systems. Resources have in fact been allocated for the enhancement and creation of territorial structures, improvement of home assistance (to reach the 10% of over-65 population), development of telemedicine and renewal and modernization of equipment and hospital infrastructure. In addition, investments are also devoted to scientific research and training programs for medical staff [13].

Going into more detail, telemedicine is addressed in sub-mission 1, with targeted interventions to develop advanced solutions of telemedicine aimed at overcoming fragmentation and lack of homogeneity of the services offered on the territory, supporting in particular patients affected by chronic diseases. Telemedicine services are indeed regarded as a powerful means to:

- reduce territorial health gaps thanks to the harmonization of standard of care;
- enhance patients' care path;

- improve the efficiency of regional health systems.

The overall intervention is implemented through a financing that amounts to €1 billion intended for telemedicine projects proposed by regional institutions, according to the priorities and guidelines defined by the Ministry of Health. Those projects may concern every clinical area and telemedicine service (tele-monitoring, tele-visit, tele-assistance, tele-reporting and tele-consulting). However, they must meet some requirements, such as being able to integrate with the Electronic Health Record and reaching performance KPIs linked to the telemedicine objectives of the National Health System. The ultimate aim of the intervention is to encourage and favor projects that aspire to realize easily scalable telemedicine platforms [14].

Telemedicine is dealt also in sub-mission 2, that has, among its goals, the objective of creating a national platform on which demand and offer of telemedicine services provided by accredited organizations can match. This initiative absorbs €0,02 billion of the total €8,63 allocated for the sub-mission [15].

An important milestone for further affirmation of telemedicine in the Italian context has been made recently by Italian National Agency for Regional Healthcare Services (AGENAS), that has systematized the indications for a new initiative in May 2022.

AGENAS is a non-economic public body funded in 1993 and subject to oversight by the Ministry of Health. Its mission is to be a technical and scientific body of the Italian NHS implementing research activities and supporting the Ministry of Health, the Regions and Autonomous Provinces of Trento and Bolzano. Therefore, AGENAS provides operational and technical support to regions and healthcare organizations about organizational, economic, financial aspects and efficacy of health interventions, as well as patients centeredness, quality and safety of care [16].

The national plan of recovery and resilience (PNRR) through the mission 6 “Salute” wants to make Italian structure more digital, inclusive, and modern. In this plan, digital transformation stands as fundamental piece to uniform opportunity all over the national territory. Its strategy is based on two architectural pillars: the new electronic health record and the telemedicine platform. The electronic health record needs to be complete in its contents and it must represent the point of reference for accessing online sanitary services. In order to make it widespread and uniform for the whole healthcare system, the aim is to strengthen document management interoperability by realizing data and documentation validation gateway. The second pillar is the strengthening and adaptation of telemedicine pathway to ease the cure of chronic and acute patients on behalf of peripheral territories, foster the

dehospitalization and finally improve care quality. Telemedicine services are strictly connected with single companies and regions. For this reason, they need to have a central governance and monitoring in order to ensure: the uniform usage of clinical workflow, the adoption of the best practices for handling specific assistance assets, the uniformity about coding and terminology dictionaries, the assessment of clinical and process outcomes and the validation of tele-monitoring devices. Those results can be achieved by the realization of a national platform (Piattaforma Nazionale di Telemedicina – PNT) that has the objective of governance and validation of the vertical regional solutions. The national platform is then linked to each interoperable vertical regional solution which carries out minimum telemedicine services (tele-visit, tele-monitoring, tele-assistance, tele-consulting) and which establishes the whole regional infrastructure. The regional infrastructure, which is unique at the regional level, is supposed to be interoperable with the one of the other regions thanks to the integration with the national platform [17].

The electronic health record platform and the telemedicine one are intended to be mutually connected, contributing to the processes of data collection and provision of services to patients and healthcare professionals. The direction for the two platforms is the one to become a single technological architecture, albeit maintaining two different roles. The electronic health record platform will indeed enable data and document collection, while the telemedicine platform will carry out the services of territorial and home taking charge of the patients [18].

The documental management is realized by regional indices, which are called Registry, that index documents in order to make them accessible from any region and allow transfer of indices that constitute the electronic health record. The management of data and the service delivery is on hand of “Ecosistema Dati Sanitari (EDS)” which owns atomic personal data according to international standards HL7-FHIR and actualizes services always regulated by the standards HL7. The Gateway assures that all the native data and documents realized by the whole healthcare system structure are compliant to standards and terminology dictionaries and translate the documents from the HL7 CDA2 standard to FHIR. Finally, it even controls if the indices of Registry are compliant to the national interoperability specifications [18]. The national telemedicine platform on Cloud is made up by two components, integrated but clearly separated on the execution process:

- **regional infrastructure of telemedicine**, which realize at least the minimum services.
- **national platform of telemedicine (PNT)**, which is managed by AGENAS.

The **regional infrastructure** is a set of vertical solutions which through the Gateway feeds up EDS and EHR with data, documents and events linked to telemedicine pathway. Examples of data, events and documents are the starting and ending point of an assistance care service or a single event as a visit or the alarm for abnormal value. The vertical solutions provide minimum telemedicine services applying the standards for data and documents production in accordance with telemedicine guidelines and HER guidelines. The **national infrastructure** is a tool for programming and government and encompasses among other:

- governance duties, planning and monitoring of telemedicine services and processes,
- assessment and monitoring of efficiency and effectiveness outcome of clinical processes,
- verification of rules application of workflow and the usage of right terminology,
- supporting on validation process of telemedicine solutions spread through the national platform for the governance and diffusion of telemedicine.

The national infrastructure does not intervene on clinical process of telemedicine services. Consequently, it does not assume clinical device features and it is not subject to certification or validation [18].

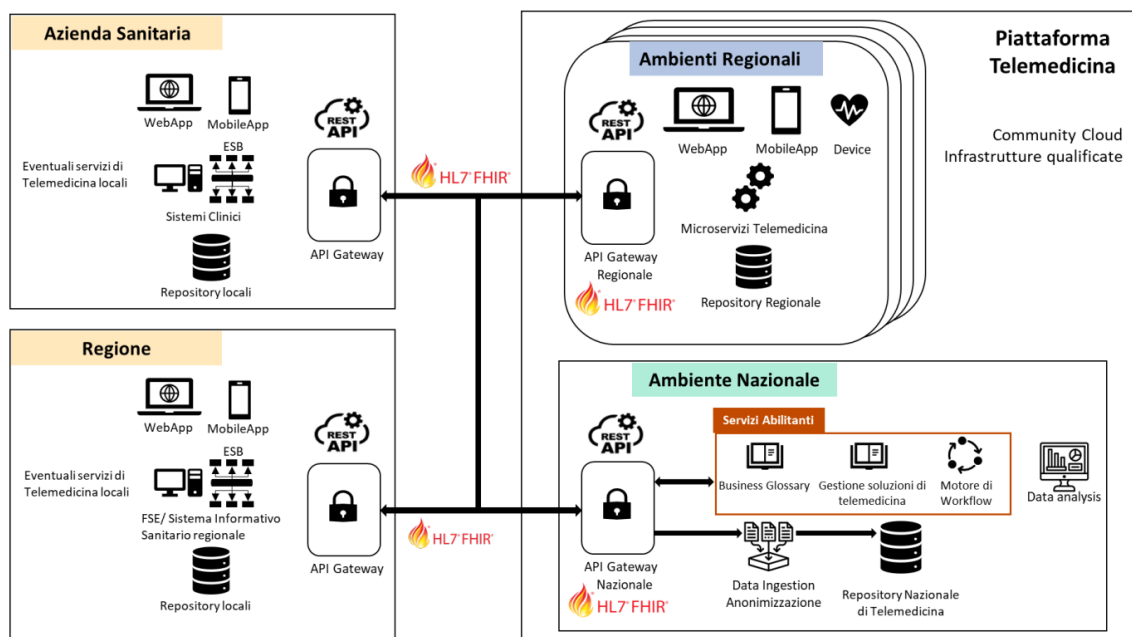


Figure 12: National platform Architecture

Within this framework, AGENAS has published on 4th May 2022 the public notice for the concession of the “Design, implementation and management of the services enabling the National Telemedicine Platform PNRR”. The document is divided into two sections, in which respectively the technical and financial economic characteristics of the National Telemedicine Platform are reported.

The first section describes the National Telemedicine Platform, meant as the set of different services that cooperating and interacting in synergy allow the realization of final services (tele-visit, tele-monitoring, tele-assistance, tele-consulting) for patients and healthcare operators. Regarding the privacy purposes, the ownership of the processing of the data collected and generated by platform will be of the Ministry of Health, while the responsibility in the hands of AGENAS, as well as the intellectual property rights of the software developed for the creation of the platform. In this section the general features that the platform should include are listed:

- taking care of the patient, with the definition of the care team in charge of monitoring the patient;
- active collaboration and participation of patients, with the inclusion of training courses for caregivers and patients, chat room and questionnaires;
- analytics, providing dashboards and customizable reports for each patient that enable a structured statistical analysis of clinical and administrative KPIs;
- tele-visit, and so presence of a structured system that incorporates, among others, video conference module, chat between the participants of the call, files and documents sharing;
- tele-consulting, with the availability of an analogous system to that of tele-visit, with the possibility of filling in requests and visualizing the available specialists;
- tele-monitoring, and so creation of a tele-monitoring plan, modification of the vitals to monitor, integration of the platform with the medical devices used for monitoring, setting of critical thresholds and alerts, creation of customizable dashboards;
- tele-assistance, allowing the access to information materials on the platform, the use of an app for patients to insert data and the presence for operators of a repository containing assessment forms of patients [18].

In the same section the technological drivers are also specified. They consist of requirements for the design of the National Telemedicine Platform, in particular they are:

- cloud readiness, it refers to the way in which the solution is delivered, and it is the one relying on cloud technology, through the model SaaS or PaaS (Platform as a Service);
- microservices architecture, the platform must have a set of flexible and customized minimum modules in which each component forms an independent asset that can interact and operate both with an internal ecosystem and with an external application;
- containerization, namely microservices must be provided in a way that allows the portability of them on different cloud providers;
- mobile oriented, the Front End interface of the platform must be designed in accordance to the paradigm “mobile first”. Every single application must guarantee the full accessibility for the final users through mobile devices. The choice to provide Mobile App native stems from the fact that mobile devices allow complete accessibility to sensors as Bluetooth or Bluetooth Low Energy, gyroscope, accelerometer through which it is possible to catch most of required detection for tele-monitoring etc.;
- security, different safety requirements must be ensured by the platform, such as the classification of operations on personal and medical data as processing of sensitive data, requirements for the qualification of cloud service providers, encryption of communication between client and server, compliance with the UNI EN ISO 27001: 2013, monitoring of the activities carried out by the single actors on the platform, encryption of data stored on database through symmetric algorithms;
- authentication and authorization, the access to platforms from patients must be designed to be able to dialogue with enabling platforms like SPID and CIE. Moreover, for some usage of services with smartphone a two-factor authentication is necessary. Finally, each user profile must be associated to an authorization with access grant to each single application module;
- privacy and compliance to GDPR, the platform must guarantee the possibility to assure complete privacy of data managed. Therefore, the solution must be implemented on an encrypted Cloud. In particular, it is necessary to consider the legislative articles Art 25 privacy by design, Art 25 privacy by default, Art 32;
- usability and accessibility, the platform must be compliant with requirements of accessibility and usability. Specifically, it must be a digital asset that enables the usage for users affected by disability. This means that

- the platform is supposed to be co-designed with patients considering continually the level of “Customer Experience” and “Customer Satisfaction”;
- flexibility and extensibility, the solution must permit to business users to start digitalization of clinical/administrative workflow, enable a greater efficiency of processes. In order to implement reuse and expansion services logics, it is fundamental to favour adoption of open-source framework of developing;
 - scalability, the platform should be able to offer an automatic scalability of its components, and it must happen in an automatic way in case specific operational conditions happen and according to the number of connected users and volume of requests;
 - availability, the platform must ensure the business continuity when actions to restore operations are needed to face catastrophic or unforeseen events [18].

The second section instead clarifies the economic and financial side of the initiative. More specifically:

- duration, the concession has a maximum duration of 10 years, and the platform must be delivered and enabled no later than November 2023;
- public contribution, a public non-repayable contribution is planned to be provided upon delivery of the platform, for a maximum amount of 49% of the investment;
- amortization, the entire investment must be depreciated over the life of concession;
- available resources, the funds allocated according to the PNNR to cover the non-repayable contribution and pay the fees for the realization of the platform amount to €200 million [18].

3 Literature review

After having defined the telemedicine terminology, clarified the context of digital health and performed a systematic literature review regarding multisided platforms, the phase of literature analysis has been conducted to analyse deeply the status of digital platforms in healthcare.

3.1 Literature Research

The bibliography research has been carried out by examining publications retrieved from Scopus database. The whole research has aimed to explore the world of digital health in all its possible meanings and applications. At the beginning of the research process various keywords were tested in order to end up with reasonable results. Here a briefly explanation of the keywords used in the literacy research:

- Digital Platform: articles related to the definition of platform and at the same time with a digital nature, thus platform operating by means of digital devices and internet.
- Two-sided platform and all the related combination of words: articles that refer to platforms made up by just two side aboard.
- Multisided platform and all the related combination of words: papers related to platform with more than two sides aboard.
- Healthcare, Wellbeing, Fitness: these keywords were needed to encompass papers addressing the topic of digital platform within the healthcare sector.

Combined with the principal keywords other filters were applied. In order to find up to date papers the first filter had the objective to limit the research in terms of publication time. Therefore, the publication time has been circumscribed from 2016 to 2021 taking into account just the last 5 years. Additionally, to reach articles that were studying digital multisided platform from the correct point of view, it has been introduced a criterion of inclusion about the subject of the article. This filter has

limited the subjects just to: Social Sciences (SOCI), Business and Management (BUSI), Economics and Econometrics (ECON), Computer Science (COMP).

Starting the research on Scopus it has been necessary 5 queries composed by different arrangement of keywords. In fact, the first query produced a huge number of papers, precisely 3969, that were not eligible as starting point. Therefore, the query has been restricted by concatenating more specific keywords producing initially 908, then 546, then 114. This last result was found by adding other two keywords which produced a limited outcome in terms of quantity and quality. At the end, through the words previously explained the research end up with 249 papers. The final query research hence aimed to investigate the state of digital platform using the keywords:

```
TITLE-ABS-KEY ( ( ( ( " digital platform" ) OR ( "two-sided platform" ) OR ( "two sided platform" ) OR ( "twosided platform" ) OR ( "multi-sided platform" ) OR ( "multi sided platform" ) OR ( "multisided platform" ) ) AND ( ( healthcare OR "health care" OR health ) OR ( wellbeing ) OR ( well-being ) OR ( "well being" ) OR ( fitness ) ) ) ) AND ( LIMIT-TO ( PUBYEAR , 2021 ) OR LIMIT-TO ( PUBYEAR , 2020 ) OR LIMIT-TO ( PUBYEAR , 2019 ) OR LIMIT-TO ( PUBYEAR , 2018 ) OR LIMIT-TO ( PUBYEAR , 2017 ) OR LIMIT-TO ( PUBYEAR , 2016 ) ) AND ( LIMIT-TO ( DOCTYPE , "ar" ) OR LIMIT-TO ( DOCTYPE , "cp" ) OR LIMIT-TO ( DOCTYPE , "re" ) OR LIMIT-TO ( DOCTYPE , "ch" ) OR LIMIT-TO ( DOCTYPE , "bk" ) ) AND LIMIT-TO ( SUBJAREA , "COMP" ) OR LIMIT-TO ( SUBJAREA , "SOCI" ) OR LIMIT-TO ( SUBJAREA , "BUSI" ) OR LIMIT-TO ( SUBJAREA , "DECI" ) OR LIMIT-TO ( SUBJAREA , "ECON" ) ) AND ( LIMIT-TO ( LANGUAGE , "English" ) )
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The query produced over 249 publications, but after applying a ranking of journals by selecting only Q1 and Q2 quartile the final number reduced to 97 papers. From this point it has been excluded not-available papers reducing the total number at 89. From these initial results a data extraction form was created to map each article regarding the business model of the platforms described. The data extraction form is composed of twelve columns useful to analyse thoroughly the papers. The columns are *Type of platforms*, *Users of platform*, *Data exchanged*, *Business Model*, *Revenue stream*, *Data acquisition technology*, *Research method*, *Conclusion*, *Barriers/Enablers*, *Regulatory*, *Stakeholders*, *Terminology*, *Multisided*, *Health*. Some columns are needed to assess if the paper is aligned with the minimum specifications of the research question which are being a real Multisided platform concerning the healthcare sectors. The other columns are needed to scan all the principal features of the business model in order to understand the level of

platforms development and diffusion all around the world and specifically in Italy. Here the description of the dimensions used for checking the alignment to the research objective and for classifying the papers from the most pertinent to the least one:

- Type of platform: this dimension had the aim to understand which typology of platform was being analysed, therefore, to distinguish between two-sided or multi-sided platform.
- Users of platform: it was needed to identify all the potential users on board the platform.
- Data exchanged: useful to get information about the category and the owners of data collected and traded by the platform.
- Business Model: in this section all the information that was not previously classified in the columns, then regarding value proposition, key activities, key resources, key partners, channel, cost structure.
- Revenue stream: here all the possible sources of income of the platform coming from users and stakeholders.
- Data acquisition methodology: this regards the possible medical devices or digital device the platform exploits to collect data for the value proposition creation or delivery.
- Conclusion: useful to sum up the principal points and features of platforms analysed along the papers.
- Barriers/Enablers: this space has the objective to collect potential barriers and enablers about the platform. Therefore, it is intended to catch opportunities or hurdles around the world of digital platform in healthcare.
- Regulatory: it clearly concerns the field of regulation about the world of digital in healthcare, that is usually intensively regulated.
- Stakeholders: here every actor being in contact with the platform for any reason is listed. Within this list there are even the platform users.
- Terminology: it is necessary to trace the vocabulary in this new emerging argument.

To have a more specific filter and being able to select the most appropriate papers pertinent to the research, other two columns have been added. During the literature reading, these two columns were the first to be filled up for each article. At the end, if one of the two columns or both of them were classified as “no” then the paper was labelled as “partially pertinent” or “not pertinent”. Afterwards this ultimate

selection, 54 papers were discarded and therefore only 35 articles were labelled as “pertinent”. These two columns are:

- Multisided: this column can contain just binary values “not” and “yes”, in order to label the paper if it tackles the argument of multisided platform or not.
- Health: this column can contain just binary values “not” and “yes”, in order to label the paper if it refers to the healthcare sphere.

The analysis ended up with a selection of papers according to the content relevance. Specifically, 35 out of 100 have been pertinent to be further and deeply analysed, which means they have been part of the literature findings explained in the next chapter. The other articles were found not aligned with the focus of the research.

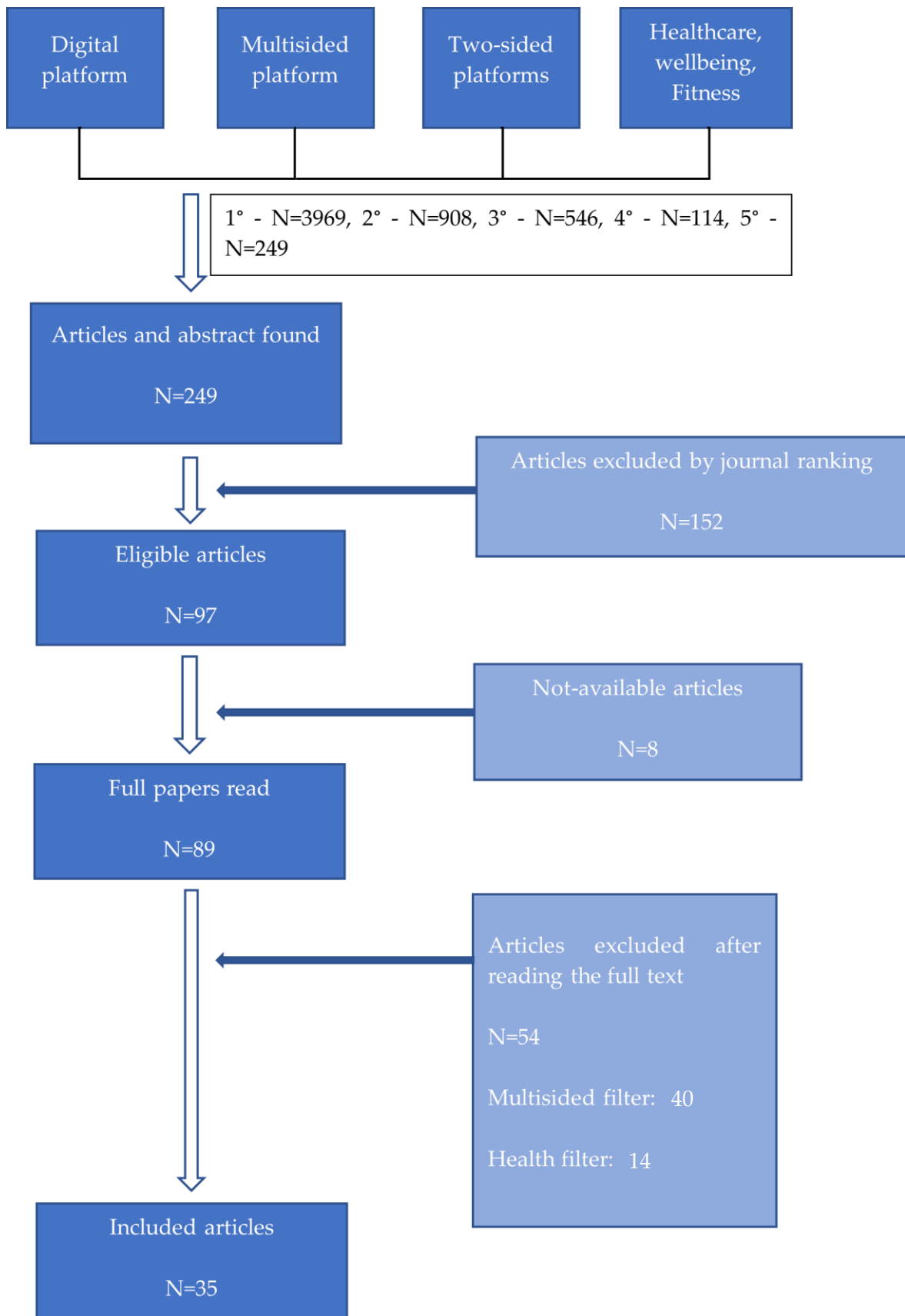


Figure 13: Funnel of literature review selection process

Analysing the publication years of the total papers found after the final query, as illustrated in Figure 14: Yearly distribution of total found papers, it can be noted the clear increasing of publications during the last 5 years. The few articles appeared in 2022 are a consequence of the timing research which was done at the very beginning of the year. The trend explains how much the topic is growing in interest and fame, especially during the pandemic which gave a boost for what concern the application of multisided platform and healthcare.

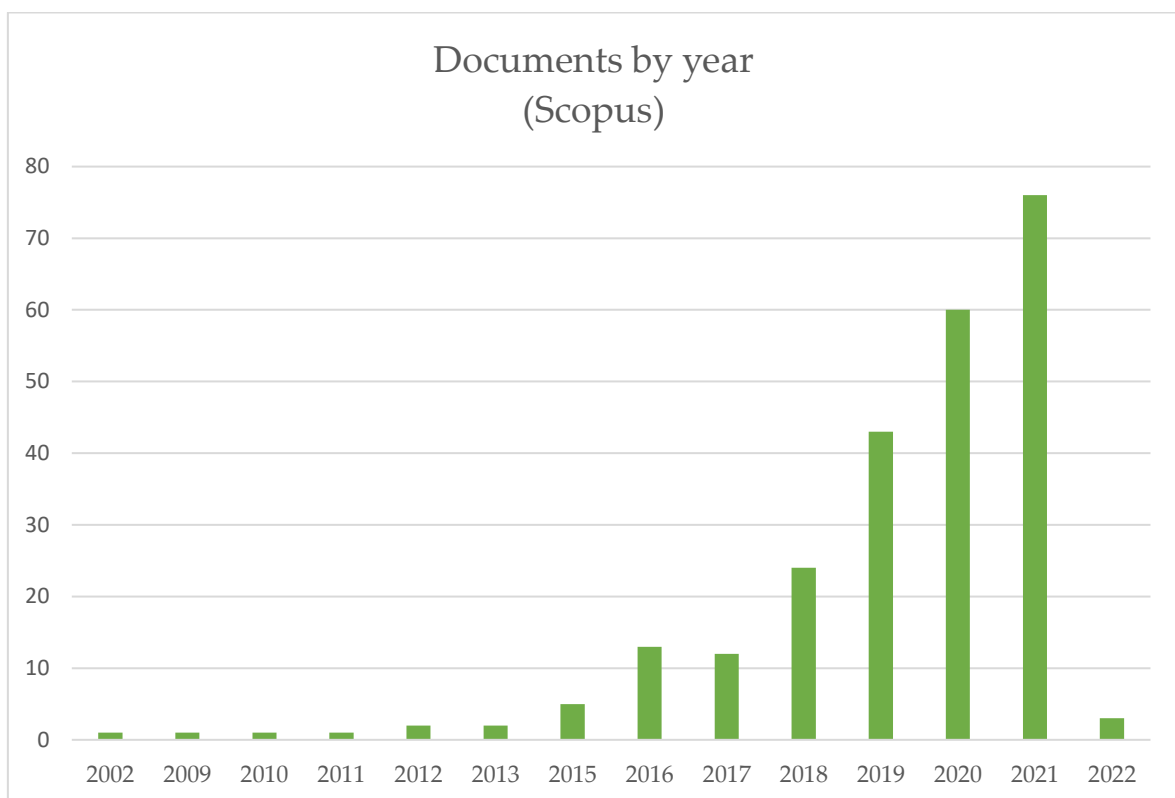


Figure 14: Yearly distribution of total found papers

Looking at Figure 15, which shows only the distribution of pertinent papers read, an evident insight comes up. More than 66% of the pertinent papers have been elaborated just only the pandemic, thus between 2020 and 2021. The pandemic has brought notable interest around the application of new business models in healthcare as the multisided platforms. Therefore, these yearly distributions make evident the youth of such a topic and the future hypothetical development that can

emerge from potential applications of digital technology in healthcare, adopting a business model of multisided platform.

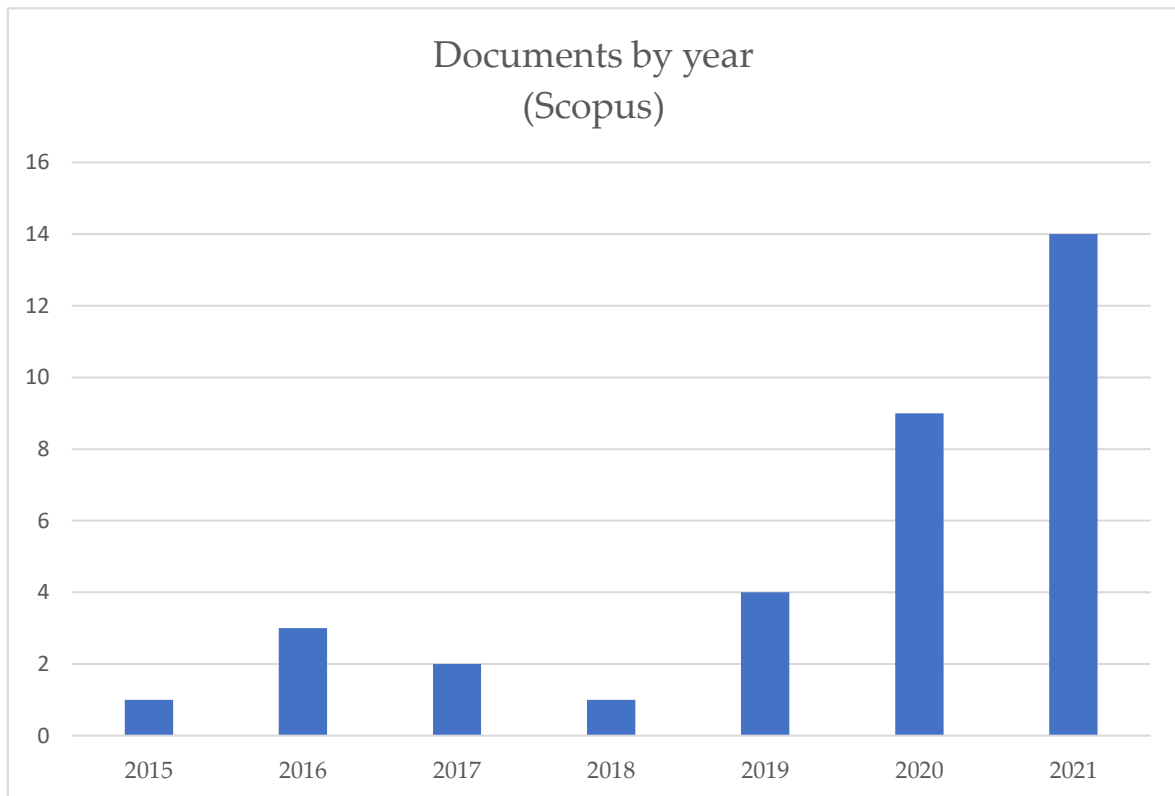


Figure 15: Yearly distribution of the pertinent papers

In Figure 16 instead it emerges that before 2015, first year in which a pertinent paper has been published, there are papers which do not study multisided platforms and healthcare together as a combination of a unique solution. Therefore, the concept of multisided platform combined with healthcare sector is confirmed to be quite an innovative topic.

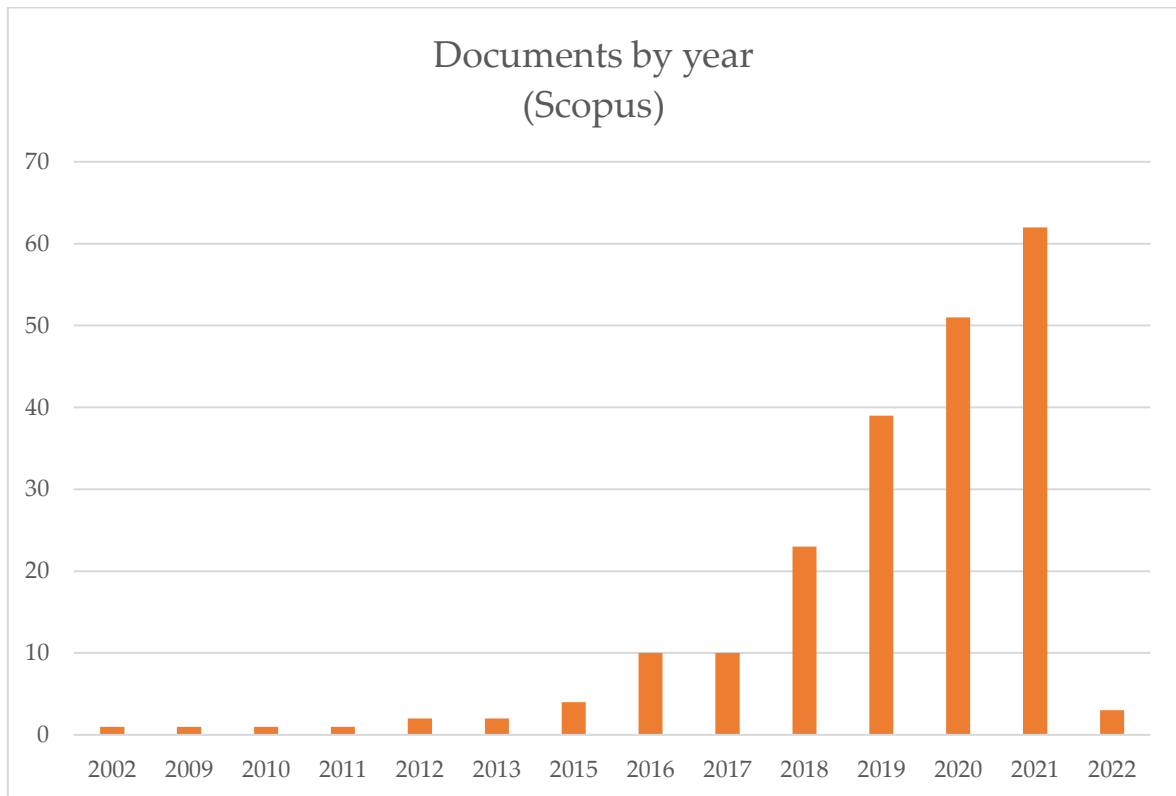


Figure 16: Yearly distribution of non-pertinent papers

Since the number of citations can be considered as a good indicator of prolificacy, it has been analysed for each article. Indeed, a higher number of citations indicates a more significant literature contribution of an article, therefore it shows how much valuable an article can be. Figure 17 classifies the articles, that have been fully read, according to the number of citation intervals. Most of them are hardly cited and correspond to the latest publication dates. Instead, the most cited articles are fairly old respect to the youth of topic. The maximum value of citations is 105 while the minimum is 0, which is recurring for the newest publication dates.

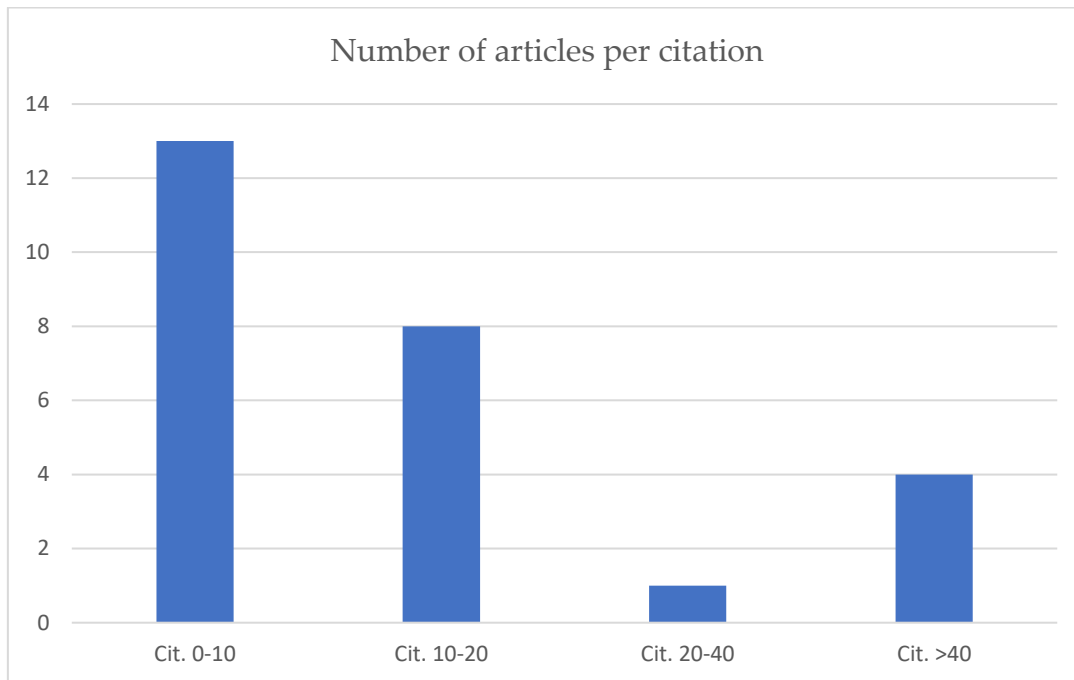


Figure 17: Distribution of articles per citation

3.2 Literature findings

From the most relevant papers the level of platform development seems to be around the same. The most developed platforms have a common value proposition emerged from the dimension “Business Model” [19]. It regards the usage of digital information tools for collecting, elaborating, delivering clinical data [20]. Therefore, it all starts from newest digital technologies [21] as Cloud computing, AI, Machine learning, Database, Blockchain which enable to work transversally, from collection, storage to elaboration and delivery of service, on every type of available data coming from different users or stakeholders. Thus, those data are managed and elaborated to deliver new services for chronic or acute disease [22], rehabilitation, medical trials, therapeutics, health logistic, healthcare efficiency, frequency of interactions, healthcare supply, online education [23], community generation insights, sustaining care outside a hospital [24] [25] and even service to help coping with COVID-19 [26]. In general platforms can be beneficial for more sides than to the high capacity to delivered customized customer services [27] [28]. The digital application can reduce even over-reliance on human adaptive skills [29] while at the same time offering new and expanded opportunities for resilient performance in healthcare [30] [31] [32] [33]. Digital technology plays even an important role in

unlocking new modalities of revenues stream for digital platform in healthcare as analysed from the dimension “Revenue stream” and “Stakeholder”. The possibility to thoroughly elaborate different type of data, derived from multiple stakeholders, permits to create value [34] [35], hence generating stakeholders’ interest and demand which finally means new revenue streams through the selling of valuable data [36]. Stakeholders, though, must be active in their role to exploit the full potential of a multisided platform. The potential can be used when its multiple constituent stakeholders actively participate in exploiting the large variety of services [37].

Another feature emerged from the analysis is the common trait of being multisided platforms [38] rather than simple two-sided platform, in particular the sides typically involved are both actors in the healthcare context (patients, doctors, hospitals, clinics, caregivers...) and with a few exceptions concerning insurance companies, developers of software, non-emergency logistic sides, third parties’ industrial partners. The influencing factor of this trait seems to be the value creation from data enabled by the technology, more specifically the possibility to co-create value among all the stakeholders and boosting the exchange of resources among the different actors or the active entities that populate the service system [39]. Therefore, the platform represents both an operational tool for improving the personalized care making platforms more and more patient-centred care oriented [40], and a strategic touchpoint to improve relationship between different actors . Lastly another important role seems to be played in fostering innovation [41]. Precisely, platforms allow to create open innovations [42], which by definition require the presence of the final customers during the innovation funnel, enhancing the

consistency of the final solutions and bringing inside the innovation process a new point of view.

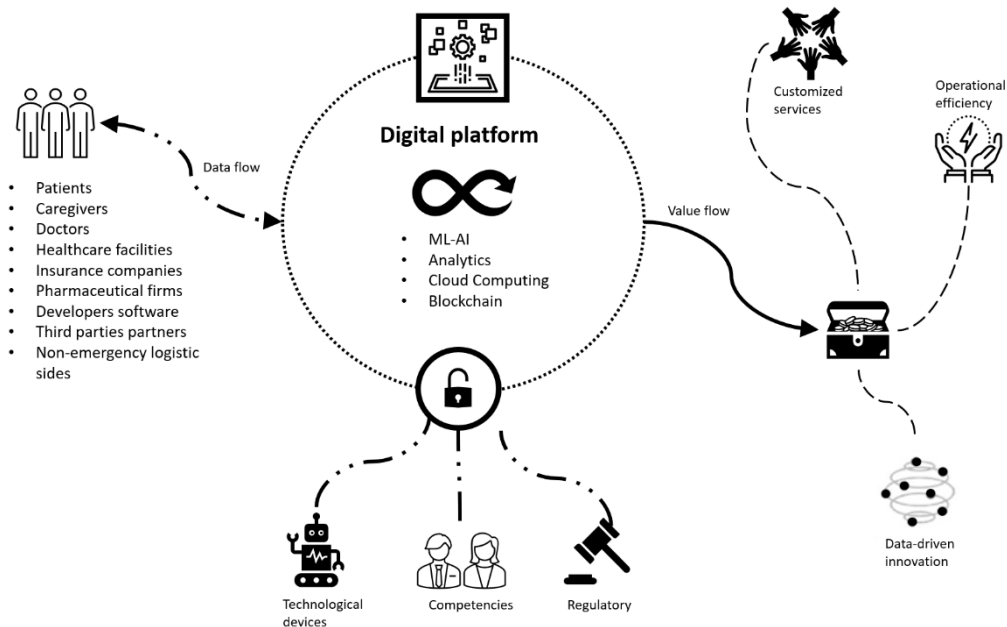


Figure 18: Digital Multisided Platform

The dimension “Data exchange” and “Data acquisition technology” have highlighted the essential role of high technology for gathering the data and thus to make platform able to deliver the service. Wearables, IoT but even questionnaire and interview are privileged tools for capturing valuable data for the platform. The data exchanged, through which the value is generated, are mainly clinical data, personal data, replies to questionnaire, information about drugs taken, product data, best practices, geo-localization data, statistics, learning information. The typology of data seems to be copious, since the platforms works as a bridge to connect various stakeholders which generate row data. Those data are the central source of value for the platforms and thus for all the healthcare sectors. There is not a single platform that has the opportunity to handle all that typology of data, but the tendence shows a convergence to have platforms with more and more stakeholders on board [20].

However, most of the real platform solutions are spread outside the Italian landscape and the main barrier to the growth seems to be found on lack of regulations, managerial competences, and digital divide [43]. Specifically, legislation is essential to handle sensitive and private data as healthcare patients’ data [44]. In some cases, these multisided platforms faced challenges to achieve operational maturity and financial viability. Entrepreneurial ventures often fail to

attain financial viability due to the initial design of the business model and the inability to evolve the model over time [45]. A solution came up from the literature regards the capability to move from providing a set of foundational services to offer more sophisticated and superior services and they need to amplify the fee models.

Therefore, in Italy it cannot be found any example of digital multisided platform aligned to what has emerged from the literature analysis. In fact, all the papers related to the research objective explain results coming from healthcare solution, but with characteristics not similar to multisided platforms.

4 Empirical analyses

The above analysis conducted in the literature review shows that very few studies have been carried out in Italy, denoting a not fully familiarity with healthcare multisided platforms in the Italian background. For this reason, since the priority of this thesis is to address specifically Italian healthcare platforms, in these chapters the subject to investigation switches from multisided platforms to telemedicine, assuming an empirical and pragmatic approach. The reasons are mainly attributable to the recent relevance that this discipline has gained in Italy, as testified by the latest investments of the Public Administration, and its subsequent growth, both in the last period and as further development in future. Indeed, the main firms that offer telemedicine services in Italy are analysed, identifying their main characteristics in terms of business model, type of telemedicine services provided and type of platform. Afterwards, they will be classified into different clusters through a two-dimensions matrix, investigating similarities and differences among them with the aim of getting insights for future research and applications.

4.1 Real examples of Telemedicine platforms operating in Italy

In this section an online search about the organizations that offer telemedicine services in Italy is conducted, by consulting mainly their websites. The following are the firms identified.

abmedica is a company operating in digital health sector from 1984. They are pioneers in the field robotic surgery and telemedicine. Regarding telemedicine, it has developed solutions of tele-monitoring and tele-assistance. The vision of the company is based on the idea of a healthcare environment able to assure a care model that embraces different actors for making healthcare increasingly connected and aligned to necessity of patients. “MAIA connected care” is the platform developed by abmedica to take charge and manage the patient clinical pathway. The services are mainly four addressing different customer segments and needs. MAIA company is dedicated to assurances and private group as integration to traditional medical services. MAIA clinic is designed to satisfy care needs of public and private hospital structure. MAIA connected care aims to improve the performances of healthcare structures and services of healthcare suppliers over the territory. MAIA doc designed for medical centers, small policlinics which have the

need to monitor their patients. The organization is therefore active exclusively in the B2B channel [46].

ArzaMed is a young startup founded in 2018 in the sanitary technology sector. Through the cloud technology it develops and commercializes software capable to simply the workload of doctors with the aim of improving patient care journey. Their telemedicine solution is a management software which provides some services to patients using some of the tools of telemedicine. It enables all the initial steps before the real health service as the booking, the payment, the management of personal clinical data, collecting medical reports, bureaucracy, and agenda. Beyond these typical and basic possibilities, the patient can take a tele-visit and doctors can take a tele-consulting with other colleagues. The revenue stream is based on monthly subscription fees with different levels of services: starter, premium, advanced. The “starter” package is ideal for healthcare professional, while “premium” and “advanced” suitable for medical centers, polyclinics and multidisciplinary equipe. Therefore, they own solutions for each type of health customer segments from professional doctors, polyclinics to hospitals and bigger medical centers [47].

COMARCH is a multinational software house that design and implement IT products for different sectors. HomeHealth is the solution for what regard the healthcare sector. It is the integration between devices for tele-monitoring and cloud platform for telemedicine. For what regards tele-visit, this platform gives the following possibilities to patients: booking an online visit autonomously, fill in all the formal document, asking questions about medical test results, replying to questionnaire, performing online medical examination by sharing documentation on platform. On the other side, the platform eases the following activities for doctors: receiving straightforward possible critical medical results, storing the registration of the online medical examination, assessing all the past medical reports without losing any information [48].

COMARCH has a telemedicine system made up by an application integrated with measurement devices of vital parameters (ECG recorder, pulse oximeter, thermometer, glucometer, sphygmomanometer) that allow the real time monitoring of the patient from distance. It can be used at home by themselves thanks to the easy procedure guided by the app. The collected data are registered and sent to the in-cloud telemedicine platform Comarch e-Care where they are analyzed and made available to doctors for a simple and rapid consultation and valuation. The doctors

can call the patient whenever there is the need due to out control parameters. It offers solutions for hospitals and clinics; thus, it is B2B.

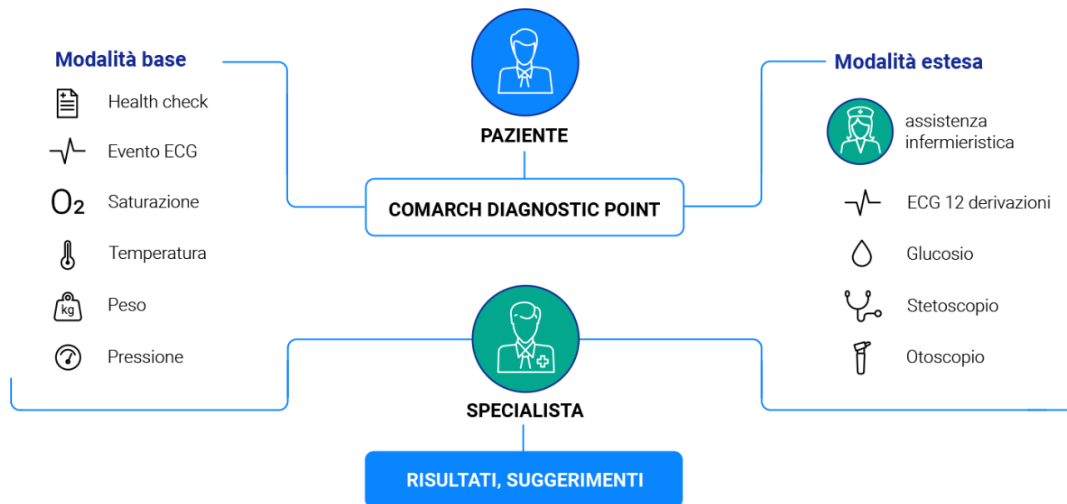


Figure 19: COMARCH telemedicine system

TeleMedware is a company that has developed a multidisciplinary software able to support doctors, experts, patients and caregivers in diagnosis and related care. Specifically, it produces software for tele-monitoring, tele-assistance, tele-visit and tele-consulting services. It does not have any high-tech device, but it is able to develop dedicated software to link outer devices to the IT system. The company's offer deploys from web page and application for smartphones to telemedicine software able to store data collected by another application. The flow of patient data starts with the collection from physical devices which can measure different parameters of patients. Then those data are transmitted to patient application which in turn sends all the data to the main software. The latter can elaborate the data and make them available to doctors for the medical reporting. The main telemedicine platform is called "FacileCare" which is made up by a set of diverse applications according to modality of usage and final users. The revenue stream is not clearly identifiable but surely, they offer large flexibility of price in relation to different clients (patients, doctors, nurse, caregivers) consequently to different needs. It is both B2B and B2C thanks to the platform that is also useful for patient managing for clinics and hospitals [49].

Biotechmed is a company operating in Italy specialized in telemedicine services which aims to deliver diagnosis and treatment from distance and to speed up

services to improve people health state. Practically the company has developed an application, called “THOLOMEUS”, which is able to collect data from medical devices to prevent or keep under control common pathologies. The application must be supported by some medical devices which can only transfer data to that application. Therefore, it is a closed environment that allows only its own devices to work with the application. There is a wide range of connectable devices which enable a complete patient monitoring. The revenues stream is based on a pay-per-use modality for what concern professional medical devices which require to be used by healthcare professionals. The other revenues stream is based on direct selling of medical devices which can be handle by any person. Instead, the main application “THOLOMEUS” is freely available on internet for downloading. The customer segments are thus both hospitals (doctors, nurses, experts) and patients who can only buy certain type of devices [50].

Another Italian telemedicine solution is the one developed by **Sigma consulting**, a system integrator company with headquarters in Rome founded in 1998 and active in the military and civil sectors. Convinced of the necessity of a virtual enhancement of the health management system, Sigma introduced a cloud platform (**Far Assistance Telemedicine Analyzer**) that remotely monitors the progression of the diseases and provides diagnostic services on the whole country, proving to be of extreme importance in circumstances of emergency and inaccessible areas. More specifically, the platform allows to measure the biometric values in real time through biomedical devices, providing early warnings in case of off threshold values, and to store and access medical records and set an agenda for home care. Moreover, it enables the direct communication and interaction on the platform between patients and specialists, healthcare professionals, assistant nurses, social workers and family caregivers through video and audio conferencing and a live chat. The main customers to whom this solution is addressed are the following target segments: medical practices, hospitals, clinics, social cooperatives, universities/campus, insurance companies, distributors of biomedical devices and organizations that deal with civil and military medical emergencies (e.g., COVID-19) [51].

AdiLife is an Italian startup with 15 years-experience in the development of healthcare platforms, born from the collaboration of Aditech srl, KOS Comunicazione e Servizi srl and Gilogica spa with the aim of reaching the excellence in the sector of the “connected health”. Awarded by the MID (“Ministro per l’innovazione tecnologica e la digitalizzazione”) among the top 5 telemedicine

applications for the COVID-19 emergency, it consists of a platform specialized in tele-monitoring, tele-consulting, tele-visit and tele-assistance that places at the heart of the healthcare process the patient. Integrating a large a set of certified diagnostic devices (such as glucometer, oximeter, thermometer, blood pressure meter, electrocardiograph, spirometer, etc.) and home automation devices, the platform is able to monitor in real time and asynchronously different vitals and medical data. Those are used to manage the patients setting alert thresholds and, in case they are exceeded, the platform will promptly inform the patients and their caregivers enabling the interaction with the other users (doctors and specialists) through different multimedia communication channels (video communication, notifications, phone call, SMS, email, social network, Google home and Amazon Echo). Relying on Artificial Intelligence, the platform will also assist the patient full time through the chatbot virtual assistant “CELESTE” and the Symptom Checker, a self-diagnosis system based on a wide knowledge of symptoms and the related diagnosis.

Moreover, AdiLife offers the possibility to share reports, medical records and images enabling the collaboration between different medical operators and specialists in the form of tele-consulting and Second Opinion. It provides also patient management tools to the doctors for the full planning of the healing process and the storage of the medical data in a private and safe setting.

Another advantage of AdiLife is its easy integration and interoperability with common old systems. As already mentioned, the focus is on the patient: the user interface is simple and intuitive, easily accessible on mobile (browser web or IOS and Apple app) and personalized solutions tailored for the consumer need (e.g., safety, dietary plan management, pacemaker monitoring, diseases degeneration, etc.). AdiLife can provide the platform services either through the SaaS modality (software as a service) or On Premise, namely physically installing the program on the devices of the customers. In both cases the revenue stream is based on licensing. The customer segments are organizations (public and private health facilities, insurance and mutual societies, firms...) and privates (patients with pathologies, general practitioners, specialists, clinicians, and individual users who want to monitor their wellbeing [52]).

Zucchetti, the first software house in Italy by turnover, has developed its own telemedicine platform, too, which is part of the package “Zucchetti HealthCare Solutions”. Its main purpose is the tele-monitoring of patients at home. Indeed, a

continuity of assistance is established also outside the hospital environment thanks to digital tools, allowing a more efficient provision of healthcare services. The platform is based on the concepts of patient takeover by the medical personnel and PDTA (Diagnostic Assistance Therapeutic Pathway). More specifically, a team of specialists defined by the client organization leads the patient in a care pathway, assigning him a Care Manager and developing an individual care plan. The electronic health dossier is so associated to the patient, in order to manage the medical history, define therapies, make prescriptions and record the daily activities (diaries) and assessments. Patients and specialists are in contact in a safe environment through an app, thanks to which the patient can log data about vitals and activities, and compatible devices (wearables such as smartwatch) that automatically collect those data in the app. Then, the application transmits the data to the control panel, that monitors the activities and vitals in the electronic health dossier. The app is user-friendly and allows the patient to access different functionalities from everywhere: it enables an effective communication with the medical team through videocall, voice call and chat; it offers an activity calendar that sends reminders about the therapy to be followed or any appointments with doctors; an area of summary on the health status of the patient is included (also with the support of a graphical dashboard reporting the trend over time) and a help request section is available to the patients, who can initiate requests for video calls to get support and emergency services. The solution is directed to organizations such as private clinics, hospitals and regional institutions (ASL), providing to them different types of offerings in terms of electronic medical record and care pathway. The different kinds of patients who can be assisted through the functionalities of the platform are: children, adult, elderly, people with chronic diseases, people with physical and mental disabilities and patients in post-acute phase. The electronic medical record has been realized using the most recent interoperability standards, so the system can be easily integrated into other healthcare applications and Hospital Information Systems. The platform can be used directly in cloud (Saas) or installed at the healthcare organization's datacenter; in both cases resorting to licensing [53].

MedEA is a diagnostic digital clinic platform that encompass 50 specialized doctors ready to deliver medical reports over 20 different branches. MedEA customer segments are doctors, pharmacies and hospitals. The service can be easily provided on a smartphone that collect data coming from high tech medical devices in charge of detecting the main vital parameters. Those vital parameters are sent to the platform which can be consulted by doctors monitoring the health state of patients. The high-tech medical devices are developed to be used easily and intuitively even

for elderly people which can have more difficulties with technology handling. The Dermatological System is the state of art of MedEA. This system is an intelligent software of images detection and diagnosis of skin health state. Thank to artificial intelligence (AI) this tool helps experts managing the heavy load of work during the cure of skin pathologies as skin cancers. The software works along with a medical device whose function is to detect images of skin health state, which will be sent and evaluated by the software and the experts. This system of AI has several functionalities that allow to generate potent information about dermatological cure for each patient. Of course, it makes available simple services of tele-visit with the wide accessible experts. Overall MedEA built an ecosystem for control and diagnosis of some pathological diseases from distance. The final effects are a higher quality and frequency of health state monitoring and a reduction of costs both on patients' side and on health facilities side in terms of logistics and organizational point of view [54].

Mediaclinics is a high-tech innovative scale-up that it aims to develop and design IT solutions for the healthcare and well-being sector. It exploits state of art technologies as IoT, wearable, cloud computing, big data analytics, AI, cryptographic to realize application on the field of wearable health. It has developed a platform whose strengths are the remote monitoring of physical parameters, automatic generation of alert when a certain threshold is exceeded, dashboards for healthcare personnel and multichannel communication means to parents and caregivers. The platform is made up by a web application and a mobile application. The first one is on hand of doctors and sanitarian operators. It permits the remote visualization of vital parameters and some other secondary activities as questionnaire compilation, the sending of data and communication. The mobile app is for users such as caregivers, and it offers the possibility to visualize data coming from sensors and the possibility to connect with healthcare personnel (doctors) when necessary. Therefore, the platform integrates various medical sensors and devices which can be bought by the patients. The application adopts an end-to-end solution that covers the whole data life cycle. [55].

CompuGroupMedical is a leader multinational firm operating in electronic healthcare. In Italy it delivers software solutions and services to public administrations, hospitals, pharmacies, specialized doctors, and patients. It is a company that based its service on tele-monitoring through a system made up by a mobile app for patients, web app for doctors and medical devices. The data flow starts from the collection of data from devices and transmitted via Bluetooth to the

mobile app, then data are sent to the web app of the doctor or hospital. The web application can visualize elaborated patients' data and it can manage notifications triggered by vital outlier parameters. Moreover the doctors can generate medical report and official diagnosis remotely. Both the applications are developed on cloud therefore there is no need to install any software. Finally CGM offers tele-consulting services to connect patients and doctors remotely through a safe and private communication channel. The revenues stream is based on licensing upon a certain amount of time defined by contract [56].

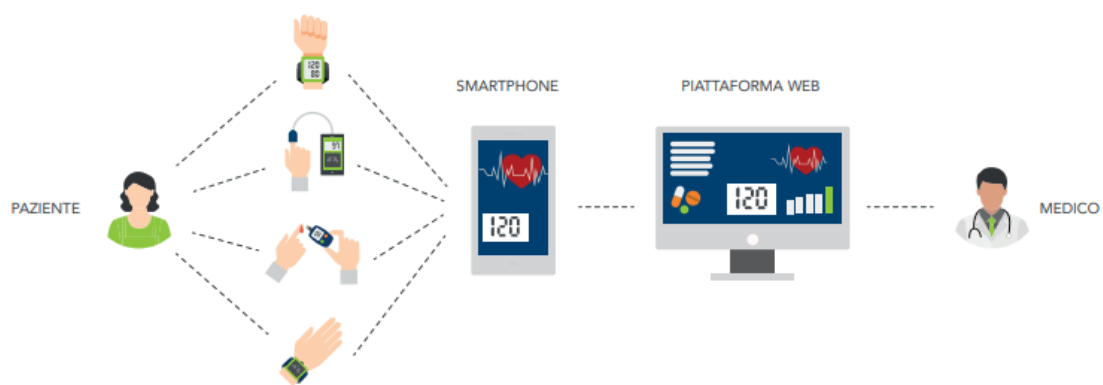


Figure 20: CompuGropMedical telemedicine solution

Doctorium is a telemedicine platform that offers a large range of services. Through any desktop or mobile device, it is possible to ask a tele-visit (from 30 to 60 minutes) in HD quality provided by the wide selection of high-level specialists selected by Doctorium. Indeed, using Doctorium it is possible to book an appointment online choosing the medical specialty of interest and the doctor. The medical specialties are several, they range from cardiology, general surgery, neurology to physiatry, psychiatry and Medically Assisted Procreation. Thanks to Doctorium, the patient has the possibility to both interact with the physician in real time and upload on the platform online medical reports such as clinical or radio diagnostic examinations. At the end of the visit, the doctor can draft a final document with eventual medical prescription (tele-reporting). Moreover, a free of charge follow-up within 48 hours is offered in case of doubts from the patient side. In case of emergencies, it is also possible to request a priority tele-visit in the shortest time.

Doctorium provides also services of tele-monitoring and tele-assistance, that monitor vitals through household devices. By subscribing indeed to the

telemedicine service offered by Doctorium, the patient will receive to his home a kit of instruments that automatically upload on the platform the data after each measurement, plotting them in the form of a graph. Patients can also count on a chatbot based on artificial intelligence. A great advantage of Doctorium is the easiness of use, indeed all it takes is downloading the IOS or Android app or using the platform's website. Therefore, it is essentially a solution for patients as final users. Regarding the revenue streams, tele-visit is sold through the pay per use modality to patients, who can see the cost of the service next to the name of the chosen specialist and visible before booking; while paying subscription fees it is possible to obtain medical devices [57].

MEDICALTECH manages an integrated information system through which design and deliver telemedicine services for doctors, hospitals, and patients are offered. The first service is the managing of clinical equipment which allows doctors to monitor patients, to set up medical devices for measuring or to transfer sanitary data. Another service is the possibility of storing data in compliance with privacy, cryptography rules. The last main service is the clinic equipment which is governed by a web-based software. This software enables doctors and experts to work on data which means having the possibility to monitor patients' chronic disease or rehabilitation.

The web-based application is a software platform which works as an interface between patient and healthcare personnel. Then according to the typology of role within the healthcare ecosystem each worker (user profile) can exploit different type of functionalities provided by the platform [58].

Net-Medicare is an innovative startup specialized in E-health and founded by different entrepreneurs - researchers, doctors, engineers, and computer scientists- and the society Kaleidos in 2016. It consists of a platform whose value proposition is centred on the easy accessibility, flexibility, cost reduction and speed of tele-visit. Indeed, it allows to book and access online medical visits with specialists simply through mobile devices (with camera and microphone) and to share medical documents, enabling the interaction between doctors and patients with an easy and intuitive interface that also includes a real-time chat. Everything is conducted in the utmost safety and privacy thanks to advanced computer encryption mechanisms. The solution targets both doctors and patients, so final users. Indeed, Net-Medicare directly collaborates with specialists in different areas, but it can also make available all the functions of the platform to independent healthcare professionals and

medical centres by payment of an annual subscription fee. If instead the specialists are direct collaborators of Net-Medicare, the platform will retain a fixed percentage of the price of the service (that is determined by the specialists themselves). For the patients instead, it is required to sign up for free on the platform and charge the credit required to pay for the visit (so pay per use). The devices allowed to perform the tele-visit are Microsoft or IOS Personal Computers and Android tablets and smartphones [59].

I-Tel, an innovative SME specialized in automated technologies, provides telemedicine services for different pathologies through the platform “**Salute a Casa**”. It enables tele-monitoring, tele-visit and multichannel interaction with the patient. More in detail, the platform allows healthcare professionals to manage the patient takeover and assign the correct treatment plan, starting from predefined models, differentiated by pathology or type of patient. It also gives the possibility to plan the daily measurements of vitals, create questionnaires, appointments for tele-visit and reminders to patients, arrange home visits and replacement and maintenance of medical devices.

The platform also incorporates an operations centre for the tele-monitoring, with the functionality of integrating different electromedical equipment and domotic sensors, that enables a constant monitoring of vitals and adherence to therapy. In case of out-of-threshold values or missed medication, the platform provides early alerts. The operations centre facilitates the interaction between patients and healthcare workers through multiple communication channels, such as SMS, mail, chatbot, voicebot, voice call and video call, used to perform tele-visit and tele-assistance.

The patients access the platform through the mobile app, which allows, between the other things, to request a tele-visit with video call on app and share medical documentation and images.

I-Tel's offer is mainly directed to regional institutions and private clinics, configuring itself as a B2B solution [60].

HTN Virtual Hospital is a company that provides telemedicine services as tele-consulting, tele-reporting and tele-monitoring of vital parameters. All the services are designed by a team of scientific experts of different sectors in order to deliver

the best solutions for primary and secondary prevention, diagnosis, therapy, follow-up and assistential continuity. The competitive advantage of this company is based on tangible and intangible assets. All the services are delivered on an advanced digital platform which allow doctors and experts to keep continuously patients under control through periodic interactions, the monitoring of vital parameters and look at the historical data. The mobile application is freely available on app store or google play for patients, but the 24h tele-monitoring service from a medical team must be bought. The data monitored are electrocardiogram, oximetry, blood pressure, blood glucose, body weight and physical activity. The web platform is able to manage many phases of user management process which are: automatic and manual acquisition of information, storing of information, medical reporting, communication between doctors, patients, and external system. The platform can be sold to healthcare facilities, pharmacies, hospitals and patients. Therefore, it means that it is capable to serve all the different typologies of health care related users [61].

Alpha Pharma is a telemedicine and telemonitoring Italian company and it plays an important role regarding the predictive and precision medicine. Through the "Iris Health Care" system they can assure the data health monitoring fed by smart electromedical appliances. Specifically, the platform is a complete system of hardware and software to deliver a service of innovative tele-monitoring regarding diabetology. It is based on cloud computing technology which is able to acquire automatically data and furnishing relevant analysis and information to patients and doctors. The system can send alert whenever there is an emergency situation triggered by data. Overall, the revenue stream is not explicated but the application for patients is freely available on Google Store and the platform of cloud computing seems to be paid as well as the medical appliances. It is a B2C company, it means that it sells services and equipment to doctors and patients directly [62].

Pazienti.it was founded in 2010 and it is an Italian innovative digital health platform with the aim of foster the disclosure of medical-scientific information and propose innovative services aligned with patients and doctor's needs. The strong point is the critical attention to the quality and truthfulness of contents and offered services delivered by more than eight thousand specialists. On the platform patients can find answers to their questions by navigating among pages or by consulting directly specialists. Moreover, they can select the best specialists among the available ones and booking a tele-visit. There is also other general information as opinions about healthcare facilities or videos "How-to" finalized at well-being of

people or pharma information. Customers can have access to service by means of pc, tablet or smartphone since the application is a web-app. Then patients do not need to download any application, but they just need to open a simple address link. Finally, the platform allows to put in contact different healthcare actors which operate in the same sector thank to the wide range of advertising and communication solutions [63].

Althea, active in the sector of integrated management of technologies in healthcare, provides social and health services to both public and private customers (B2B) through the “Tele-health Service Centre” (Centro Servizi di Telesalute), with offices located across Italy and more than 190 employees. It offers a multichannel access system able to match the demand of patients with the offerings of public and private health providers, enabling the communication between the different actors with the aim of effectively and efficiently solving the needs of patients. More in detail, Althea offers services of tele-monitoring through remote systems tracking physiological parameters and tele-assistance 24/7 in case these parameters denote situations of emergency, by activating forms of relief and assistance such as warnings to the family caregivers and first aid. It also allows patients to perform an electrocardiogram thanks to easy devices and transmit it to an operations center for the reporting. In addition, the Tele-health Service Centre provides support and help through a periodic telephone contact [64].

A real peculiarity of Althea is that it can make available a team of its own experts in consulting and project management to help clients in the planning and implementation of innovative social and health services.

Vodafone has developed telemedicine solutions to assist public authorities and healthcare companies in providing a better healthcare service in the last years, through partnerships with actors in the sector. Indeed, Vodafone offers software platforms connected with IoT devices and wearables that continuously track a wide range of vitals, enabling the tele-monitoring of patients at home and the functions of tele-consulting and tele-reporting. The set of devices includes sphygmomanometers, pulse oximeters/saturators, thermometers, electrocardiographs, balances. These transmit the data acquired to the software platform, that provides alerts to the doctors in case of off threshold values and lack of compliance with the therapeutic plan. A contact center is also available for patients [65].

CSP Telemedicine Srl is a society that offers services of tele-monitoring of vital and physiological parameters of the patients through a secure and encrypted web connection system. It also allows to issue medical prescriptions (tele-reporting). Tele-monitoring is provided by CSP through the “VitalConnect” patch, that is able to monitor in real time vitals and arrhythmias, sending data and alarms to doctors and to the operations center of CSP. Indeed, CSP makes available 24/7 services to its clients provided by the “Centrale Operativa 24/7”, that supports clinical functions in hospital setting and manages independently patients and alarms sharing data in real time with the physicians. In addition to the patch, that is single-use and is valid for seven days, other medical devices connected are provided: sphygmomanometer, pulse oximeter, glucometer, coagulometer and electronic balance. All the data monitored by those devices are sent in real time to the VitalConnect platform, which is customizable and accessible by pc or smartphone and pad through the app. By logging in, it is possible to check the data and receive alerts for values that exceed the threshold. CSP’s customers are pharmacies, insurance companies, pharmaceutical companies, private health entities, public and private companies, patients, hospitals, doctors, “Aziende Socio Sanitarie Territoriali” (ASST) and retirement homes. [66].

ENEL X has developed a service of telemedicine for companies and their employees. Thanks to the digital service companies can offer a complete package of wellness to their employees which consists in monitoring the most important risk factors for their health. Enel X make available the application for the users, then it offers the first check-up visit at Policlinico Gemelli to assess the health state. Then based on the check-up assessment the doctor defines the more aligned wellness program and he delivers the necessary smart band to monitor vital parameter. Data are gathered and sent by the app to doctors. Finally, according to schedule the patient can have a tele-visit to monitor the program. Enel X has developed just the application through which patients can get tele-monitoring and tele-visit services. The smart band are not developed by Enel X but they can interact with the main application (Smart assistance e-Well) [67].

Engineering, the leader digital transformation company in Italy with a very diversified portfolio and a deep knowledge of cloud computing, cybersecurity, metaverse and AI & Advanced Analytics, has developed in collaboration with the local health authority (Asl) of Foggia a telemedicine platform for the tele-monitoring of COVID-19 patients (that integrates the solution “AMICO” for people affected by chronic diseases), enabling the connection between the Territorial

Operating center and the residence of patients. More specifically, for each patient tested positive for COVID-19 virus a personalized monitoring plan is defined by medical staff of the Respiratory Diseases Department, with the specific vitals to monitor through electromedical devices. In so doing, each plan is saved in the platform and the required devices are provided to the patients by the nurses of the Integrated Home Care Service. Those devices, with the support of an app, will send the data regarding vital parameters to the platform, enabling the monitoring by the nurses of the Territorial Operating center and Respiratory Diseases Department and the intervention if needed. The application used by patients for smartphones or tablets allows to collect data from the devices through Bluetooth, view the measurements of vitals and values outside the normal range and fill in self-assessment questionnaires. Generally speaking, Engineering's E-Health portfolio of offerings is based on customized platforms for telemedicine services, targeting both territorial local health authorities, as already seen, but also hospitals. In this last case, also tele-visit is enabled. All the telemedicine offerings implement innovative technologies such as AI & Advanced Analytics, Machine Learning, Internet of Things, Intelligent Automation (RPA), Cloud and Cybersecurity, that represent the key resources and competitive advantage of Engineering. The company offers these solutions with the SaaS modality, so licensing as revenue stream [68].

My Digital Health is the telemedicine platform developed by **Health Point** specialized in tele-visit. It basically consists of an application for smartphones, tablets and pc that allows patients to book for a specific date and hour a tele-visit with a chosen specialist and conduct it remotely, paying online. In the app, there is also a section called "La tua cartella sanitaria", namely a virtual archive in which it is possible to collect and share with the specialist the medical documentation and receive the medical report and prescription after the tele visit. Using Bluetooth, it can also connect with electromedical devices and smartwatches for the monitoring of biometric measurements and in so doing producing weekly reports about the health status. Customer segments are patients, doctors, firms and pharmacies [69].

GPI is an Italian company born 30 years ago. It grew up thank to significative investments on M&A and projects developed along with university and national research centers. It aims to develop state of the art solution to make healthcare services sustainable and improve people life quality, thus the goals are to innovate care models, optimize processes and shrinking costs. The offering is made up by an integration of IT, consulting and design competences organized in 5 business area. One of those is Care business area, which offers services and technologies for taking

in charge and empowerment of patients. Among others particular services it has been developed POHEMA which is a solution for digital health able to adapt itself to continuously changing future scenario. Specifically, it delivers telemedicine, tele-visit and tele-monitoring services. Thanks to nano intelligent appliances and dashboard it can delivers the best tele-monitoring service, through which doctors can detects patient critical areas. It provides central services of specialists for supporting the whole network of caregivers. It is a B2B [70].

Pagine Mediche has developed a platform that brings together doctors and patients, enabling them to perform tele-visit and tele-monitoring on the app “**Visitami**”. Indeed doctors, selecting their professional specialization and the preferred offer plan, can visit new patients simply using smartphones and PC, sharing files and receiving the payment online when the tele visit is concluded. They can also remotely monitor clinical parameters through the patients’ devices and intervene if needed. In addition, the platform allows physicians to manage their appointments by providing a professional agenda. For the patients instead, it is simply required to download for free the app, search for the specialization of interest and book and conduct a tele visit in a few minutes. They will pay directly the professionals, at no extra cost [71].

In addition to target doctors and healthcare facilities, Pagine Mediche enables also to realize special projects for pharmaceutical companies, insurance companies, institutions and earns a revenue stream from advertising.

Exprivia is an international group specialized in information and communication technology able to drive the business changes thank to digital technology. It offers simple solutions created by the connection and integration of different competences. It is one of the main players on digital transformation of companies and one of the sectors is actually the healthcare. Regarding this sector it offers telemedicine solutions through the application eLifeCare. This platform allows the patient managing from home 24h per day. The solution reduces costs of SSN, optimize process time, and improve patient life quality. Tele-monitoring is delivered by the App which is available for the patient with the integration of medical devices. Data are going to be gathered and stored on patient healthcare folder in this way the doctor can provide cure plan to the patient. Tele-consulting and tele-visit are available as well on the platform. Finally, tele-assistance services can be delivered by healthcare personnel throughout the peripheral territory.

Exprivia sell the software to any type of public of private organization or doctors. Therefore, it can be defined as a B2C and B2B [72].

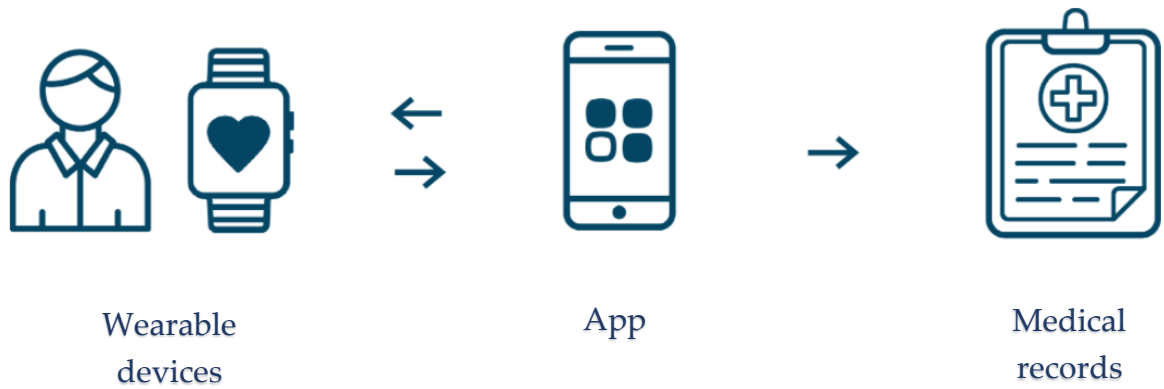


Figure 21: Exprivia telemonitoring data flow



Figure 22: Exprivia tele-visit data flow



Figure 23: Exprivia teleassistance data flow

Medtronic, the US leader in healthcare technologies, offers in Italy digital platforms services to assist patients and medical teams, especially with the outbreak of COVID-19. More specifically, “DIRECTO” is the solution available for healthcare professionals and patients in cardiology, offering tele-monitoring of the parameters regarding patients who carry cardiac devices. It is also possible to perform tele-visit of the patients at home through tablets. WeCare instead is the solution of tele-monitoring for the users of Medtronic devices for the treatment of diabetes. Recently, Medtronic has introduced a platform of tele-monitoring, Get Ready, that allows COVID-19 patients to register their data on it and the clinical team to check them through a web application. Moreover, Medtronic offers also the possibility of tele-consulting for the remote collaboration of interdisciplinary support teams [73].

MioDottore.it is one of the most famous websites in Italy for booking a medical appointment, connecting patients to over 200.000 medical specialists. In addition to this, the platform offers also telemedicine services, specifically tele-visit, allowing patients and doctors to perform a remote visit. Patients can use the platform free of charge, whereas health professionals must pay a subscription fee.

Belonging to the same group of MioDottore.it (DocPlanner) there is **TuoTempo**, a solution that is exclusively designed for hospitals and big clinics. It consists of a tool that manages the communication between patients and healthcare operators across different channels, sending customized messages to patients. Using the app, it is also possible to book appointments, make payments and share images and medical reports. In addition to tele-reporting, the other telemedicine service offered is tele-visit. Indeed, patients can perform remote visits wherever they are. TuoTempo also

includes the section “reports”, a business intelligence center that offers insights and maps patients’ data exploiting a dashboard.

Like MioDottore, the French **Doctolib** enables patients to look for the better specialists and general medicine doctors for their needs and book an appointment. It also allows to share medical reports and documentation, and doctors can manage their patients through an online agenda. While they sell tele-visit solutions in the French and German market, the only telemedicine service Doctolib offers in Italy is tele-reporting, indeed patient can request online prescriptions [74]. Even in this case, the use of the platform is free for the patients, whereas a monthly subscription is needed for doctors. In addition to them, Doctolib also serves hospitals and health centers (such as “Policlinico Gemelli”, “Fatebenefratelli Isola Tiberina di Roma”, “Centro Diagnostico Italiano di Milano” and “Humanitas di Torino”) [75].

Philips, in collaboration with Pfizer, has developed a telemedicine project called “Vicini di salute” aimed at improving the therapeutic adherence of chronic patients. It basically consists of a solution enabling the tele-monitoring of vital parameters, allowing the patients to be constantly in contact with the medical workers and receive updates regarding the adherence to the therapeutic path. In so doing, doctors can intervene if needed. The project involved different Italian hospital facilities, such as University Hospitals, polyclinics and ASL [76].

TICURO REPLY is the product of Healthy Reply for telemedicine, tele-monitoring, which enable the processes care continuum. It represents improve the life quality of patients and represents a valid help for doctors, insurance, firms, and health facilities. It exploits the newest technology available as IoT, Cloud computing, Big Data mobile apps. For each different typology of customer (insurance, firms, public or private clinics) TICURO REPLY offers tele-monitoring, tele-visit and tele-reporting services whose advantages are different for each. Tele-monitoring services is based on medical wireless devices which allows to gather vital parameter according to a medical plan predetermined. In case a certain parameter overcome a threshold an alarm is automatically generated by the monitoring system. Then starting from a set of gathered data TICURO REPLY can creates personalized medical plan such as monitoring plan, pharmacological plan, rehabilitation plan [77].

TESI eViSuS is the telemedicine solution by **TesiSquare** specialized in tele-visit, tele-assistance and tele-monitoring. Indeed, it allows health facilities and retirement

homes to perform tele-visit in every moment (e.g. video visits of peritoneal dialysis for patients at home or in retirement homes, video visits for malnourished patients at home or in retirement homes, video visits for patients affected by skin lesions in retirement homes and public health facilities) and assist patients and caregivers in the execution of distance healthcare procedures, thus reducing the risk of hospitalization. In so doing, TESI eViSuS enables to continuously monitor the patients. Technically speaking, the TESI eViSuS system consists of a transportable “Totem” (Remote Station), equipped with a high-performance camera, touchscreen monitor and handsfree mic, and a Control Station through which the medical staff can connect to one or more patients simultaneously and check the camera of the Remote Station [78].

WelMed through its white label platform is able to put in contact patients, doctors, healthcare facilities and companies. They offer tele-visit, tele-reporting and tele-consulting services. Indeed, it enables patients and doctors to perform video visits, have a continuous online communication and transmit electronically certificates and reports in a safe environment. Costs and times of the visits are defined by the practitioners. Doctors can also exploit the schedule for the appointments and the tele-consulting service “Intramed”, that allows them to communicate and cooperate, also with specialists of other facilities. More in detail, its customers include patients, doctors, healthcare facilities, life science companies, insurance companies, hospitals and clinics [79].

THCS is born with the aim of improving health and quality life of fragile people with different physical and social problem through the usage of innovative technology in the field of telemedicine. The services are delivered to public and private healthcare structures, they are customizable in relation to different needs, and they are suitable for third parties’ integration. THCS exploit the teams of experts able to provide telemedicine services by the integration of technological platforms and electromedical instrumentations. Therefore, THCS provides service of tele-reporting and data managing but it can also deliver tele-monitoring of vital parameters service thank to the system ability to interact with different diagnostic appliances. The bunch of customers contain ASL, polyclinics, pharmacy, public institutions, firms, but the company plays a service center role without selling any software [80].

Ultraspecialisti offers services of specialist telemedicine to patients, caregivers and healthcare facilities, guaranteeing an efficient and effective communication with

doctors. Therefore, the company works as a service center. For patients it delivers services of tele-visit with experts by sharing medical exams. It allows the patients to have a repository on which diagnosis and medical file can be stored. For healthcare facilities it provides the innovative platform for the remote managing of patients and virtual hospitals. The revenues stream is a pay per use method, and it seems to be both a B2C and B2B since it provides the telemedicine platform as a service to specialist/patients and hospitals and clinics [81].

EOS, an Italian consulting company, has developed an innovative system of tele-monitoring and tele-assistance, *Santigo*, to support the healthcare system. It consists of different applications that allow chronic patients, elderly people and patients in rehabilitation to be assisted remotely by nurses and doctors. For instance, the system enables a remote monitoring of vitals through an IOS/Android app and a set of sensors (it is the case of *Santigo Health Monitoring App*, that specifically addresses COVID-19 patients). *Santigo Mental+* instead has the aim to prevent mental disorders by sending notifications in case of changes in the physical or psychological state of the patient, while *Santigo NightProtect* is focused on the night tele monitoring of elderly people in retirement homes. The application specially developed for chronic patients and patients in rehabilitation is called *Santigo Home+*. With this wide range of solutions, EOS can serve doctors, patients, retirement homes and hospitals, enabling a timely and coordinated action [82].

Vree Health is a company specialized in design, develop and commercialization of digital health products and solutions as tele-monitoring, tele-consulting, tele-visit services. Tech-Care is their strength point. It is a platform which makes available telemedicine services for everyone, anywhere and always. One of the Tech-Care tools is *Doctor Plus* which is the main platform for telemedicine. It allows the telemonitoring through the usage of a kit made up by specific medical appliances and an application. The latter consents the access to telemedicine services such as the storing and visualization of data coming from the kit of medical appliances. Moreover, *Doctor Plus* make available those data to all the stakeholder (doctors, nurses) involved in the process. Lastly, the platform encompasses a center of service where professionals can help doctors and patients with technical issues [83].

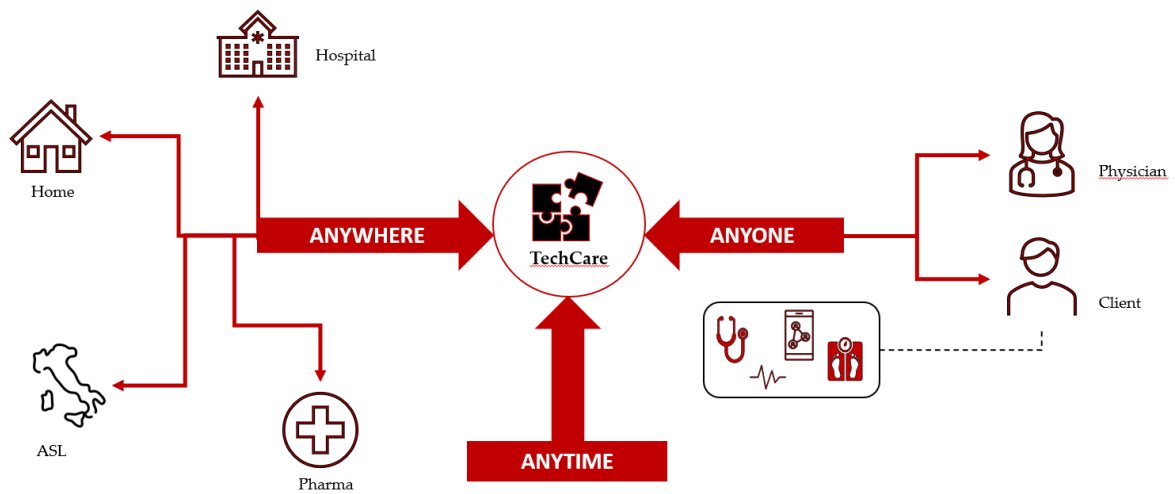


Figure 24: Vree Health telemedicine system

4.2 A proposed classification for the main Italian telemedicine companies

In order to have a clearer picture of the actual Italian landscape, a classification by matrix has been exploited. The matrix is made up by two dimension which are “Type of Business” and “Type of Interaction”.

“Type of Business” refers to the channel in which the company is active, therefore B2B or B2C. However, a further explanation is needed about this dimension. Indeed, for the sake of simplicity, an important assumption has been made regarding what is meant by B2C and B2B. A company is classified as “B2C” if it provides and sells its solutions directly to final users, namely patients and doctors. An organization instead falls within the “B2B” category if its clients are hospitals, private clinics, institutions etc. However, there are cases in which the target customers fall in both the “B2C” and the “B2B” cluster, in this instance a third category is introduced, “B2C & B2B”. The “Type of Business” dimension has been introduced as it is valuable to give a portrait of the scope of action of the Italian telemedicine companies. Indeed, the way these organizations conduct their business can be considered as symptomatic of their level of integration with the national health system and, more generally, of the status of diffusion and acceptance of telemedicine. Indeed, if most of the companies sells their solutions mainly to

hospitals and institutions such as ASL may imply that the overall system is moving towards a general inclusion of telemedicine as an ordinary practice of healthcare services. On the other hand, if the main customers are instead private individuals, this may indicate that there could be a widespread rate of approval by the society regarding the recognized added value of telemedicine, but maybe currently there are no clear and structural regulatory references such that the public market is profitable.

The second dimension, "Type of Interaction", deals with the time duration of the telemedicine service provided by the company. As a matter of fact, it may be "discrete", namely a single one-shot interaction between the users of the platform, or "continuous", involving a taking care of the patient that lasts on the medium/long-term. A necessary clarification needs to be done, indeed all the companies that offer both discrete and continuous solutions have been classified in the category "continuous", since it is a more structured service that requires a higher level of operational and organizational effort from the companies. Indeed, this type of service turned out to coincide most of the times with the tele-monitoring one, that asks for more resources and may heavily affect firms' operations. It is relevant to investigate this feature because it can highlight a better customer involvement, allowing to steadily create value on the long run by assuring a more effective health service and consequent better clinical outcomes.

Moreover, analysing these dimensions it can emerge where there is actually more competition both in terms of typology of service delivered and type of target customer.

Examining the information collected in the previous chapter, the matrix results to be as follows:

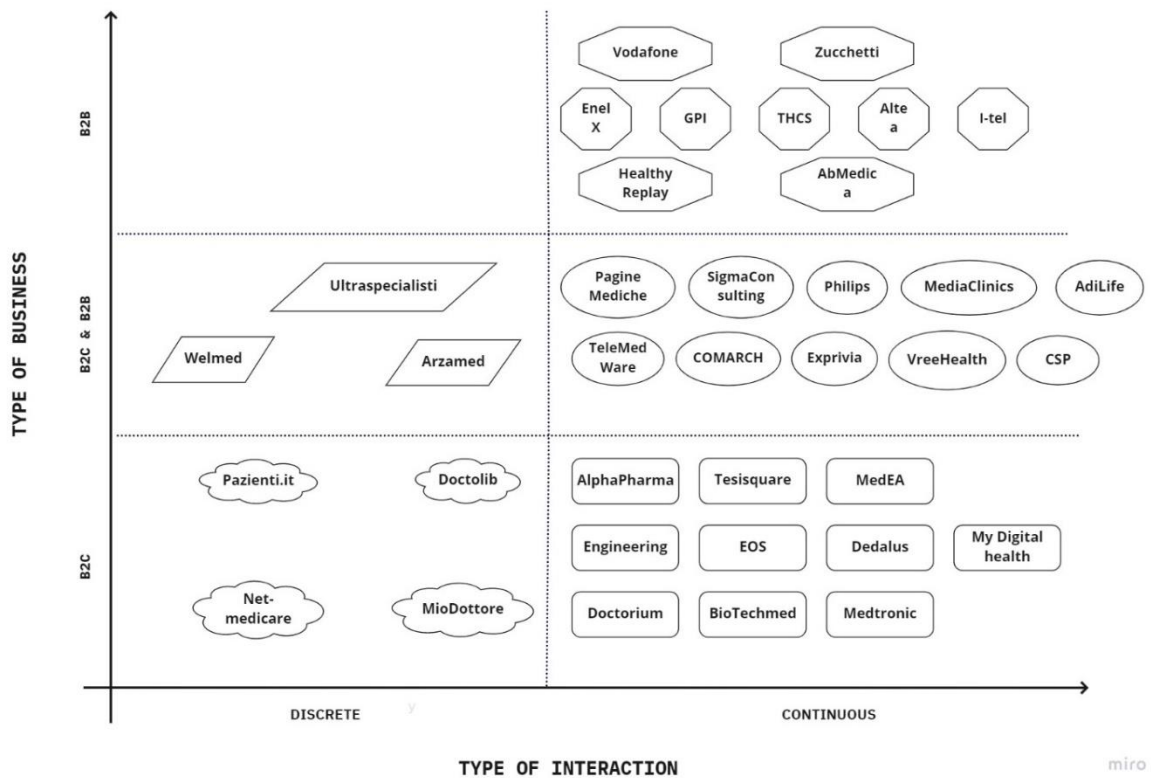


Figure 25: Classification Matrix

Deeper insights that stem from the matrix will be analysed in the chapter “Findings” and discussed in the chapter “Discussion”, together with what emerged from “Methods”.

5 Methods

The aim of this work is to analyse the business model of telemedicine platforms, deepening the most relevant features. The methodology applied for acquiring information for that purpose is presented below in this section. Thus, the empirical research methodology selected to gather data is explained, followed by the concrete implementation of that method.

5.1 Research methodology: multiple-case study and interview

Empirical research methodology refers to the procedures and techniques employed for collecting and analysing data, allowing to draw conclusions about a topic. The different variants of research are mainly:

- Qualitative one: it consists in the acquisition of knowledge from a qualitative perspective, therefore numerical and quantitative collection and measurement of data are not relevant in this typology of research methodology. Examples of techniques used are case studies, ethnography and interviews;
- Quantitative one: it focuses on quantitative and numerical information, leveraging on statistics, linear regressions, econometric models, surveys, laboratory experiments, simulations and mathematical calculations in general [84].

For the purpose of this study, qualitative research methodology will be applied, in particular resorting to multiple-case study and interviews to gather information and knowledge about the reality of telemedicine platforms in Italy. These techniques have been chosen because they are considered as the most suitable to acquire valuable insights in a context like that of telemedicine. Indeed, the direct witness of several people holding prominent roles in their companies can represent a highly effective way to deeply examine a sector quite unexplored, in which a comprehensive pool of quantitative data is still in short supply. Hence, some of the companies previously described in the paragraph 4.1. will be subject of interviews, as explained more in detail in the next section.

5.2 Interview creation and respondents

After having selected the techniques to collect information, the drafting of the interview addressed to the companies' personnel took place. It was carried out taking into account the relevant points emerging from the literature review and the empirical context analysis. More specifically, the interview can be structured in the following parts:

- Introduction (about the general picture of the company and the role of the representatives);
- Questions about the empirical part (types of service offered by the company, data collected and exchanged, barriers and benefits, etc.)
- Questions about the business model (users of the platform, revenue streams, key resources, etc.)

Permission and consent about the quotation of the company's name in the body of the thesis and the recording of the interview for the purpose of processing information also were asked.

The interview has been finalized with the following questions:

- 1) Can you kindly describe your company and your role inside it?
- 2) Which kind of telemedicine services does your company deliver?
- 3) Is the interaction and communication between the users on the platform continuous over time or is it a "one-shot" solution?
- 4) Which type of data does your company collect from users (e.g., patients, experts, facility)? What are the usage objectives of those data (e.g., product improvement, marketing, R&D)?
- 5) Is your solution made up by any software or hardware components? Those are developed in-house or obtained through outsourcing? Does your company leverage on owned healthcare professionals to deliver the product/service?
- 6) Which are the target customers of your offering? Specifically, which target customers are usually paying?
- 7) In which modality are your services paid (e.g., licensing of the platform, monthly/annually subscription fees, direct purchasing)?
- 8) Which were and are the main barriers you face during the realization and commercialization of your telemedicine platform?
- 9) Which were and are the main benefits obtained during the realization and commercialization of your telemedicine platform? In particular, which is the value added that your product offers in terms of pain reliver or gain creators?

- 10) Does the company leverage on revenue streams other than the ones related to its core business (e.g., advertising on the platform)?
- 11) What was the level of diffusion of your telemedicine services before the pandemic, if already present on the market? Has the target of clients changed? And how do you see the evolution of the telemedicine market in the future?

As already explained, all the questions have been defined taking as inputs the information acquired through the literature review and the empirical context analysis and eventual cues generated by them. The aim of those interviews is indeed to investigate more deeply these data, creating added value on them by extrapolating significant findings that will be reported in the next chapter.

The first question is of general and introductory nature, and it has the aim of deepening the knowledge obtained with the empirical context analysis.

The second one also is intended to investigate the companies, with focus on the solutions offered. The overall objective here is to outline the Italian telemedicine market, providing an overview of the diffusion of the different telemedicine services in Italy.

The third question is focused on the type of interaction existing between the users the platform puts in contact, namely whether there is a continuous engagement able to create value on the mid- and long-term or it limits to a “discrete” contact. This question has a relevant weight since it refers to one of the dimensions used in the matrix to cluster the different companies. It is important to deepen this aspect in the light of what has emerged from the literature review, since it is one of the most important variables to increase the patient engagement. In fact, from the literature review, it emerged the necessity to make platforms customer-centred in order to create value even for other users within the platform. Moreover, from the empirical analysis it is clear that most of the companies have already implemented solutions with a continuous patient’s engagement. Therefore, this question was elaborated with the aim to really discover if and how the patient engagement is pursued.

The fourth question is made up by two sub questions regarding the typology of data collected and the usage of them on the platform. This question is important to comprehend the functioning of the telemedicine solution. Indeed, the literature review conducted pointed out that all the digital platforms deal with data, basing their value proposition on them, given their inherent nature. Therefore, knowing this aspect of them is the basis to have a picture of one of the main pillars that made up digital platforms and in this case telemedicine platforms.

Both the analysis revealed that technologies have a critical role in creating and capturing value for these platforms. The fifth question has therefore the role of thoroughly verifying the tools that make up the solutions offered by the firms, also giving a portrayal of what the technological progress is in the Italian telemedicine sector. In addition, here it is also investigated if the companies' business model includes the realization of the software and platform and the production of hardware such as medical devices needed for the provision of the final service, or instead they are obtained through outsourcing resorting to external partners. Moreover, the organizations are also asked if they are equipped with own healthcare professionals, who can deliver the medical service first-hand through the platform. Both points are important to understand the level of integration of the firms in the provision of the medical service.

The sixth and seventh question have the same goal of clarifying the revenue streams, which is an important feature for the business model of a company. It is truly important to identify the main customers in general, which most of the time correspond to who is going to pay for the services or products, but it not always the case. Then after having individualized the paying customers, it is even worthwhile to know the methods of payment given the different type of customer involved into the telemedicine sector. Moreover, different type of payment methods may allow diverse engagement with clients, for instance a pay-per-use modality could be favourable to a long-lasting partnership in a B2B relationship. Finally, revenues streams spread over time give the benefits to have cash inflows more stable and continuous on the medium or long-time horizon.

The eighth and ninth questions are about the specific experiences of the companies in terms of difficulties faced during the realization and commercialization of the telemedicine platform and benefits derived from it. Barriers and criticalities may be, for instance, inherent in the relationship with customers, management of data, management of core processes, the field of regulation and so on. Benefits may be declined both as advantages for the organizations that developed the platforms and as value added offered to the customers. These questions therefore report the generic difficulties faced in the Italian telemedicine sector and highlight the gains these companies bring to the society, with the aim of giving insights about the levers that generate them.

The tenth question regard alternative source of revenue which derives from the exploitation of the telemedicine business. With this question the objective is to investigate the actual valorisation of the sector and the potential value that can be extracted in the future. This question was elaborated by the analysis of the literature

which highlighted different channels of value through which earn possible revenue streams. Therefore, it was needed to have a question to assess the level of exploitation of the telemedicine. Moreover, it will be worth to know what can be sold differently from the usual telemedicine services and related devices. For instance, in most of the cases from the literature analysis data were the principal source of value to be exploited and many stakeholders from other sectors are usually truly interested in obtaining both elaborated data and simple raw data.

The final question aims to make a comparison between the actual situation of the company and the past situation before COVID-19. The pandemic has massively speed up the pace of digital platform adoption even in the healthcare sector due to the clear need of remote care from home. Therefore, it is expected to discover interesting changes both for companies and patients but even for what regard regulatory and public healthcare. This may be useful to understand the development of some block of the business model as the target customer or the offered services.

For the success of this phase, a significant support has been provided by the “Osservatorio Sanità Digitale” of the “Politecnico di Milano”. Indeed, it is recognized at national level as a reference point in the field of telemedicine. Getting in touch with it, it has been possible to rely on its network of contacts and then select relevant organizations for the developing of interviews. Regarding the respondent companies, they are part of the pool of 39 organizations analysed in the empirical context analysis. Indeed, they have all been contacted, using the email addresses, if available, on the companies’ website, or through a request in the “contact us” section. The organizations that have responded successfully giving willingness to participate in the interviews were 9, and they coincide with the surveyed ones. In the following sub-chapters, the most relevant evidence obtained from the interviews are shown, addressing the companies one by one.

5.2.1 Enel X



Enel X is a new business line of Enel just concerning telemedicine sector made up by a team of experts on the field of innovation. The person who has been interviewed is an engineer whose role is project manager within the department of innovation and sustainability. Enel X is able to provide customized solutions end to

end, therefore it develops platforms with dissimilar features according to the customer needs. As a main partner for developing and delivering end to end solutions, they operate with one of the first-class hospitals in Italy as well as in Europe.

Table 1: Enel X - Empirical contents 1

Telemedicine services	Type of interaction	Type and usage of data
Tele-consulting, Tele-visit, Tele-monitoring, Tele-reporting	Continuous	Personal data for Marketing, anonymous feedback for Product improvement

Table 2: Enel X - Empirical contents 2

Barriers	Benefits
Resistance for doctors regarding telemedicine, Digital divide for elderly people, Lack of confidence towards the digital, Data privacy	Development of new telemedicine solutions (Eye Tracking), User friendly design and user journey (involving doctors and patients) for decreasing hurdles, Logistic benefits, Hospital bed savings, Increasing number of de-hospitalizations

Table 3: Enel X - Business Model

Customers	Revenue stream	Other revenue streams	Software / Hardware / Human
Private Hospitals, Public Hospitals, Healthcare facilities, Insurance companies	Public tenders, Monthly/annually usage fees, Direct payment for Upgrading	No	Software – inhouse, Hardware – outsourcing, Human - outsourcing

Before the pandemic Enel X was a small company that was implementing initial solutions and projects. What really changed after the pandemic is the consciousness about how important and effective telemedicine can be in making the system more resilient. In fact, there has been changes in regulatory, public administration, governments and people awareness. This led Enel X to increase its business and commercialize some of the previous project. However, the future developments will proceed towards an increasing adoption of telemedicine and the pace will be kept by the public healthcare which is the real enabler for the sector.

5.2.2 GPI



GPI is a big Italian group made up of more than 7000 employees, with a turnover of € 360m in the last year. It proposes itself as a partner for the private and public healthcare sector, offering different services and solutions such as technologies, devices and methodologies. Different business units compose the group, the company representative interviewed is part of the R&D department, whose focus is on PHM (Population Health Management), virtual care and artificial intelligence.

With regards to AI, the business unit has developed predictive algorithms and a Machine Learning algorithm about the dynamic stratification of the population in risk cohorts. The modular platform provided by GPI is based on the Population Health Management, a model whose pillars can be summed up in four different phases:

- stratification (identification of the people's demand for health) and division of the population into clusters;
- organization of the workflow and processes according to the clusters, defining the services for each cluster;
- organization and management of the provision of services and of the interaction between the actors;
- actual delivery of services and measurement of the performance.

This model allows the platform (POHEMA) to engage patients along all the therapeutic pathway, from the taking charge to the follow-up.

Table 4: GPI - Empirical Contents 1

Telemedicine services	Type of interaction	Type and usage of data
Tele-monitoring, Tele-visit, Tele-consulting,	Continuous	Medical data, personal data for R&D

Table 5: GPI - Empirical Contents 2

Barriers	Benefits
Digital divide, privacy and standards compliance, lack of digitalization in some contexts, difficulty in reaching rural areas with internet	Make the healthcare system more flexible (able to answer to the needs faster and with fewer resources), effective adherence to therapies, increase of the engagement of all users, better sharing of info, coordination among the stakeholders, Development of new telemedicine solutions (Monitoring of vitals through Voice Analysis)

Table 6: GPI - Business Model

Customers	Revenue stream	Other revenue streams	Software / Hardware / Human
Asl, clinics, regional institutions, healthcare providers, government (CONSIP)	Direct purchase for the service (SaaS)	No	Software (Modular platform Pohema) - inhouse, Hardware (IoT devices) - inhouse (add-on devices for tele-visit) - outsourcing, Human - outsourcing

Regarding the changes brought by the pandemic, GPI has followed the trend of the public and private healthcare sector, being their partner, focusing on the provision of telemedicine services. GPI has therefore seen increased demands, even if the company proposed solutions of telemedicine (in particular PHM) at the beginning of 2020, too. For what concerns the future of the Italian telemedicine market, according to the representative much depends on the institutions and public tenders.

5.2.3 CSP



The contact person for CSP is a doctor who has been working on telemedicine since 2013 being part to an American company for some years. This allowed him to have a real term of comparison with the Italian healthcare sector. CSP offers tele-monitoring services in partnership with a private clinic. It is able to monitor patients 24/7 through a high-tech device. The partnership with the clinic instead is essential to assess all the clinic data coming from the device, since it is made up by a simple patch that can be attached to the chest without being annoying for the people who wear it. Therefore, this solution can monitor instantly vital parameters over medium-long period of time.

Table 7: CSP - Empirical contents 1

Telemedicine services	Type of interaction	Type and usage of data
Tele-monitoring	Continuous	Clinical data for service delivery, no use of data by the company

Table 8: CSP - Empirical contents 2

Barriers	Benefits
Lack of regulatory	No need of knowledge or competence for patients, Emergency saving solution, Time savings for patients to be controlled, Selling of knowhow available

Table 9: CSP - Business Model

Customers	Revenue stream	Other revenue streams	Software / Hardware / Human
Patients, Insurance, Clinics, Insurance, Public hospitals	Pay per use, Specific agreement depends on the different service	No	Software – outsourcing / Hardware – outsourcing / Human – inhouse

The pandemic has pushed forward the awareness on telemedicine which was initially very scarce. the COVID-19 has highlighted all the weaknesses of the past and actual solutions of healthcare service. Therefore, as consequence CSP leveraged the situation to make them known in fact they succeeded in widening the catchment area.

5.2.4 Ultraspecialisti



Ultraspecialisti is an innovative small and medium-sized enterprise (SME) born in 2016 as a start-up with the specific mission of creating a telemedicine platform. As explained by the interviewee (the Co-founder and Chief Executive Officer of Ultraspecialisti), the company saw in this solution the answer to “healthcare migration” in Italy, namely the phenomenon for which patients are assisted in other regions than the one of residence. This is of course symptomatic of lack of services and local inefficiencies, entailing additional costs for both patients and the healthcare system. More in detail, the platform focuses its scope on specialist medicine, indeed it is based on an algorithm that matches patient’s need with the specialist who responds better to that demand. To reach this aim, the platform allows doctors to collect medical data through questionnaires with medical history, automatically submitted to patients according to the pathology. Then, the software enables the transfer of all the exams and imaging, allowing the specialists to visualize them. The documentary analysis is therefore the first step of the process. As a matter of fact, the platform works as a remote business tool for professionals. All is conducted ensuring the outmost safety and privacy protection. According to Ultraspecialisti’s policies, the obligation for doctors is to give a written response to patients. So, the final output of the process is the release of a medical report, that can be obtained following a tele visit, at the discretion of the specialist.

Table 10: Ultraspecialisti - Empirical Contents 1

Telemedicine services	Type of interaction	Type and usage of data
Tele-visit, Tele-consulting, Tele-reporting, Tele-monitoring	Discrete	Medical/diagnostic and personal data for R&D, service improvement, marketing

Table 11: Ultraspecialisti - Empirical Contents 2

Barriers	Benefits
Resistance for doctors and patients regarding telemedicine, Lack of confidence towards the digital	User friendly experience (involving doctors and patients in the co-design), Logistic benefits, Optimization of processes and management of patients for doctors, Reduction of outpatient visits for hospitals and space savings

Table 12: Ultraspecialisti - Business Model

Customers	Revenue stream	Other revenue streams	Software / Hardware / Human
Patients, Caregivers, Hospitals, Polyclinics, Firms, Insurance companies	Patients - pay per use, Hospitals - subscription fee or % retained on each patient	Content marketing through the development of informative websites on pathologies and advertising fees on them	Software (cloud platform) – inhouse, Hardware (devices for telemonitoring) – outsourcing, Human – outsourcing

The pandemic has brought more competition and pressure to Ultraspecialisti, that was already accustomed to work on telemedicine, but it did it in a more “reflective” way. The company has also developed services devoted to non-COVID-19 patients, who were penalized by overcrowding in hospitals, supporting them remotely on the platform. Regarding the future of the sector, the CEO of Ultraspecialisti sees huge potential, particularly in relation to the large set of data handled by these platforms. Indeed, there is scope to profitably exploit these user-data, managing, optimizing and selling them to interested third parties, above all pharmaceutical companies, but always respecting the General Data Protection Regulation (GDPR). Furthermore, progress in data elaboration and data analysis may enable collaborations oriented to research projects with partners holding complementary know-how (such as research institutes and universities). In conclusion, the interviewee expressed his hope concerning the development of telemedicine in Italy, namely that resorting to telemedicine as first choice should become a routine practice, enabling to realize gains and efficiencies for both patients and the healthcare system, and not be framed simply as an emergency solution.

5.2.5 Pazienti.it



Pazienti.it was born in 2010 by a doctor and during the years the company has developed new business models. Starting as a simple forum for assessing hospitals, it became a place where patients could get answers from experts. After that the company added the possibility to book appointments with doctors for a visit. Nowadays instead it is a digital platform on which patients can search for a specialist and they can have a first check-up visit. The visit has the aim to get know the patient with the doctor and it can be useful to have an exchange of initial information before the real visit. Therefore, it cannot be seen as a real visit and as consequence doctors cannot elaborate and send a clinical report through the platform. The partnership between Pazienti.it and the doctors is essential to deliver the best outcome, since the platform is available only for private doctors and the latter are the only one who interact with patients. The partnership concerns even the revenue sharing which means that the company and doctors divide the revenues coming from patients according to a prior agreement. The platform can be used both by the final customer then being a B2C solution and by a company that want to use it within their environment then being a B2B solution. The interviewee is the operations manager of Pazienti.it, therefore he oversees projects, he handles the web-application and builds up supplier relationships.

Table 13: Pazienti.it - Empirical Contents 1

Telemedicine services	Type of interaction	Type and usage of data
Tele-visit	Discrete	Personal data for service delivery, Questionnaire, and phone call for service improvement

Table 14: Pazienti.it - Empirical Contents 2

Barriers	Benefits
Lack of regulatory clarity, Resistance for patients and doctors towards telemedicine	Speeding up the check-up process with doctors, Logistic cost saving, Rapid feedback about a health concern, Reduced information asymmetry between patient and doctors, Therapy adherence of patients

Table 15: Pazienti.it - Business Model

Customers	Revenue stream	Other revenue streams	Software / Hardware / Human
Patients, Pharmacies	Patients - pay per use, Pharmacies – specific agreements	Publishing, Communication channels	Software (data analytics and backend) – inhouse (audio and video) - outsourcing, Hardware (devices for telemonitoring) – outsourcing, Human – outsourcing

The pandemic has influenced Pazienti.it under the point of view of the quantity of visitors. In fact, during the emergency a significant number of patients engaged the platform and consequently the general awareness about telemedicine has raise.

There was not any change on the business model of the company neither on the main target or customers.

5.2.6 Ab Medica



Ab Medica is a company historically specialized in the sale and distribution of robotic equipment and technological material in healthcare. More recently, the group is also active in the development of products such as software for telemedicine solutions, through the unit “Made in Ab medica”. The two company representatives are part of the latter, and they are respectively Senior Manager in the Project Management Office & Development department and Telemedicine Strategic Development Manager, who is directly involved in the functional and regulatory management of the telemedicine platform provided by Ab medica, “MAIA”. The certified platform can enable all the telemedicine solutions provided by the national guidelines. In addition, the company has commercialized “WinPack”, a medical device that, in combination with MAIA, allows a continuous tele monitoring of multiple vitals.

Table 16: Abmedica - Empirical Contents 1

Telemedicine services	Type of interaction	Type and usage of data
Tele-monitoring, Tele-visit, Tele-assistance, Tele-consulting, Tele-reporting	Continuous	Health data and personal data for service delivery, no use of data by the company

Table 17: AbMedica - Empirical Contents 2

Barriers	Benefits
Bureaucracy, Lack of regulatory clarity, Digital divide, Resistance for doctors towards telemedicine	Cost savings for hospitals, Time savings for patients, Optimization of processes and management of patients for doctors, Logistic benefits, More patients' data available for doctors, Predictive ability thanks to AI

Table 18: AbMedica - Business Model

Customers	Revenue stream	Other revenue streams	Software / Hardware / Human
Hospitals, public and private clinics, insurance companies, retirement homes	Annual licensing fee (Software as a Service), loan fees for tele-monitoring devices	No	Software (MAIA platform) – inhouse, Hardware (WinPack) – inhouse (other devices) – outsourcing, Human – outsourcing

Ab medica is involved in the field of telemedicine since 2004, but before the pandemic the small platforms developed by the company were mainly used for national and international research projects and pilot studies. Their application area was limited to the experimental one. So, the commercialization of the platform was not yet contemplated and there were not potential clients willing to buy it. In this

phase the main purpose was to prove the added value brought by telemedicine. With the arrival of COVID-19 instead, public and private healthcare facilities have begun to become customers of Ab medica, with the willingness of adopting the platform to deliver telemedicine services. About the future of telemedicine in Italy, the two respondents predict that it will permanently enter public health as an ordinary practice, and even in the private sector, with a growing collective awareness of its advantages, it will become more and more present. Indeed, the desired scenario is the one in which all health services that do not require a complex or urgent response will be carried out remotely rather than in hospital facilities.

5.2.7 Zucchetti



Zucchetti is the biggest Italian software house with more than 7000 employees and a turnover of 1.3 billion of euro. It was born in the 80's from Nino Zucchetti, an accountant who initially developed solutions for his sector. At the end of 90's, due to the good results it was obtaining, he started to invest on developing solutions for company accountability. In the last years Zucchetti focused on creating new solutions for different sectors as logistic, hospitality and lastly the sector of healthcare. Zucchetti aims to play a central role in assembling all the potential solution available on the market. This role emerged from the fact that the actual telemedicine market is massively fragmented with hundreds of solutions. These solutions are developed by numerous start-ups, and they are specialized on just a telemedicine solution as tele-monitoring, tele-visit or just on a specific chronic disease or solutions able to work just with specific high tech devices. In this way it would be difficult to create a one standard solution for the healthcare system because it would be needed of multiple interfaces and complex solutions able to work with different entities. Therefore, Zucchetti wants to integrate the whole system by creating general management platforms in which it is possible to handle vertical and different services dedicated to precise cluster of patients by leveraging different telemedicine solutions as tele-monitoring, tele-visit or tele-consulting. This idea can be implemented thank to new standards for clinical data handling which are fundamental to integrate different information systems. Otherwise, they could

not be integrated and thus not having the capacity to share, manage information and finally create real value for healthcare stakeholders. Getting to the point, the scope of Zucchetti is to create an ecosystem made by an integration of myriad telemedicine solutions that permits to manage a multi-offer approach.

The interviewer is an entrepreneur, and he is the co-founder of a software company called Softwareuno. Nowadays he is in charge of managing the new business unit of healthcare within Zucchetti company.

Table 19: Zucchetti - Empirical Contents 1

Telemedicine services	Type of interaction	Type and usage of data
Tele-monitoring, Tele-visit, Tele-consulting,	Continuous	Personal and clinics data for internal audit, benchmark services, marketing activity

Table 20: Zucchetti - Empirical Contents 2

Barriers	Benefits
Digital divide, Resistance for patients and doctors towards the telemedicine and in general the digital	Therapy adherence, Computerization of the processes, Optimization of hospital resources, Time and resource savings

Table 21: Zucchetti - Business Model

innoCustomers	Revenue stream	Other revenue streams	Software / Hardware / Human
Private clinics, RSA, Social healthcare facilities, Public healthcare	Annual subscription for the license, Purchase of the service with monthly/annual fees (Saas)	No	Software – inhouse, Hardware – inhouse, Human – outsourcing

According to Zucchetti, the pandemic has made possible a big step forward in the field of telemedicine regarding firstly the regulatory. In fact, the interviewer is convinced that all the e-government trials that have been made are failed because of a lack of standardization. This lack of standardization has not made possible to have a point of reference for creating a data flow between national entities (healthcare, public administration) and citizens. Nowadays instead the legislator does not intervene directly with the building of digital system, but it obliged the adoption of a neutral and standard language which allows the growing of a system within which information can be shared and used by any entity. In this way even the change of old information system will be feasible since the standards will lower the cost of implementation and installation due to a common database for each solution. For instance, the public tender coming from the Italian PNRR makes available huge number of resources to develop telemedicine solutions aiming at helping the Italian healthcare backbone to be realized and thus starting a new era for the digital healthcare.

5.2.8 Healthy Reply



Xenia Reply is born recently in 2022 as a spin-off of Healthy Reply. Its focus are telemedicine and hospitality which are the main business units of Healthy Reply for what regard the health sector. Within the health business unit, Reply does not have just telemedicine services, but it offers other type of services that can be sold in different contexts and sectors. The interviewer holds the role as business unit manager within Xenia Reply whose role is to oversees the whole healthcare unit of Reply.

Table 22: Healthy Reply - Empirical Contents 1

Telemedicine services	Type of interaction	Type and usage of data
Tele-monitoring, Tele-visit, Tele-consulting, Tele-assistance, Tele-reporting	Continuous	Personal and clinics data for service delivery, Questionnaire for product/service improvement,

Table 23: Healthy Reply - Empirical Contents 2

Barriers	Benefits
Resistance for elderly people and digital divide	Reduced hospital congestion, Logistic cost and difficulties, Operational efficiency, Therapy adherence, Better clinical results

Table 24: Healthy Reply - Business Model

Customers	Revenue stream	Other revenue streams	Software / Hardware / Human
Private clinics, Polyclinics, Public hospitals	Monthly fees for license, Direct purchase for single service	No	Software – inhouse, Hardware – outsourcing, Human – outsourcing

The influence of the pandemic was the greater knowledge of patients' needs. As a consequence, Reply had the opportunity to develop telemedicine services without any preoccupation regarding the potential customers. In fact, before the pandemic Healthy Reply did not have a dedicated business unit, but just at the beginning of 2022 it created a specific business unit about telemedicine. At the contrary the interview is concerned by the high number of new solutions that have been emerging since the pandemic due to the increasingly awareness of telemedicine and for the future institutional investments as the well-known Italian PNRR. This, according to him, can led customers to experience the telemedicine solution in a wrong way pushing them away from the real value and benefits of the digital health. Regarding the future developments the interviewer think that after this wave of new start-up which are growing in number there will be a stabilization of the market with just few surviving solutions but there will not be a unique product for the whole Italian market. These phenomena will be present to meet the different requirements that each Italian region has respect to others but there must be uniformity regarding standards for data handling and sharing in order to have an equal point of reference for future improvements.

5.2.9 THCS



The company was born with the aim of offering ICT services in healthcare and welfare. All the services and products are realized to be customizable in function of diverse customer needs and they are prepared for the integration with third party's systems. The company has always worked with the conviction that technology has to adapt to the contest and in this context all the THCS solutions are born. The business representative holds the position of Project Manager within the organization, and personally follows the project "ADIGest" focused on home assistance.

Table 25: THCS - Empirical Contents 1

Telemedicine services	Type of interaction	Type and usage of data
Tele-visit, Tele-monitoring, Tele-reporting	Continuous	Clinical data, Personal data, Service duration, Geo-localization, KPI

Table 26: THCS - Empirical Contents 2

Barriers	Benefits
Digital divide for physicians	General cost reduction for patients

Table 27: THCS - Business Model

Customers	Revenue stream	Other revenue streams	Software / Hardware / Human
ASL, healthcare associations	N.D.	No	Software – inhouse, Hardware _ outsourcing, Human – N.D.

The pandemic did not change typology of customers for THCS. According to the interviewer, the future of healthcare will depend on the level of informatization and telematic, mostly in the context of home assistance.

6 Findings

In this section it is going to be reported all the contents obtained by the interviews. The contents are going to be analysed in order to get insights out of them. The aim is to apply a critical analysis to all the information gathered by the interviews in combination with the empirical analysis that has been previously done. The result of this examination will be useful to have a clearer and more schematic summary of the evidence that will then be elaborated to get some conclusion in the final chapter. It is significative to anticipate that several concepts emerged are confirmed and validated by the workshop organized by the “Osservatorio Sanità Digitale”, that was an opportunity to deepen some of the main themes with relevant actors of the sector, like the National Institute of Health (ISS).

6.1 Empirical contents analysis

The first empirical analysis regards the different typology of services that have been delivered the most by the 39 telemedicine companies deepened. It has been used a histogram with percentual values respect to the overall in order to identify the weight of each telemedicine solution over the total.

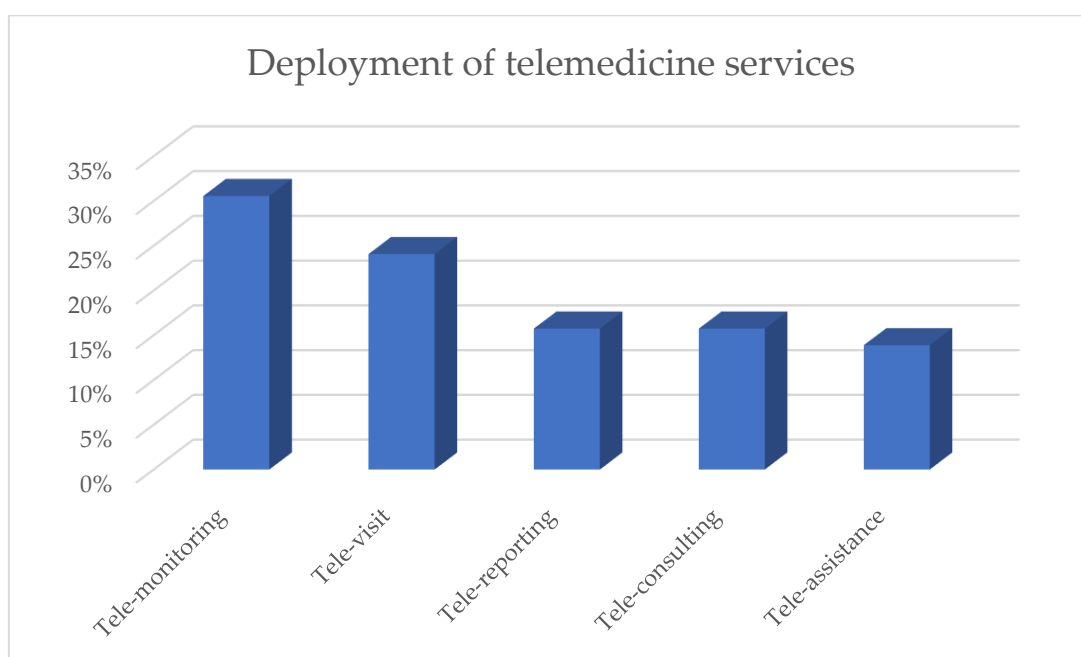


Figure 26: Share of main telemedicine services provided by Italian companies

As depicted in the above graph, tele-visit and tele-monitoring are the most diffused telemedicine services which count for nearly the 50% of the total. This clue may indicate that those services are the most preferred by the market and consequently allow a sustainable revenue stream which cannot depend substantially on a different income than private patients or private company at this stage of telemedicine diffusion and development. Moreover, the prevalence of this type of service may be not linked with the simplicity of solution development and implementation, since an effective tele-monitoring service could be challenging to build and commercialize due to inherent technological complexity. Instead, tele-reporting, tele-consulting and tele-assistance are the least diffused and for the same reason it may be a consequence of lack of demand as well as lack of regulation which can be a source of public revenue stream. Indeed, the regulatory can unlock diverse cash flows that can surely help the financial sustainability of weaker telemedicine solutions.

Another insight that can be grasped is a common trait among all the telemedicine firms. Indeed, looking at the services delivered at least one between tele-monitoring and tele-visit is part of the offer. It might mean that the two solutions are the main core business while the other have a subordinate role. Tele-monitoring and tele-visit probably have been the first value proposition embraced by telemedicine companies. Then after having consolidate tele-monitoring or tele-visit services other “secondary” solutions started to be implemented.

To verify whether the interviewed companies constitute a considerably representative sample of the overall telemedicine sector, the following graph has been introduced, that sums up the frequency with which the different telemedicine services are offered by the nine companies interviewed.

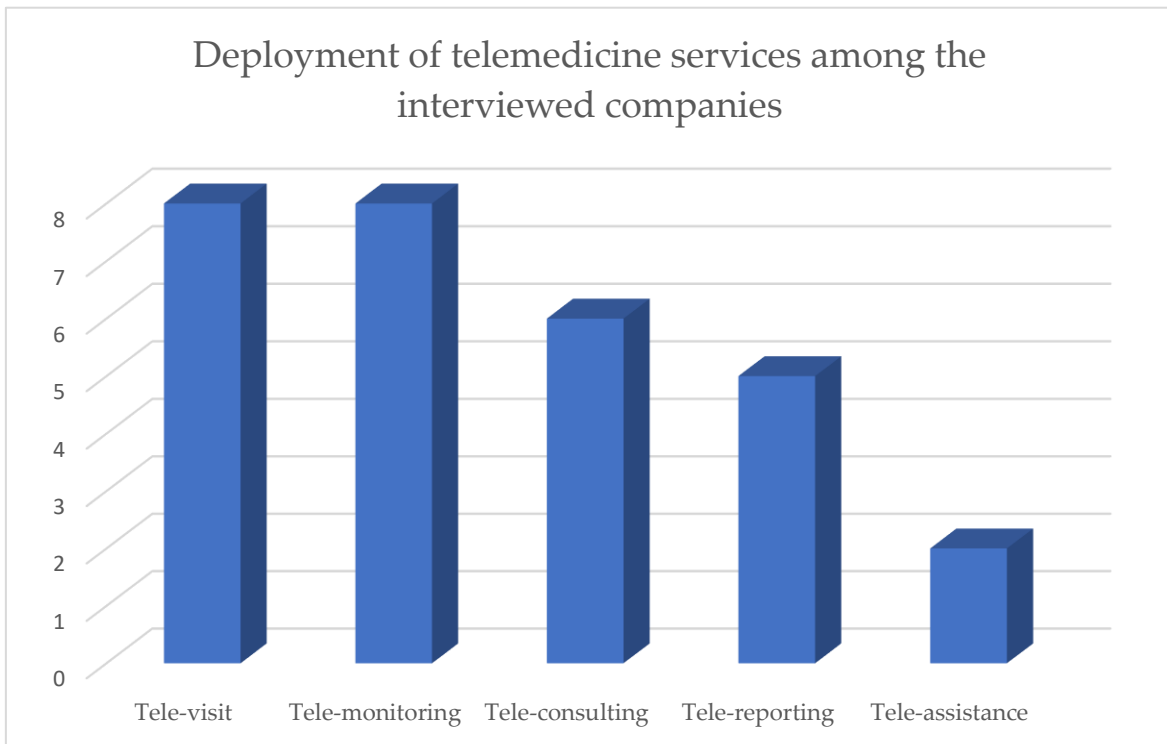


Figure 27: Share of the main telemedicine services provided by the companies interviewed

Tele-visit and tele-monitoring proved to be the solutions in which the companies are currently more specialized, since eight companies out of nine include these services in their offering portfolio, confirming the previous results. As already explained before, this may be indicative of a potential centrality of this kinds of solution in the telemedicine world, conferred by the impactful usefulness and efficiency generated in the patient's healthcare pathway. As a consequence, the demand pushed by clients, either they are attributable to the national health sector or belonging to the private sector, could have affected this prevalence. Further investigation about the services is needed for some of the nine organisations interviewed. Indeed, despite most companies show similarities about the modalities, techniques and technologies used in the supply of the aforementioned solutions, there are different nuances among them. It is the case of Pazienti.it, that offers a preliminary examination aimed at grasping general information rather than a more structured tele-visit.

The second empirical analysis regard the interaction typology meaning the time duration of the service. Indeed, two type of interaction has been identified: continuous and discrete. The continuous one refers to a medium or long-lasting

interaction between the users and the doctors through the telemedicine platform, while the discrete one refers to a short or “one shot” interaction. Seven out of nine interviewed firms permit a continuous contact. All of them share at least tele-monitoring, while the one having a discrete service do not have the tele-monitoring solution. Instead, there is another company that has the tele-monitoring service, but it does not deliver a continuous service. In this case it has appeared to have an integrated solution with the tele-visit. The company offers just tele-monitoring in parallel with the tele-visit therefore the interaction lasts just for the short time during the tele-visit.

It is clear that tele-monitoring is inclined to be used in a medium long-term duration since it required in most of the cases collection of vital parameters for a medium timelapse and it is associated to a clinical therapy that has to follow several steps. Moreover, the tele-monitoring solution is made up by more complex and structured solution, since it requires the integration of high technological devices combined with software applications. In fact, from the interviews it shows the effort needed to embed all the hardware and software components and then materialize a final tele-monitoring service that was truly capable to meet and satisfy the customer as well as doctors. Especially doctors had to get used to a different way to work, but in most of the cases after experiencing the advantages they did not come back to the previous way to cure specific patient disease. Considering this final point, the tele-monitoring has been exploited essentially for the care of exclusive chronic or acute diseases. Indeed, this type of service is a strictly vertical solution for the care of single diseases, but it allows to perform thorough clinical assessments due to its inherently nature of being a constant analysis over time.

About the potential collection of user-generated data, all the firms have categorically ruled out the monetization from them. The use of data, if any, is always carried out obviously respecting the GDPR regulations in terms of privacy. The purposes of use vary from company to company. Different companies such as ENEL X, CSP, Ab medica, Pazienti.it and XENIA Reply claimed that the clinical data gathered by the platforms are only accessed by the healthcare professionals, therefore only with the ultimate aim of service delivery. As a matter of fact, they are encrypted and not usable by the organizations themselves. Regarding personal data, Xenia Reply, Pazienti.it and ENEL X stated that they collect information through questionnaires and feedbacks, even if anonymously sometimes, in order to enhance the service offered in the context of a continuous improvement. ENEL X also added that it can use, prior authorization, personal data for marketing purposes. Same application field for Ultraspecialisti, that exploits medical and personal data also for service improvement and research and development.

Zucchetti uses aggregated anonymous user-data to conduct internal audit aimed at improving internal systems and to deliver benchmark services to the client companies about their performance. GPI employs clinical and personal data exclusively for research objectives, for example to develop predictive algorithms on the platform. THCS is the unique company instead that gathers data about geo-localisation, in order to provide a complete protection to patients, particularly with respect to tele-monitoring of elderly people. The main insight that emerges from all the cases examined is that at the moment user data is not a revenue-generating asset for those platforms.

In this paragraph it is going to be reported barriers, hurdles, and benefits from the nine companies interviewed. Starting from the barriers or hurdles faced during the realization and commercialization of the solutions, in many cases there were similarities and communalities.

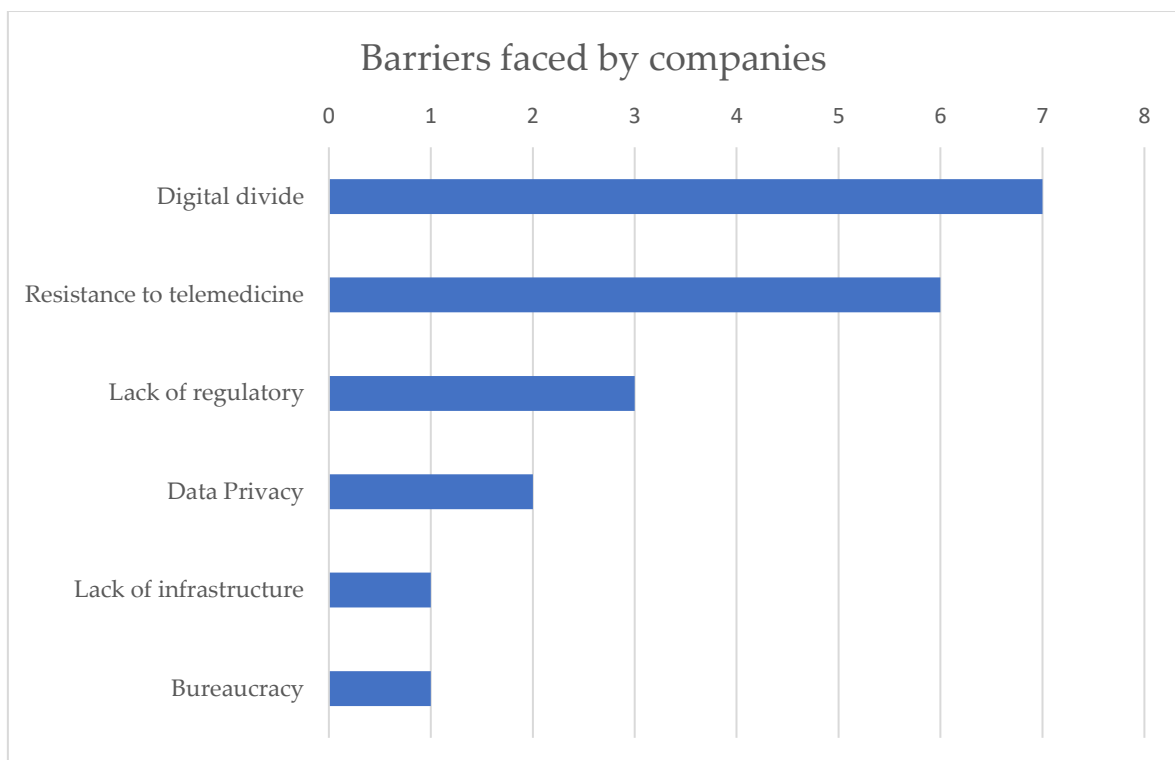


Figure 28: Barriers to realization and commercialization

The most cited hurdle it has been “digital divide” together with “resistance toward the telemedicine for patients and doctors”. Precisely, the two type of barriers have been cited 13 times in total and 7 company out of nine share the same hurdle. The “digital divide” refers to the competence gap about the usage of digital tools. In fact, it has been highlighted the difficulty to initialize and diffuse new ways to deliver medical service due to the lack of competence that doctors and especially patients have. This led to the second obstacle faced by the companies which is the resistance towards telemedicine world. Indeed, the low capability to handle technologies and thus to work exploiting digital devices or working by remote caused a strong resistance in most of the cases. Few are the cases that shows a proactive behaviour to learn how to use technology or working by remote. Because of this resistance, biases have been generated about the advantages of the telemedicine solutions. Doctors focused just on the negative aspect which is the distance from the patient and as a consequence the possibility to lose engagement with him.

The successive barriers are “lack of regulatory” and “data privacy” whose root causes lay on legislation. The lack of regulatory is a serious impediment for the system functioning, since one the principal feature of companies’ business model is the revenue stream and exactly the latter has not clear regulatory. Half of the interviewed company have highlighted the necessity to get clear information about prices and unit of measure to earn money after a service delivery. For instance, televisit’s prices are set, but there is not any unit of measure regarding the time duration of one medical performance. Therefore, a company has to adjust the time duration of one performance to the actual doctor hourly wage which result at the end a medical service of few minutes of time. Data privacy seems to be more an obstacle to optimizing the usage of personal and clinical data. The GDPR plays a key and fairly role for defending the integrity and privacy of patient’s data. At the same time, it represents a limit for exploiting deeply data value. For instance, Ultraspecialisti has been seeing different source of value coming from those data, in particular through the elaboration of clinical and personal patient data it could be possible to extract valuable insights that may became attractive for many and diverse stakeholder.

The last stated barriers are “Bureaucracy”, “Lack of infrastructure”. Referring to bureaucracy it has been emphasize the complexity in creating and then commercializing telemedicine solution due to the time constraint that is needed for the Italian public administration in elaborating documents and certifications. While the lack of infrastructure is related to the low level of internet connection which impede a proper service effectiveness and in the worst case it limits the spread and adoption of this new way of clinical service delivery.

At the contrary of the barriers, benefits mentioned by the companies are several with differences according to each specific solution implemented.

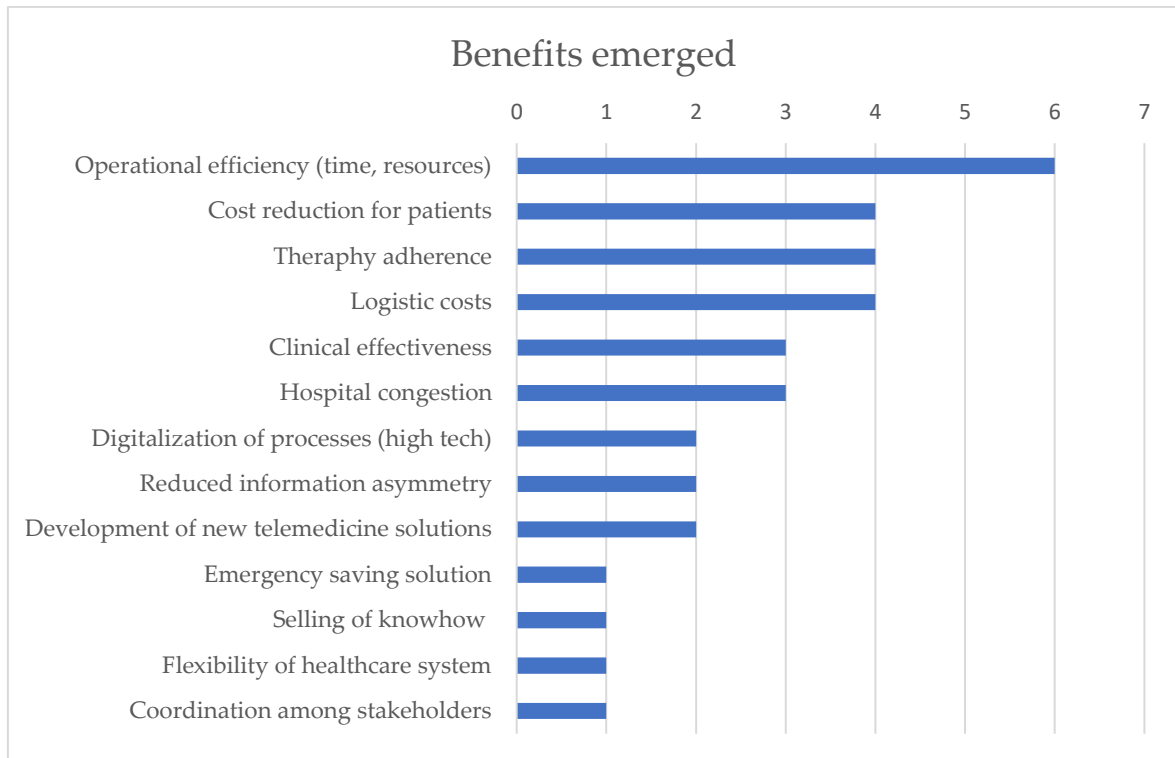


Figure 29: Benefits from realization and commercialization

“Operational efficiency (time, resources)” has been stated most of the time. It came up from all the B2B solution as a prove that telemedicine not only create advantages for patients, but it has effects even on hospitals and other sector as the insurance. The principal reason relies on the possibility to enhance organization of work in terms of time losses, resource allocation, space optimization that overall have a relevant positive incidence on clinical processes. The same reasoning can be elaborated referring to the benefit “Cost reduction for patient”. The majority of the company referents have mentioned this benefit observing that patients get the main advantage in time saving and cost per unit of medical service. Always related to patient “Logistic costs” has been remarked for half of the company highlighting the clear cost travel saving due to the opportunity to meet the doctor, the nurses or being monitored from any place. A critical benefit emerged is “Therapy adherence”. Especially those B2C companies have found a key role in patient engagement through the telemedicine. Indeed, the fact of being strictly and periodically followed by means of appointments, tele-visit and tele-monitoring, permit a major adherence

to therapies and therefore excellent clinical results. As a consequence of these initial benefits just described, “clinical effectiveness” and “hospital congestion” are clearly outcomes stem from operation efficiency and therapy adherence. Finally, there are single benefits which have been noticed just few times from companies, but they encompass interesting thematic as “Coordination among stakeholders”, “Flexibility of healthcare system”, “Reduced information asymmetry”, “Emergency saving solution” and “Digitalization of processes”. Coordination among stakeholder has been cited by the companies referring to the capability of improving the relationship not only between doctors and patients, but even among external actors. Instead, flexibility means both the capacity to make the healthcare system more resilient when coping with extraordinary events like a pandemic and the capability to cope with a wider range of patient clinical situation and behaviour. A very peculiar benefits has been discovered by Pazienti.it which thanks to the possibility to consult their forums patients can find insights about diseases generated by previous patients and specialize doctors. Finally, Zucchetti declared the opportunity to exploit telemedicine as a pioneer to make healthcare processes increasingly digital through technology available. All of these aspects will be elaborated in the following chapter.

6.2 Business model analysis

The first business model dimension analysed is the one regarding the customers of the companies, namely who are the subjects paying for the solutions offered. Even at this stage, the connotation of the terms “B2C” and “B2B” channels is the one explained in the paragraph 2.1.2. The majority of the organization, six out of nine, is merely active in the B2B, counting among the most frequent clients ASL, public hospitals, private and public clinics. Regarding the three companies selling also to final users, CSP, Ultraspecialisti and Pazienti.it, the last two correspond to the ones offering only discrete solutions. For what concerns CSP instead, the company representative stated that its B2C customer segment is not so developed, and this is due to the high purchasing costs of telemonitoring services for final users. Another interesting insight emerged from the interviews is the willingness of companies active in the B2B channel to expand their audience, also involving provision of telemedicine services directly to patients and doctors. Therefore, moving to a B2B & B2C reality.

Regarding the methods through which those clients are required to pay the offered services, a clear correlation between them and the type of customer involved emerged. Indeed, in the B2B channel the main revenue streams are represented by

licensing fees related to the platform and purchases with the Software as a Service modality, if the clients are private organizations. In case of public partners instead, the source of income consists basically of public tenders. For what concerns B2C, pay per use is the only modality currently in place.

About the eventual presence on the platform of other revenue streams than the one of telemedicine, seven companies out of nine have denied this possibility. Pazienti.it instead stated that an additional source of income is the one associated with partnerships aimed at realizing editorial plans for disease awareness and patient engagement on the platform. Ultraspecialisti developed vertical websites of content marketing subject to sponsorship, and therefore not really an additional revenue stream present on the platform. What has been declared in unison and sharply is that there are no firms that exploit source of revenue such as data trading and advertising on the telemedicine platform.

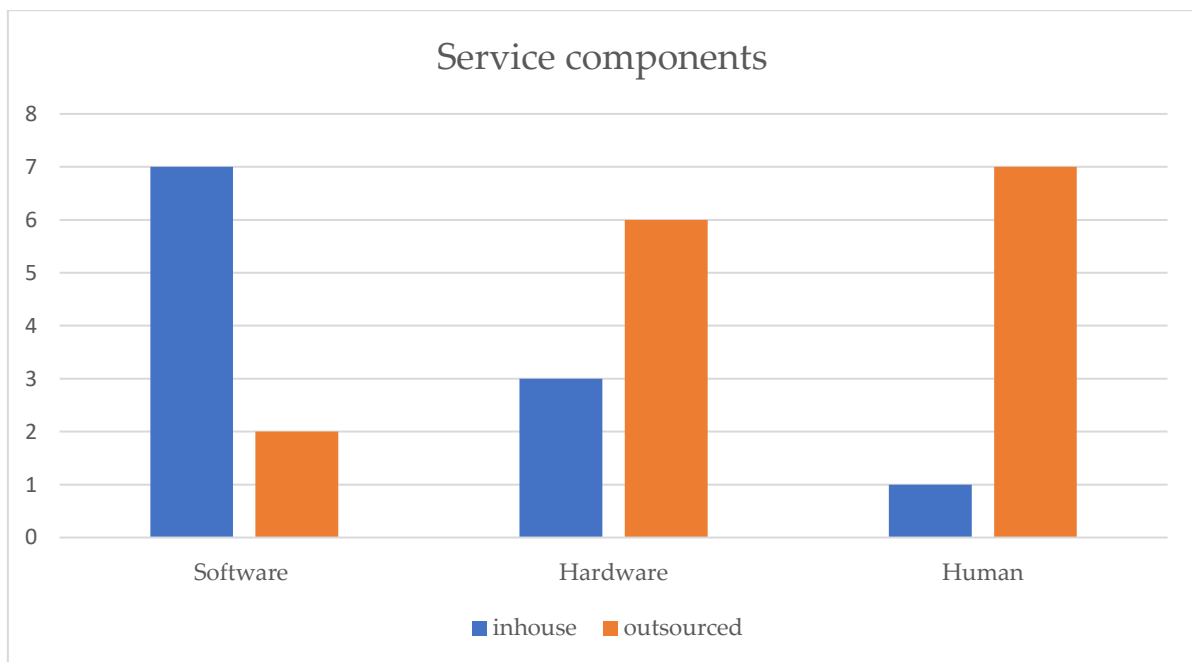


Figure 30: Components of the offerings of the companies interviewed

In this paragraph it will be described the actual state of the main service components that constitute the whole telemedicine service, providing an indication on what are the key resources of the different companies. The above graph has been realized with this aim, depicting the number of companies that provide each element of the offering portfolio and if those are produced inhouse or obtained through

outsourcing. In case some of the organizations resort to production for a part of the resources and sub-contracting for another part of the same category (e.g., two different kinds of hardware devices), the companies have been included and counted in one or the other side depending on the relative weight of the two different components for the final service provision. In the previous chapter it has been individualized three main components with which a company is able to deliver most of its services. From the graph it is clearly visible two opposite paths. The majority of companies being B2B are specialized just on the software component which is the core value for the usage of high technology tools. Some of them are starting to integrate advanced hardware components to render more complete the service. Just one company chooses to have the human component, CSP, which is represented by general doctor or expert. In this case it is evident that the final customer can be just patients and private company as insurances. In fact, in that case the company is also a B2C. Therefore, companies usually decide to give in outsourcing the resource which is part of the service but at the same time it can become even a further customer enjoying the platform with distinct revenue share deals between the company and the human component. Regarding the hardware it appears to be a fifty-fifty situation. On one hand companies that have decided to develop its own medical devices to create a close environment with the software or selling them creating another income source. On the other, companies that decided to verticalize their businesses just on software which perhaps is able to pair and exchange data with all commercial devices.

6.3 Pandemic influence

In this chapter it will be reported similarities or differences about the impact of the pandemic on the companies' business model.

Unlike other companies, for Enel X and Healthy Replay the pandemic has given the chance to make a big step forward for developing new solution starting from nearly zero. In fact, CSP, GPI, Ultraspecialisti have had a positive effect for their revenue stream, but they already had all the solutions operative. Ultraspecialisti declared higher competition after the spread of the pandemic, because of the birth of several new start-ups, but it was prepared to face this type of problem even thanks to solutions dedicated to slightly different patients, who were for instance penalized by overcrowding in hospital, supporting them remotely on the platform. Pazienti.it had an increase on number of visitors and consequently an increase of patients engaged on platform. AbMedica, before the pandemic, had all the solution already mature, but their applications were limited to experimental field as pilot projects or

research projects. Therefore, the applications were properly designed but the commercialization was not possible due to the lack of customers. After the pandemic AbMedica found the market space for selling telemedicine solutions to public and private companies. For Zucchetti the pandemic has played a role in delineating the future standards for healthcare system integration. Apart from the evident growing of awareness on telemedicine, Zucchetti wanted to stress the change on data handling legislation.

For what concern the future development of telemedicine sector there is a convergence towards the idea of a bright future for telemedicine if some conditions will occur. One of those is the how much the government is going to invest both in term of money and of legislation. According to most of the companies' referents, public tenders are going to be needed in the next future to sustain the progress of the actual main actors but at the same time a clear and complete legislation will be indispensable to create a solid ecosystem. A remarkable position about future development of the telemedicine role has been expressed by AbMedica and Zucchetti. The former foresees that all the healthcare services that do not require urgent or complex response will be delivered through telemedicine rather than in hospitals facilities. Zucchetti expect the birth of considerable number of vertical solutions which will need a central node responsible for coordinating the large service offer and managing the data more efficiently and effectively. Zucchetti is trying to conquer the central role s a principal coordinator for all the single solution, because it has his main competence in developing software for the managing of data.

7 Discussion

After having described the telemedicine background from a theoretical and contextual perspective, portraying the history of e-health in general and then focusing on the Italian national healthcare system and the telemedicine development in Italy, a literature review has been performed. It was carried out examining the papers obtained as output of a keywords-based query made through Scopus. The review, that is intended to deepen the state and features of healthcare multi- and two-sided platforms, revealed a deficiency of research studies and awareness about this topic in Italy, that is the area of interest of this thesis. Consequently, the scope of analysis has been changed, moving to the empirical one. Indeed, an analysis of the main healthcare platform solutions currently present in Italy has been conducted, disclosing however that at the moment there are no relevant multi-sided platforms in use and on the market such as those dealt with in the publications reported in the chapter 1.2. "Multi-sided platforms". The solutions that come closest to this topic are telemedicine platforms, that acquired increasing relevance and growth in Italy because of the recent government initiatives and resources allocated. The focus of the thesis therefore shifted to the business model of telemedicine platforms. After having described the main organizations offering such solutions, the work proceeded with the interviews of some of those, with the aim of reporting the main findings about their features and business model.

In this section, these findings will be discussed, taking into account also what emerged from the literature review, with the aim of making a complete overview of what is the current state of telemedicine platforms in Italy and what future developments might be.

With regard to the range of services, tele-monitoring e tele-visit proved to be the much more offered than the others. As already explained, this predominance may be motivated by the central role that they play in generating benefits for healthcare operators and value for patients on the medium and long-term. Indeed, in addition to increase efficiency reducing logistics costs and boosting process optimization for doctors, those solutions allow to provide a comprehensive health service to patients, also enabling predictive analysis in the case of tele-monitoring. Moreover, those solutions entail more complexity, requiring articulated systems that permit the good outcome of the service. All this may have influenced clients' demand, raising

their willingness to buy tele-monitoring and tele-visit solutions, and as a consequence driving companies to specialize on them.

The structure of the solution package described above outlines the typical kind of interaction between the users of the platform, too. Indeed, the widespread presence of tele-monitoring among the offered services implies for the majority of telemedicine companies the establishment of a continuous interaction between the two sides of the platform, that usually extends over the medium and long term. The general trend, both on telemedicine organizations and clients' side, is therefore that of considering telemedicine as a valuable process able to create benefits engaging patients during all the therapeutic pathway, from the taking charge to the follow-up. Anyway, also the services that consist of "one shot" interaction (such as tele-visit, tele-consulting, etc) will have a relevant role, especially if repeated over time, in a future scenario in which they can serve as the favourite options for routine visits and non-urgent and uncomplicated medical cases. Therefore, a positive trend may be expected also for these solutions.

Other topic which certainly deserves further evaluation is the one related to data collection. From the interviews conducted it emerged that value capture based on user-data is still at its early stages, since all companies declared that no commercialization of data occurs on the platforms. The organizations that confirmed the employment of data generated by the users of the platforms revealed that the main use is the one aimed at improving the solutions offered and internal processes. Therefore, it is possible to state that the strategy used to capture value is the one of e-ethnography. Indeed, it is necessary at this point of the discussion to integrate the findings emerging from the interviews with the knowledge collected through the theoretical overview on multisided platforms. Even if the current Italian telemedicine platforms cannot be properly classified as multi-sided platforms, since for instance cross-side network externalities are not emerged clearly, they may fall into the category of transactional two-sided platforms. But as predicted by some of the respondents, there is great potential to extrapolate profits from the large set of processed data resorting to data trading. Indeed, there are several players that could attach great value to that information and thus trigger significant demand flows, such as pharmaceutical companies and research institutes. Whether user-data can become a direct revenue generating asset depends very much on the compliance with future regulations about data protection, and this applies especially in a sector like healthcare that involves very sensitive data.

The digital divide and regulatory are going to be the keys factors for the future telemedicine sector. As reported in the findings chapter, nowadays digital divide,

which comprehend the existent gap between who has access to digital technologies and who has not, is very largely diffused. For what concern the Italian landscape, the principal causes are underdeveloped telecommunication infrastructures and lack of competence for both sides of platform's users. In fact, if on one hand patients were expected to be unprepared for the usage of digital technology, on the other hand even doctors are reluctant to the adoption of digital devices. This tendency is going to certainly decrease with the entrance of younger generation, but there are promising results nowadays. Most of the patients and doctors who made use of a telemedicine service have enjoyed the experience and obtained successful clinical results. This could mean that patients would just need to be encouraged at the change in order to experience all the real advantage of these services. Although the central government has done big leaps forward in term of regulatory, there is still large space for improving market rules. Indeed, telemedicine has considerable potential to create value and thus to increase the whole economy around the healthcare. This value can be exploited if and only if there will be investments focused on clarify some pillars around the telemedicine as prices and standardization of information and data management. Another relevant aspect point out from the findings is the GDPR topic. It is very stringent due to the confidential information that are handled by telemedicine services. However, the authorization to manage and work on those sensible data would unlocking a huge potentiality for telemedicine companies both to deliver state of art clinical service and to discover new revenue streams. These statements are validated by the results of the literature analysis. In fact, several articles described the importance of data management as platform business model centrality.

Great light should be shed on the variety of different benefits that came up from this research. The benefits, at the contrary of the barriers, have an impact on more than two sides of the platform. In fact, in this case even hospitals enjoy relevant benefits. This reinforces the usefulness of telemedicine, which has some hurdles to be overcome yet, but it delivers a series of benefits for every actor on board. Hospitals seems to obtain most of the advantages; therefore, it means that government will see a great money return. The money return is represented by operational efficiency, clinical effectiveness, hospital decongestion, digitalization of processes, flexibility of healthcare system and development of new telemedicine solutions. Telemedicine could be a serious answer to the biggest future issues of healthcare as lack of doctors, lack of resources, customized care, and higher future demand due to demographic reasons. Those trouble are also mentioned in the literature and digital platforms are described as potential solutions. Even though as it is now, telemedicine is not a mature platform on which several stakeholders can interact, but it has all the potential to elevate healthcare to an advanced market on

which various sectors can join and from them generate remarkable positive effects for healthcare system.

Analyzing now closely the business model, interviews reflected that key-customers are predominantly represented by other healthcare actors and organizations, such as ASL and hospitals. In few cases, namely when the companies just offer “discrete” solutions like tele-visit, the only customers turned out to be final users. It is possible to hypothesize a double trend for the future of telemedicine sector: from one side, the companies born to offer through the B2B channel more structured solutions, maybe because initially possessing the required technological know-how and resources, are expected to operate also in the B2C, as declared by their representatives and along with an increased awareness of telemedicine in the society; on the other side, firms serving solely patients and doctors will likely take the opportunity of high volumes of demand by health authorities, public and private clinics to embrace also the B2B market. So, to sum up, an overall convergence trend towards B2B & B2C could be envisaged.

Focusing now on the modalities used by clients to pay for the offered services, it can be seen that the main revenue streams are the classical ones used for technological services and products such as software. Of significant importance are public funds, that will make the difference in terms of resources for telemedicine platforms in the short and medium term. Indeed, those companies are not yet able to systematically bring on board of the platform private stakeholders that can guarantee relevant sources of income.

The above aspect is also linked to the presence or not of additional revenue streams apart from the ones related to telemedicine. The interviews showed that they are almost absent, highlighting a business model that is solely confined to telemedicine boundaries. However, as already explained dealing with the theme of data, there could be the opportunity to open the access to other income streams like advertising, especially with the eventual increase of B2C audience on the platform.

The service components trend shows that nowadays the majority of the companies are specializing just on software and hardware components of the telemedicine services. While the human component, which is made up by healthcare personnel as physicians, nurses, or specialized doctors, is left outside the service mostly to hospitals and clinics. This tendency is going to increasingly create platform solutions available for both final customers and other businesses. Therefore, telemedicine companies specializing on just software and hardware are going to compete in B2C and B2B markets by offering the digital platform ready to be operational in hospitals, clinics, polyclinics and in the future even in other sectors

as pharmaceutical, universities, etc. In this way a telemedicine company will have the opportunity to focus only on the development of the best software solution and leaving the human components to the healthcare facilities which have already the organizational structure to manage properly human resources. The hardware component will maybe not a crucial service component since the software is going to be programmed for being able to connect and interact with any medical devices. The latter at the same time are going to be standardized to the ultimate technology available on the market in order to make them pairable with software.

The future of telemedicine platforms seems to be bright in Italy, leveraging a business model that is sustainable and scalable, but for it be so a clear and supportive stance from the government is needed, through fundings and transparent regulations. The latter is essential to protect healthcare data, that is paramount being data leakage socially unacceptable [85], and at the same time to unlock the real capability of such a platform. In addition, a massive enhancement and modernization of telecommunication facilities are more than required to cope with the infrastructural lack that affects Italy (in this perspective, great impact will have the “Digital Agenda for Europe” and the Italian “Ultra-broadband strategy”). The aforementioned factors can also be the enablers of that change of culture that is so demanded by the interviewed companies, but obviously it is a long process that requires time and effort. A cultural change that will be needed to initially face and then embraced new interactional forms between health professionals and patients which may reconfigure roles and responsibilities as well as wider structures of digital society [86].

8 Conclusions

Despite the previous considerations, there are further insights worthful to be extrapolated by future research. Moreover, there are some limitations regarding the present study that can be overcome with additional development.

Based on what has been investigated in this study, it has been noted that the telemedicine sector is a premature market. This is evident by the age of all the realities interviewed. Some of them were born two or three years before the pandemic, but all of them were modest entities with a small number of customers and the service delivered to them was limited to pilot projects or just to do testing. Only after the pandemic the market started to grow with the consolidation of some companies. Although the market has been regulated in terms of law and the awareness among the final users has risen significantly respect to the early days of telemedicine, the market is still in an initial phase where every day young startups continue to be born, legislation has still relevant lacks concerning the prices and data management and finally the potential users are growing in awareness towards the digital medicine. Therefore, it would be interesting to repeat the study in the next future in order to catch further potential developments of telemedicine services and their stakeholders.

Same reasoning can be applied on the Italian literature status of digital multisided platform in healthcare. This is probably a consequence of the first steps that digital platforms are making in Italy, and it suggests reviewing the literature in the next years to evaluate thoroughly the characteristics, the benefits and all the main features of telemedicine future.

Another possible limitation can be found in the empirical analysis, where not all the existing companies have been interviewed thus it has affected the completeness of findings collected. In case of complete availability to interview all the companies in the Italian market there would be more insights to be processed therefore it would give the chance to compare different applications of telemedicine. Consequently, a more complete analysis would have permitted to study the actual business model features with the possibility to delineate a future business model convergence and thus anticipate where the competition would have been. However, since the sector is in full development it could be worthful to analyze the same companies in a few years to monitor where the evolutions have appeared.

Interesting research about the role of digital platform in healthcare could be performed by changing the point of view of the study. It has been examined the business model status of telemedicine by taking the point of view of the platform, which it has been applied by interviewing the digital platform creators. Another way to find out new traits, attributes of them could be take the role of the stakeholders. Therefore, trying to assess the telemedicine market from all the possible stakeholders, as pharmaceutical companies, patients, universities, government, insurance and so on, point of view could highlight new surprising elements which otherwise would not be possible to discover.

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