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Can We Enable Digital Transition in Healthcare Delivery?

Insights From a Survey of Telemedicine Services in the Piedmont Region

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ABSTRACT

Implementing digital health transition is challenging. Whilst technology progresses rapidly, the appropriation of innovation in healthcare is slower and has to deal with the local context. This is the case with Piedmont, an Italian region where in the last decade a number of telemedicine projects have been launched. In order to assess their implementation a survey has been recently conducted by the regional Health Department. This work builds upon the results of this investigation. The conceptual approach underlying the survey is illustrated and the main findings of the investigation discussed. To examine the regional situation, a notion of telemedicine maturity model is used. By making it explicit the main dimensions entailed in developing an ehealth service, its application can facilitate the digital health transition in the region. A core argument is that to handle the complexity of ehealth projects a collaborative environment for exchanging health knowledge should be implemented.

KEYWORDS

Ehealth, Ehealth Maturity Level, Health Knowledge Exchange, Healthcare Organization, Monitoring, Regional Healthcare Governance, Socio-Technical Systems, Telemedicine Benefits and Barriers

INTRODUCTION

Telemedicine is the use of ICT to improve patient outcomes by increasing access to care and medical information. Many definitions of telemedicine have been given. They reflect the evolving links between advancements in technology and healthcare (Vesselkov, Hämmäinen, & Töyli, 2018) and the changing health needs and contexts of societies (WHO, 2010).

According to the World Health Organization, telemedicine is: "The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities" (WHO, 1998, p.1).

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In Europe, the notion has gained popularity since 2008 when a communication by the European Commission urged Member States to: a. assess their needs and priorities in telemedicine; b. include these priorities in their national health strategies; and c. address issues such as accreditation, liability, reimbursement, privacy and data protection in order to enable a wider access to telemedicine services (European Commission, 2008; European Commission, 2018a; HISMSS Analytics, 2018)).

Telemedicine is part of ehealth, a field established in the Fifty Eight World Health Assembly (2005), which defined it as "the cost-effective and secure use of information and communications technologies in support of health and health-related fields, including health-care services, health surveillance, health literature, and health education, knowledge and research" (World Health Assembly, resolution WHA58.28, 2005, p. 109).

Viewing telemedicine in the ehealth wider perspective has motivated two reflections.

The first summons a higher-level view and highlights the importance of telemedicine, as an ehealth component, to support a public health system achieving the goal of universal coverage. The issue belongs to longstanding discussion on how to improve the efficiency and financial sustainability of healthcare systems, while enhancing their effectiveness and ability to meet social needs (Kutzin & Sparker, 2016). By improving health functions and strengthening control knobs, ehealth offers new potential for reforming how the health system actually operates.

This is a major concern of the European Commission (2014) who called for actions to focus on:

- Strengthening the effectiveness of health systems (through health systems performance assessment, integration of care and improvement of patient safety and quality of care);
- Increasing accessibility of healthcare (through transparent criteria for access to medical treatment; better planning of health workforce, cost-effective medicines, integrated models of care);
- Improving the resilience of health systems (through stable funding mechanisms, Health Technology Assessment, ehealth based information systems).

The second reflection is more focused and deals with how telemedicine projects can be developed in situated contexts and contribute to deliver healthcare more effectively. Here notions of socio-technical systems come to the fore.

A variety of aspects have been investigated such as: a. the multiple dimensions underlying these systems and how stakeholders' level of awareness would affect their possibilities to be engaged (Clegg et al., 2009); b. the role of discursive practices through which different ways of learning collectively contribute to the realization of telemedicine projects (Nicolini, 2011); c. the opportunity to adopt a design perspective of the telemedicine initiative that supports the evolution of health needs and contingent characteristics of the context (Gerhard & Herrmann, 2013).

Since the early 2000s, arguments of both streams of reflection have progressively become more prominent in the health policy of many countries, as elderly people with chronic disorders grew in number and financial resources for healthcare progressively reduced.

The increased attention has also made apparent that the introduction, appropriation and use of information and communication technology in healthcare is a complex issue. Failing to recognize it has caused a number of difficulties in putting in practice technology supported healthcare, such as (Greenhalgh et al., 2017):

- The oversimplified account of the conditions in which the project had to be developed;
- The low maturity of the technology and unclear value proposition;
- The inadequacy of organizations in coping with a particular innovation;
- The complexity in the financial, regulatory and legal environment;
- The inability of the program to adapt and evolve over time.

To overcome the implementation problems of telemedicine projects, a valuable strategy can be pursued by connecting these two reflection streams, e.g. linking the experience acquired in individual implementations to more generic problems common in the telemedicine domain (Broens et al., 2007; van Gemert-Pijnen et al., 2011).

This paper is a contribution to address these issues in a regional setting confronted with the need to make its health policy programs more effective.

The study builds upon the results of a survey conducted in 2017 by the Piedmont Health Department to investigate the status of the telemedicine projects.

The discussion is organized as follows.

After an overview of the national and regional -healthcare situation, the conceptual approach underlying the survey is presented. It takes inspiration from the principles of socio-technical design and uses the guidelines of the European Commission and Italian Health Ministry for its operational implementation.

To get deeper insights into the regional situation, an analytical lens based on a concept of maturity models is applied. This approach enables better managing information systems and technology in the healthcare domain (Vidal et al., 2016) and shows how ehealth implementation steps depend on the digital development stage.

The last part of the paper provides some general remarks for facilitating the digital health transition in the region. A core message is that to handle the complexity of (e)health projects a collaborative environment for exchanging knowledge should be built.

BACKGROUND: AN OVERVIEW OF THE HEALTH ORGANIZATION IN ITALY AND PIEDMONT

A National Overview

In Italy, the healthcare is regionally based and provides free of charge universal coverage. In the 1990s, Italy started a drastic reform of the public administration, which gave sub national governments (regions) a greater autonomy in managing public services, including healthcare. Today healthcare is organized in three levels (Nuti, Vola & Bonini, 2016):

- **The national level:** The Health Ministry, Parliament, and Government lay out the national health guidelines and plan (PSN—Piano Sanitario Nazionale) and ensure that the general objectives and fundamental principles of the national health system are met;
- **The intermediate level:** Regional authorities implement the PSN, including independent legislative and economic competences to manage hospitals and appoint health staff;
- **The local level:** Local Health Units are responsible for maintaining relationships with general practitioners, corporatized hospitals who sell their services, and other public and private health structures inside and outside the region.

All the levels are involved in the provision of telemedicine services.

At the national level, the European ehealth and telemedicine recommendations have been promptly taken up by the Health Ministry, who laid out an Italian ehealth strategy and published guidelines for developing these services (Ministero della Salute, 2012).

At the local level, several pilot telemedicine projects have been launched since the early 2000s, although their implementation faced a number of problems.

In additions to the kind of difficulties highlighted by Greenhalgh et al. (2016), three factors were particularly impeding in the Italian context: variability in healthcare, regional autonomy in healthcare management, and delay in digital take up.

Because of differences in the clinical factors (diseases and severity levels), unpredictability of certain patient flows, and professional care heterogeneity, healthcare has an intrinsic variability (NHS Confederation, 2004). Although the health sector is an information and knowledge intensive industry (OECD, 2017), this great variability hampers the diffusion of digital technology.

This intrinsic variability of healthcare also emerges when comparing a few indicators at country level. Compared with other European countries shown in Table 1, for example, Italy turns out to be more demanding in terms of healthcare needs because of an ageing population. This is putting serious stress on healthcare organizations with some of them being unable to guarantee effective services, such as adequate duration of hospital stays or appropriate frequency of diagnostic exams with the appropriate technology. This may increase inequality among the population.

Regional decentralization of health service provision in 2001 gave local health units new potential for healthcare delivery. It created favorable pre-condition for developing contextualized ehealth initiatives. In several areas, local health units were able to launch pilot telemedicine projects and test services in real practices. Differences in regional health organization, however, hampered the creation of seamless regions of care (Moruzzo, 2017). They precluded the normalization process necessary for addressing licensing, legal liability, individual data protection, and reimbursement (May & Finch, 2009).

One of the main drawbacks of the decentralization process was a significant variability in local health expenditures. In some regions, this has caused severe budget imbalances which threatened the economic sustainability of the national health system.

To improve the situation, in 2004 the central government forced those regions with health spending gaps to adopt a Financial Recovery Plan. This should not only reduce public expenditures but also lay out strategies to improve clinical and efficiency in the healthcare organization. Piedmont was one of these regions.

Today, most financial imbalances have been settled and health spending in Italy is in line with or even below that occurring in most developed European countries, Table 2.

According to the European digitization index, in 2018, Italy ranks 25th out of the 28 Member States, and belongs to the low-performing cluster of countries (European Commission, 2018b). Progress in eGovernment is also slow, in spite of the development of ehealth Services Italy occupies the 8th place among European countries. The national Digital Agenda Strategy 2014-2020 and the National Ultra-broadband Strategy were adopted in 2015.

Table 1. Senior population and features of health organization in Italy and in some European countries

	% 65 Years Old and Over (2017)	Length of Hospital Stay (2016, 2017)	Hospital Discharge Rate for 100000 Inhabitants (2016)	Total Hospital Beds per 1000 Inhabitants (2016)	Magnetic Resonance Imaging (MRI) Exams per 1000 Inhabitants (2016)	Computed Tomography (CT) Exams per 1000 Inhabitants (2015, 2016)
Italy	22,3	6,9	11.671	3,2	67,0	81,0
France	19,2	5,7	18.783	6,0	114,0	204,0
Spain	19,0	5,9	10.423	3,0	83,0	109,0
UK	18,1	6,0	12.770	2,8	57 (*)	85 (*)
Germany	21,2	7,5	25.686	8,1	136,2	143,0

(*) hospital only

Source: health database OECD. doi: 10.1787 (Accessed on 30 January 2019)

Table 2. Health spending in Italy and in some European countries

	Total Health Spending as a % of GDP (2017)	Government/ Compulsory Spending as a % of GDP (2017)	Health Spending Per Inhabitant (Euros) (2017)	Pharmaceutical Spending as a % of Health Spending (2016)
Italy	8,9	6,6	3.542	17,7
France	11,5	9,5	4.092	13,9
Spain	8,8	6,3	3.371	19,1
UK	9,6	7,6	4.245	11,4
Germany	11,3	9,6	5.728	14,3

Source: health database OECD. doi: 10.1787 (Accessed on 30 January 2019)

A Regional Overview

Public healthcare in Piedmont employs about 54000 people and costs about 8 billion € per year (about 1900 € per inhabitant in 2017). Healthcare is provided through several health agencies: 12 Local Health Units with distributed facilities are responsible for the delivery of local health care services (primary and specialist care, outpatient services, public hospitals); 3 University hospitals; and 3 Independent public hospitals.

The regional health priorities are set in accordance with national directives by the Regional Health Plan issued every three years and approved by the Regional Council.

Piedmont was the first Italian region to publish guidelines for telemedicine services aimed at providing long-distance high-quality cost-effective healthcare, along with recommendations for the organization and evaluation of the new services (ARESS, 2008).

In Piedmont, as in other Italian regions, telemedicine projects have developed in a patchy way and failed to be integrated in the overall healthcare system. Lack of a clearly defined legal framework, curtailing of resources imposed by the regional 2010-17 Financial Recovery Plan and the impact of the economic crisis negatively affected its development.

The national telemedicine guidelines (Ministero della Salute, 2012) and health strategy of the 2010s (Ministero della Salute, 2011) gave new stimuli to the development of telemedicine projects. Firstly, they encouraged Italian regions, including Piedmont, to realize the potential value of these services for responding to the care needs of an ageing population increasingly affected by chronic diseases. Secondly, they provided a common framework for service implementation, including a reference architecture and assessment indicators. Finally, they recognized regions as legal entities entitled to accreditation, delivery and management of these services.

In 2015, Piedmont acknowledged the national telemedicine guidelines, paving the way to the integration of telemedicine services in the regional healthcare system.

To give some clues about the context in which the digital health strategy as well as telemedicine services will have to operate, a few indicators are shown to compare Piedmont with the neighboring European regions: Vallée d'Aoste, Liguria, Lombardia and Emilia-Romagna (in Italy); Rhône-Alpes, Auvergne and Provence-Alpes-Côte d'Azur (in France). Although not close to Piedmont, Auvergne has been included as it has been recently joined with Rhône-Alpes.

Selected from the available official statistics, the indicators give a coarse comparative outline of the regional socioeconomic, health and digital profiles.

The health data reported in the Eurostat Yearly Book 2018 (Kotzeva, 2018) provide an overview of the main health problems. They show that chronic diseases are the leading cause of disability and death in the EU28. During the period 2013 to 2015, they accounted for more than half of all deaths in the EU-28 with a combined death rate of 548.8 (Kotzeva, 2018, p. 44). The lowest death values

were recorded in the French regions. With a 5014 value, Piedmont was one of the Italian regions where the burden of chronic diseases was highest.

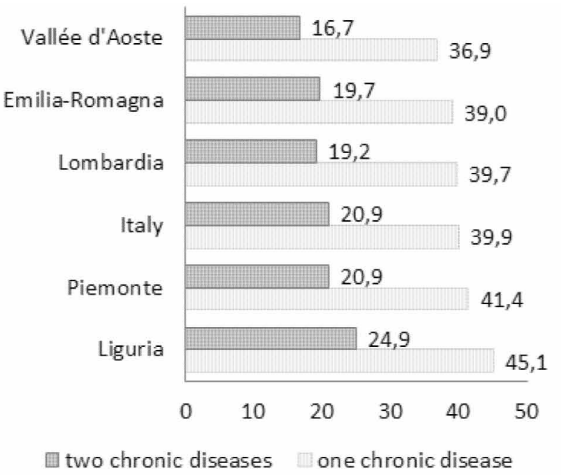
In Italy, 4 out of 10 people are affected by a chronic disease and half of them suffer from more than one (see Figure 1). As for the selected regions, Piedmont is the region were the share of people affected is the greatest after Liguria.

A report by the Osservatorio Nazionale sulla Salute (2018) highlights that yearly primary care is most costly for patients affected by congestive heart failure (€1.500), ischemic heart disease (€1.400), Type 2 diabetes (€1.300), osteoporosis (€900), and hypertension (€864).

The socioeconomic indicators in Table 3 reveal that Piedmont is less densely populated than most of its Italian neighbors; its economy is weaker, the population older and less educated. Most of these differences hold true when comparing the Piedmont situation with the French regions.

The health profiles, as measured by the per-capita distribution of health resources (hospital beds, doctors, pharmacists, nurses and midwives) are relatively homogeneous across the areas of the two countries. Major differences between the Italian and French regions come out for the number of hospital beds and of nurses and midwives, Figure 2.

Figure 1. Percentage of population affected by chronic diseases in Piedmont and neighbor Italian regions (2017). (a) % of population with one and two chronic diseases. (b) Prevalence of chronic diseases (*)



(a)

	Hypertension	Arthrosis, Arthritis	Allergies	Osteoporosis	Chronic Bronchitis	Diabetes	Nervous System Diseases	Heart Diseases	Duodenal/Gastric Ulcer
Liguria	20,1	22,6	11,1	9,7	6,6	5,5	5,6	4,2	2,5
Emilia-Romagna	15,9	17,3	8,9	6,2	4,6	4,4	4,5	4,0	3,0
Piemonte	18,1	16,1	9,6	6,6	6,4	6,0	5,1	4,5	2,4
Lombardia	17,7	14,1	10,8	7,3	5,5	4,7	3,8	4,4	2,4
Vallée d'Aoste	14,1	13,1	11,6	5,2	6,5	3,8	4,0	3,1	1,9
Italy	17,8	16,1	10,7	7,9	5,9	5,7	4,5	4,1	2,4

(*) The squared cases are the diseases which in Piedmont had the greatest increase since 2013

Source: Istat multiscopo

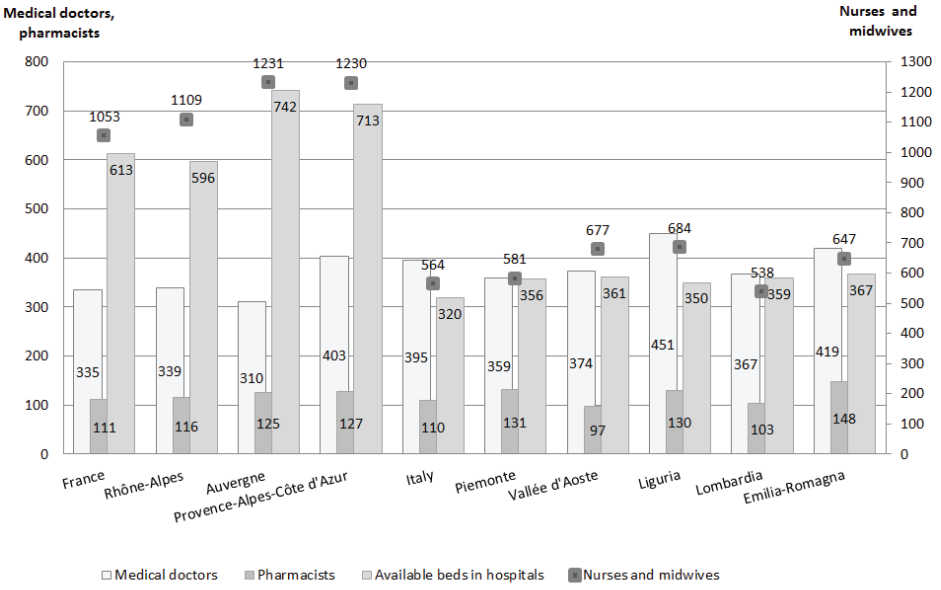
(b)

Table 3. The socioeconomic profile of Piedmont and its neighboring regions (*)

	Population Density 2016 (Inhabitants/ Square km)	GDP per Inhabitants 2016 (Euros)	Persons with Tertiary Education 2017 (% of Active Population)	Median Age of Population 2017
France	105,5	33.300	38,2	41,3
Rhône-Alpes	149,1	32.800	41,2	40,1
Auvergne	52,3	28.300	30,7	45,6
Provence-Alpes-Côte d'Azur	161,3	30.800	38,8	43,9
Italy	203,6	27.700	21,2	45,9
Piemonte	174,9	29.400	19,6	47,9
Vallée d'Aoste	39,2	34.900	19,1	47,1
Liguria	290,0	30.800	21,7	50,3
Lombardia	434,5	36.600	22,5	45,9
Emilia-Romagna	201,4	34.600	22,4	46,9

Source: Eurostat

Figure 2. Distribution of healthcare resources in Piedmont and in neighboring regions, 2016 (hospital beds refer to 2018) (numbers of units for thousand inhabitants)



Source: Eurostat

Examining the regional digital profiles, as accounted for by conventional ICT indicators, such as broadband diffusion and access, shows that country differences exist as well. Overall, the digital profile of French regions reflects a more advanced stage of digitization than the Italian areas, Table 4.

For all the indicators, furthermore, Piedmont ranks worse than the other Italian regions taken into account (except Vallée d'Aosta). The gap also emerges when comparing the indicators accounting for the implementation and use of Electronic Health Records. Piedmont is among the lagging regions.

Table 4. The digital profile of Piedmont and its neighboring regions

	Percentage of Individuals				Percentage of EHR users (*)			
	Households With Broadband Access (%)	Frequency of Internet Access: Daily	No Use of Internet	Individuals Who Used the Internet for Interaction With Public Authorities	EHR Implementation Index	Citizens	Doctors	Local Health Units
France	81	70	8	71				
Auvergne	80	69	10	67				
Rhône-Alpes	80	71	8	72				
Provence-Alpes-Côte d'Azur	81	72	7	73				
Italy	83	68	19	24				
Piemonte	84	71	17	25	60	1	32	6
Vallée d'Aoste	80	68	16	29	98	54	100	31
Liguria	85	76	14	25	86	1	0	0
Lombardia	86	72	14	28	100	56	100	100
Emilia Romagna	88	74	13	29	99	13	100	59

(*) In January 2019, 16 Italian regions (out of 21) have adopted the electronic health record (although only a minority of them for all health services).
Source: A. Eurostat, 2018. https://www.fascicolosanitario.gov.it/ accessed January 2019. HER: Electronic Health Record

DESIGNING THE TELEMEDICINE SURVEY

With the aim of meeting the requirements of the national telemedicine guidelines, in 2016 the regional public health authority decided to survey the implementation stage of telemedicine projects in Piedmont. A questionnaire was sent to the regional Local Health Units to collect data.

It was designed to help: a. the researcher, for whom the questionnaire was an opportunity to explore, in practical cases, constructs from socio-technical system health studies; and b. the administrative staff who viewed the questionnaire as a means to comply with compulsory administrative requests by national health department.

In the following, we first outline the conceptual underpinnings of the questionnaire and then illustrate how they have been translated in the investigation protocol.

Conceptual Underpinnings

Literature about e-health and telemedicine has progressively accumulated over the past twenty years and an idea of its accomplishments can be grasped from the recent systematic reviews by Bongiovanni-Delarozière & Le Goff-Pronost (2017) and Greenhalgh et al. (2017).

A telemedicine service is associated with a socio-technical system, e.g. a system where outcomes emerge from interaction of people and technologies. The most obvious benefit is that through improvements in user usefulness, it increases access to care by making examination, consultation, and education available at hands. As pointed out by Diamantidis (2017), the service involves a transition from of the traditional "you come to us" to a "we'll come to you" healthcare delivery approach.

For Friedman (2009), at the heart of a health socio-technical system is a concept according to which a person "in partnership with an information resource is better than that same person alone". This is a core theorem of social informatics for which the following corollaries must be substantiated: a. information resources must ultimately be built for the benefit of people; b. they must be correct, and c. be able to increase users' knowledge. The last corollary consequence is maybe the most intriguing

as it acknowledges the fact that the success of the application of the theorem depends on person-information interactions whose results cannot be predicted in advance.

The unpredictability of these interactions is an intrinsic feature of the complexity of healthcare system and has been recognized since the early 2000s. To guide the active design of health services, for example, Coiera (2004) suggested a few rules:

Rule 1: Technical systems have social consequences: introducing a technology into a setting affects not only the target users but also the people surrounding them.

Rule 2: Social systems have technical consequences. Humans relate to the world with social rules and values and use these same rules to judge and interact with technologies.

Rule 3: We do not design technology we design socio-technical systems. If the social and the technical components are inseparable, the design of technological systems needs to include social structures, and entail innovation in clinical roles, work processes, and culture change.

Rule 4: To design socio-technical systems in a proper way, we must understand how people and technologies interact. In particular, attention should be paid at peoples' health, human cognitive limits and workloads.

To cope with the complexity of healthcare system, a system model approach is recommended (Carey & Crammond, 2015). This is also the case for telemedicine. On the informatics ground, it has been suggested (Kamsu-Foguem, 2014) that to design the service three different but complementary aspects are entailed:

1. The functional aspect which enquires what the service does (is expected to do) in its environment;
2. The structural aspect which describes the arrangement of its components;
3. The behavioral aspect which is related to the evolutionary nature of the service, e.g. to its history and organizational capability.

Furthermore, it is emphasized that combining insights into these aspects allows us to grow our understanding of how to develop a telemedicine service.

In relation to the sociological domain, a relevant but still open question is how a telemedicine practice becomes doable in specific institutional setting. In this respect, May & Finch, (2009) argue that several processes are involved and deserve attention:

- A set of ideas about the meanings, use and utility of the (new) service should be grown up;
- Different actors should be enrolled, paying attention at the factors that inhibit or promote their participation as an individual or a collective organization;
- The outcome of the service functioning should be evaluated on a regular basis, by judiciously combining communal appraisal (formal monitoring patterns) and individual appraisals (experiential practices of judging the value of a practice).

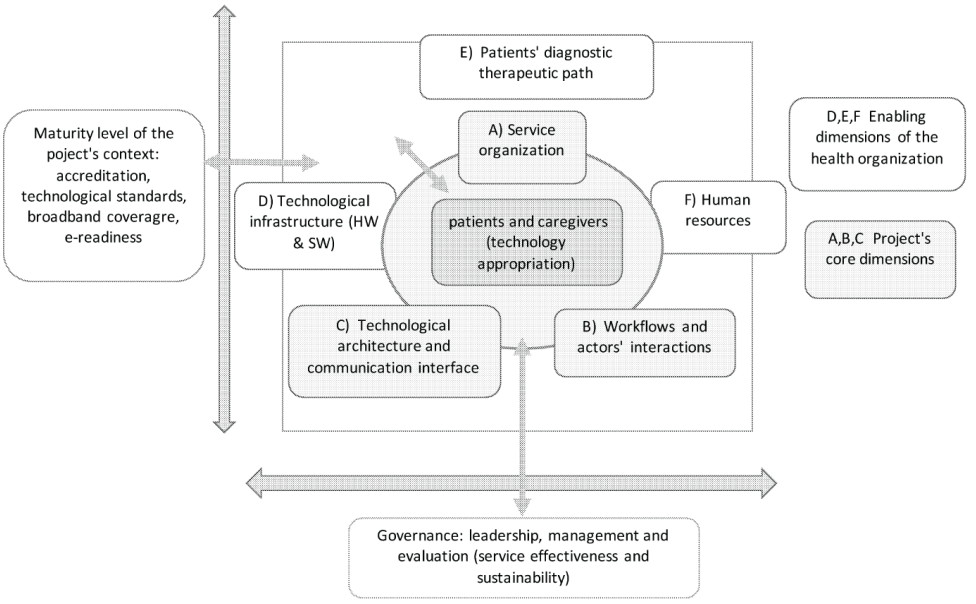
Given the survey's goal, the design of the questionnaire mainly focused on the structural aspect of a telemedicine service.

A conceptual framework, based on the research by Broens et al. (2007), Sittig & Singh (2011), and Taylor (2015) is used. The scheme in Figure 3 graphically represents it.

The scheme shows that patients and caregivers are at the core of a telemedicine service. Although not explicitly mentioned, patients' acceptance and appropriation of the technological devices are additional aspects not to be neglected (Moores, 2012; Cook et al., 2016).

The scheme distinguishes four major components that provide internal and external observation focussed on a telemedicine service.

Figure 3. A descriptive scheme of a telemedicine service (Occelli et al., 2017)



The internal observation deals with:

- The health operational unit which has the primary responsibility to deliver the telemedicine service. Main components refer to (see the core dimension in Figure 3): a. how the service is organized and the appointed health staffs collaborate with each other; b. the architecture of the technological infrastructure, types of devices and communication network; c. the workflow for delivering the service, managing its temporal continuity and coping with emergency (Mortensen, 2015);
- The organizational environment in which the telemedicine operational unit operates. To enable its functioning a few conditions are required (the enabling dimensions in Figure 4). For example, attention should be paid at: a. defining appropriate clinical paths for the patients likely to be enrolled in the telemedicine services; b. training courses for the health staff to use the new technology; and c. updating the current information system to comply with the interoperability and privacy standards.

The external observation refers to:

- The level of maturity of the broader context in which a telemedicine project is developed. As pointed out in e-health evaluation studies (Kidholm et al., 2012), the capability of a context to promote innovative-oriented changes is a fundamental pre-requisite for the implementation success of the new service. This capability results from a variety of factors, such as the institutional and normative service liabilities, the stage of technological development of an area (broadband coverage and access, diffusion of e-services) and more generally the e-readiness of the resident population (i.e. familiarity with technology, and level of competence in using the Internet);
- The overall governance of the telemedicine service. With this term, we mean the capability of the telemedicine socio-technical system to both assess its own activities and evolve itself as, over time, health needs, care priorities and technology change. Several activities are involved

such as: engaging local stakeholders in the improvement or innovation of the service making the service more widely known, by advertising it among the resident population; and including it in the activity program of the health care unit, overseeing the functioning of the service by monitoring and assessing its effectiveness and performance (Hammerschmid & Jones, 2012).

Since healthcare services involve complex interactions among various stakeholders, a main undertaking is to analyze how the introduction of telemedicine modifies these interactions (van Dyck, 2014). The value of the changes in these interactions is what needs to be assessed. As pointed out in the previous section, it requires a systematic account of the various factors affecting the interactions, without neglecting the conditions of the context. To carry out this activity, therefore, a comprehensive approach is advocated.

The Questionnaire

Inspired by the conceptual framework of Figure 3, the questionnaire takes advantage from the analytical insights provided by international studies (Kidholm et al., 2012; Taylor et al., 2015; Telehealth Quality Group, 2016) and makes reference to the guidelines by the Italian Health Ministry (Ministero della Salute, 2012). It investigates the following domains:

1. **General information:** Aimed at building a regional registry of TM services. Collected data includes: name and aim of the project, location, clinical specialty and type of service. The latter is based on the terminology of the national guidelines, which identifies specialist telemedicine (including tele-consultation, tele-reporting and tele-cooperation), tele-monitoring, diagnostics and screening;
2. **Financing:** Financial sources that are used to support the functioning of the existing TM projects in the local health districts. At present, each TM service has to provide its own financing. Getting evidence about this aspect is crucial to assess the economic sustainability of these services;
3. **Technical aspects:** Characteristics of technical equipment (type of internet connection, hardware and software, medical devices, maintenance, etc.) and regulatory and licensing requirements (safety, data protection, regulatory frameworks). Surveying these aspects is important in order to assess to what extent the technical characteristics of TM services meet data transmission/protection standards and are appropriate for the service purpose;
4. **Organization:** It includes the requirements in terms of quality, accountability, safety and effectiveness. The organization of workflow needs to make clearly acknowledgeable who is responsible for the service implementation, monitoring and reviewing (Telehealth Quality Group, 2016). To investigate these aspects the questionnaire asks how the resources and procedures of TM services have been included in the plan and managing procedures of the Local Health Units;
5. **Legal aspects:** See below:
    a. Users' information, that is if adequate information is given to patients and caregivers about the new service and about privacy data requirements (including informed consent as stated by national/regional regulations);
    b. *Ex ante* evidence-based assessment of appropriateness, efficacy and safety of the TM care in comparison with conventional care approaches;
    c. Transparency of the contracting/tendering procedures with external providers (call for tenders, specification documents on the delivery of services and supplies);
6. **Ethical issues:** They are similar to those of conventional medical care. However, the use of ICT raises new concerns about data confidentiality as it also involves personnel outside the health sector, such as DB managers and IT specialists. According to national and international regulation patients must give their consent for using the data generated by the TM procedures. At the time this study was undertaken, personal data protection and privacy were treated according to EU regulation 2016/679;

7. **Information and training:** They concern new competences for healthcare professionals and staff related to the use of digital health technology to enable adaptation of clinical practice and ensure competent provision of telecare services. On the other hand, comprehensive information to users and caregivers can increase their willingness to accept the new care paradigm;
8. **Benefits/critical issues:** They account for perceived benefits and criticalities from the perspective of professionals and staff.

RESULTS OF THE TELEMEDICINE SURVEY

An Overview of the Results

The survey gathered data about 45 telemedicine projects, although 2 respondents did not complete the whole questionnaire (Occelli & Scelfo, 2018).

The main results are summarized in Table 5 and a case study is briefly outlined in the box.

BOX: An integrated telemedicine service for managing chronic heart failure in an urban area.

The project has a high maturity level as it addresses in a satisfactory way all the dimensions investigated in the survey. Particular attention has been paid to ethical issues and privacy.

This pilot project was launched in 2015 by the Ordine Mauriziano public hospital in Turin, the Piedmont regional capital. It involved an ICT research Institute (Istituto Superiore Mario Boella), the local health care Unit (Asl TO1) and the local network of general practitioners.

Its main goal was to test the feasibility and effectiveness of a telemonitoring service for patients affected by chronic heart failure living in a neighborhood of Turin.

The service was designed according to national and international guidelines and was included in the regional clinical pathway for managing chronic heart failure. Moreover, the pilot phase was set up following the methodology of a clinical trial. It included:

- Approval of the study protocol by the Ethics Committee;
- Eligibility criteria for patients' enrollment;
- A procedure for the follow-up of enrolled patients (a 1:1 randomization was adopted; 20 patients in the TM- arm and 20 in conventional care, duration of follow-up: 24 months);
- A selection of key performance indicators to measure the quality of the service, clinical outcomes and cost-effectiveness.

Personal data protection and privacy were treated according national and EU Regulations (D.L. 196/2003; EU 2016/679). Thorough information was given to patients through specific forms on informed consent, on the exercise of data protection rights (EU 2016/679 arts. 15-22), on the security of personal data and on the possibility to notify a personal data breach to the supervisory authority (art. 33).

No significant differences were found in the number of emergency room visits, DH admissions and additional visits. Given that the length of Hospital stay was greater in the TM group, no drops out were observed in the TM group.

Some results were affected by the small sample size, however the pilot phase showed that the TM service was feasible and able to strengthen the patient-GP-specialist relationships which lay the foundations for the continuity of care between the hospital and local healthcare Units.

Insights From the Survey Results: A Maturity Level Approach

To sharpen the analysis of the collected data, an operational approach has been used to provide a synthetic account of the level of implementation of the projects. It refers to a telemedicine maturity model proposed by van Dyk et al. (2013) which consists of three main dimensions:

Table 5. Main results of the survey of telemedicine projects in Piedmont, 2018

Dimension of Analysis	Specific Items	Main Results	Comments
1. General information	Geographical distribution	40% of the projects are carried out by the Local Health Units of Turin metropolitan area	
	Clinical field	Cardiovascular and diabetes are the disease areas where services are more widespread (33% and 12% respectively).	Distribution of the projects by disease areas is coherent with the data about the most prevalent chronic diseases shown in Figure 1
	Type of service	Tele-monitoring was the most prevalent (about 44%) followed by tele-consulting (36%). Remote medical reporting services have the largest catchment area in terms of patients (about 465), followed by specialist telemedicine services (182) and remote assistance (147)	
	Age	The majority of projects (58%) have been existing for at least three years. 24% are 10 years old or more. About one third has been developed in the last three year.	
2. Financial sources	Type of funding	Projects are almost equally supported by national/regional public funds (38%) and private grants (40%) of local donors. Financing is ad-hoc based	The economic sustainability of the projects is not ensured
3. Technical aspects	Digital connectivity and ICT equipment	Digital connectivity services are distributed almost evenly among fixed, wireless and mobile networks. About a third of the projects use a combination of digital network services and a majority has introduced data protection measures	Technological requirements are dealt with on a local basis. Regional/national Interoperability is not an issue
	Data protection and compliance to national/ EU standards	Most of the projects have adopted measures for data protection and comply with to EU/national standard protocols. Half has signed a maintenance contract with a provider and less than a half have established procedures to respond to complaints/ technical problems and guarantee minimal quality levels for the service	

continued on following page

Table 5. Continued

Dimension of Analysis	Specific Items	Main Results	Comments	
4. Organisation	Institutional consolidation of TM service	Only 1 out of 5 projects has been concerned with efforts to include TM service within the management procedures of their Local Health Units.	Most of the projects are stand-alone healthcare initiatives	
	Service quality assessment	Most of the projects (70%) have defined procedures for quality assessment/evaluation of TM services.		
5. Legal aspects	Information to patients and caregivers	40 projects (90%) provided information about the TM service and data collection/ treatment	Conditions to make the service legally viable are addressed by most of the projects	
	Ex ante analysis	30 projects (70%) carried out an evidence-based assessment of appropriateness, effectiveness and safety of the TM care prior to its implementation		
	Transparency issues	14 projects (33%) have drafted documents for managing service delivery		
		10 projects (23%) have launched calls for tenders to select contractors for services/technology supply		
6. Ethical aspects	Strategy for empowering patients/caregivers	11 projects (25%) have been concerned with ethical issues and the new service submitted to the ethics committee.	Ethical issues have been only partially dealt with	
	Coherence with existing clinical pathways	About half of the projects have been developed in accordance with established clinical pathways (PDTA)		
	Submission to an Ethics Committee			

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Table 5. Continued

Dimension of Analysis	Specific Items	Main Results	Comments	
7. Information and training	Information/training of professionals and health operators	About 90% of the projects see to training the professionals and staff. This number reaches 100% for those services existing for more than 7 years	Education and training of healthcare staff and TM users are widespread among the projects	
	Training of patients and caregivers	2 out of 3 projects include training for patients and caregivers and this is mostly the case for the more recent projects.		
	Information to citizens	1 out of 5 project promoted information campaigns for the general public		
8. Benefits and critical issues	Impact on Quality of Life and service functioning	Increase of quality of life is mentioned by 44% of the projects; improvements of appropriateness by 37% and of service organization by 35%	Notwithstanding pilot phase has been relatively long, TM sustainability issues are not yet solved	
	Critical aspects	Lack of reimbursement rules and financial support (42% of services); organizational shortcomings (35%) and technology-related problems (28%)		

Table 6. A comparison of some indicators for TM and conventional groups

	Home Telemonitoring	Conventional Care (GP Visit)
Number of measurements (blood pressure, heart frequency, O_2 saturation, body weight)	6346	8013
Alarm messages	1263	1963
Emergency room visits	3	3
Day Hospital admissions	13	11
Total number of days in hospital stay	64	42
N. of additional visits	15	15

- eReadiness categories which account for the determinants necessary to support a successful implementation of a telemedicine initiative;
- Telemedicine process steps which describe the information and communication steps for the execution of a telemedicine process;
- Maturity levels which identify the development stages of the service implementation.

That model intended to be a diagnostic tool for describing and assessing telemedicine services as well as for guiding and educating stakeholders towards their optimization.

Given the scope of the regional survey, in this study we used a simplified version of the model and made a few adaptations in the original framework. First, we had to drop the telemedicine process dimension, as it was not addressed in the survey. Second, we re-defined the eReadiness categories according to the collected type of data. Finally, to measure service maturity level we considered the presence or absence of a set of previously selected indicators.

Notwithstanding these approximations, the study made an effort to describe the analytical dimensions retained in analyzing the telemedicine projects. In doing this, it adhered to the recommendations by Hick & Boles (2004) which emphasized that any evaluation of telemedicine services should make it explicit the dimensions considered in the analysis, and namely: a. level of observation (individual, community, society); b. focus of analysis (cost, quality, access); c. type of activities (clinical, education/research, administration).

In this case, the regional level of observation belongs to the meso–level, this being something in between a (micro) view of the functioning of each single service and a (macro) view of the performance of the total number of projects, as a whole.

Here we are not concerned with the evaluation of telemedicine services, but with the stage of implementation of the projects. The focus is on the investigation of the range of factors that depending on the implementation stage, are likely to affect the TM service viability.

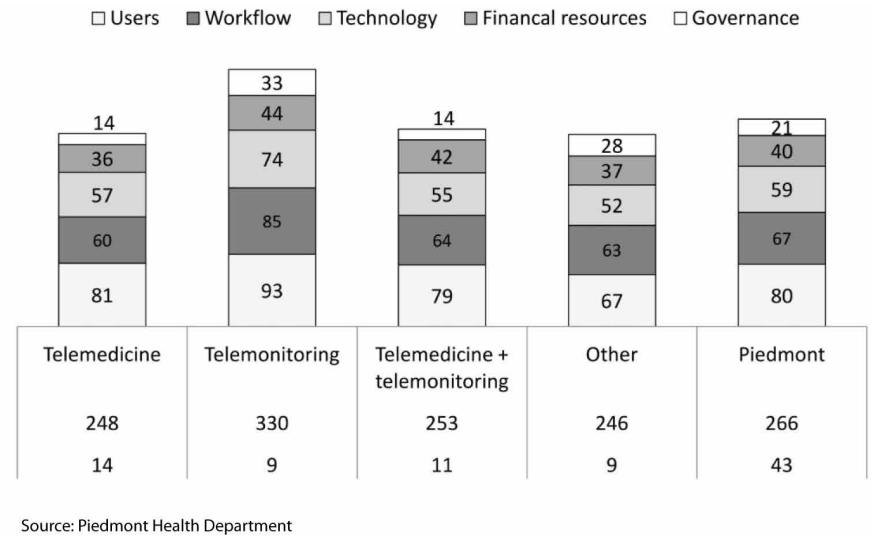
The type of activities, e.g. the eReadiness categories in the model by van Dyket al. (2013), has been defined according to the collected type of data. The following analytical categories have been specified:

- Governance:
  - **G1:** Including the telemedicine service in the Local Health Units' strategic plan;
  - **G2:** Carrying out an information campaign for citizens;
- Workflow:
  - **W1:** An approach to service quality assessment;
  - **W2:** An integration in patient therapeutic pathways or in clinical trial; W3. a procedure for service improvement;
- Users (patients and medical staff):
  - **U1:** A formal procedure for informing patients and family about safety and data privacy issues;
  - **U2:** A training and or an education program for doctors and care operators;
  - **U3:** A specific training for patients and caregivers;
- Financial resources (funding sources):
  - **R1:** Regional Health Funding;
  - **R2:** Funding from local Healthcare Unit;
  - **R3:** Others (private donors, and bank foundations);
- Technology:
  - **T1:** Measures for data protection;
  - **T2:** Minimum quality requirements and guarantees for service functionality;
  - **T3:** Procedures for handling complaints and failures.

To measure projects maturity level a very basic approach has been used. It assumes that this level depends on the valued items in each category. If, for example, all the all the items in the 5 categories were valued, the project' overall score would be 500. Underreported or omitted item's field have been given a zero value, Figure 4.

By adopting this approach, the average score obtained for the Piedmont telemedicine initiatives is 266. As shown in Figure 4, the category with the highest score is that related to users (80), followed by that concerning workflow (67), technology (57), financial resources (40) and lastly governance (21).

Figure 4. Maturity score of telemedicine initiatives by type of service and analytic categories in Piedmont, 2017 (Captions in the bars: average score, above; number of projects, below)



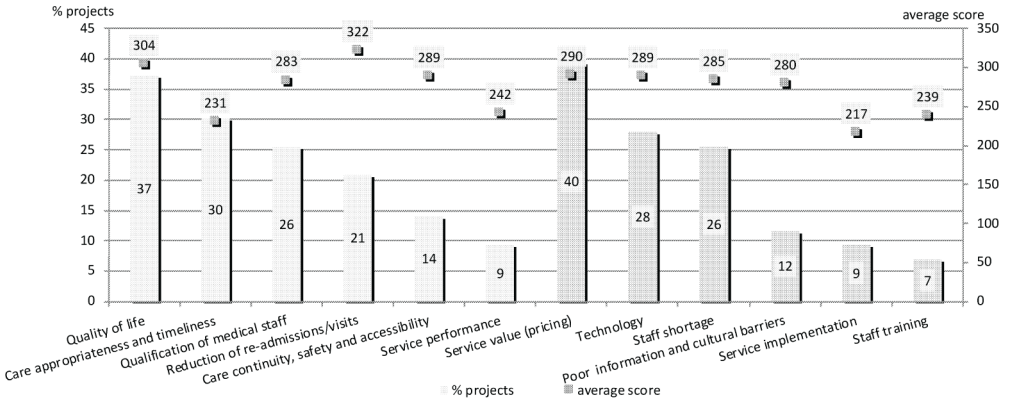
Source: Piedmont Health Department

As for the type of delivered service, tele-monitoring would be the most mature, with a score (330) appreciably higher than the regional average (266). Compared with the regional value, governance is the category with the highest relative distance.

To provide further ground for the discussion, it is worth investigating whether there is a relationship between the maturity scores as obtained in the analytic exercise and the respondents' opinions as for the benefits of these services and the problems encountered in their deployment (see Table 5).

Among the benefits, improvements in the patient's quality of life were mentioned in 37% of the projects and constitute the largest class. Progress in the appropriateness and timeliness of care was the second most mentioned benefit, shown in 30% of the cases, Figure 5. Strengthening the work

Figure 5. Distribution of Piedmont telemedicine projects by benefits (light gray) and implementation problems (dark gray) and average maturity score, 2017. Source: Piedmont Health Department.



Source: Piedmont Health Department

capacity by health personnel (qualification of medical staff) ranked third and was acknowledged in one out of four projects (26%). Projects that report benefits related to the quality of life have an appreciably higher maturity score (304) than the regional average (266). The highest score (322), however, distinguishes those projects where, among the positive effects, there is a reduction in patients hospital re-admissions and visits.

As for the critical issues, the most concerning, reported by 40% of the projects, relates to the economic sustainability of the new service. As telemedicine is not yet included in the health reimbursement policy of the region, there is a lack of financial resources to support its costs over time. An additional difficulty pointed out by 28% of the respondents is the lack or unavailability of certain technologies; they include the poor performance of broadband connectivity in some sub-regional areas.

The lack of interoperability (an essential technical prerequisite for ensuring the functionality of the service) does not seem to be an issue. Probably, the questionnaire was unable to tackle the aspect in a proper way. In this regard, it is worth pointing out that for half of the respondents' interoperability was viewed as an aspect of the organizational strategy rather than as a technical matter.

Shortage of healthcare staff, along with the difficulties to employ them within an appropriate regulatory framework, constitute the third most critical issue (26% of the projects reported it).

The projects showing these issues have maturity scores between 290 and 285, above the regional average. A similar score was reached by a relatively small number of projects (12%) which report poor information about ehealth and the existence of cultural barriers to the diffusion of telemedicine services.

One may wonder to what extent the findings of this survey are likely to be observed in other European countries. This is not easy to answer as, to the authors' knowledge, no comparative investigation has been carried out so far at regional level.

Results from a telemedicine survey in the County Council of Västerbotten, a Swedish region, may offer some clues (Molén & Holmner, 2016). In this region telemedicine has been in use since the mid-1990s, but a systematic strategy for developing high quality services was lacking. To set a solid foundation for this strategy, a survey was carried out through interviews to the individuals who had driven the development of telemedicine in their respective units. This aspect was also present in the Piedmont survey along with the fact both surveys did not investigate the patients' perspective.

When comparing the two studies it is worth noting that both found that:

- Documenting and evaluating the beneficial effects of telemedicine is not a consolidated practice;
- Although technology fulfills health-care unit needs in most routine workloads, several respondents request training to use the new equipment and a better coordination between units that work in similar ways.

CONCLUSION

The study presented here is the first of its kind in Piedmont. Its aim was to assess the development stage of the telemedicine projects in the region while complying with a few national information requirements concerning these services.

The protocol of analysis investigated the structural aspects of the telemedicine services and covered several domains: financing, technical aspects, organization, legal and ethical issues, patient information and training. Opinions about the benefits and criticalities of the services were also collected from those who had a main responsibility in managing the projects.

An account of the level of implementation of the projects was proposed building on the collected data, making their assessment easier.

The results show that a rich telemedicine experience existed in Piedmont, both in terms of the covered disease areas (with cardiology and endocrinology being the privileged ones), and types of services. A certain variety is also evident in the degree of maturity of the various initiatives, as some of them have existed for a long time.

We are aware that a comparative analysis with other regional cases would help give more ground to these results. This entails to widen the observation lens and design an agreed investigation protocol. The experience gained in the EU study by the Joint Action to support the eHealth Network (2017) could highlight a good procedure.

Notwithstanding the limitation of the survey, its results gave evidence that the transition of telemedicine projects from pilot to current practices requires not only institutional efforts but also governance actions for making their integration easier in the regional health system.

In this respect, a few aspects deserve further attention. Their investigation can help bridge the micro-macro ehealth approaches, and develop better digital services tailored on regional healthcare requirements about efficiency, effectiveness and equity.

The first, relates to the opportunity to identify the priorities in the telemedicine strategy and its relationships with the regional ehealth policy. It entails to answer to questions such as:

1. To which extent do projects respond to the health care demand of chronic patients? Which clinical and/or economic aspects should be prioritized?
2. How a new service is integrated (or could be integrated) with those already existing in Local Health Districts? How this integration may be affected by the deployment of broadband services and population e-readiness in the area?

The second aspect deals with the maturity level requirements, in terms of healthcare, organization and economic components, for a telemedicine project to be sustainable and eligible for inclusion in a regional medical practice. To properly assess them is crucial for setting the functional criteria necessary to the accreditation of telemedicine services and to their integration in the regional health system.

A number of international standards and studies already exist that provide a well-documented set of reference criteria, concerning adherence to the territorial context, service effectiveness; quality, adequacy and appropriateness of organization, technology and care; level of integration with the regional ehealth system; performance of the ICT infrastructure; economic assessment (Kidholm et al., 2012; Taylor, 2015; Telehealth Quality Group, 2018).

The experience gained in Piedmont suggests that in order to make TM services more appropriate to the context, the design of the investigation cannot be a standalone activity.

All actors having a responsibility in delivering telemedicine services, clinicians, healthcare and IT staff, patients, caregivers, have a say in the effort. Their involvement would raise awareness about the set of conditions, necessary to develop a regional integrated telemedicine system. As already documented by the literature several factors are entailed, such as the spatial distribution of healthcare services, patients' accessibility (Cutchin, 2002; Wang, 2012), the normative framework (May& Finch, 2009) and organizational asset (Clegg et al., 2009).

The creation of a collaborative socio-technical system for exchanging knowledge about the values generated by the new services is an effort worth being pursued; it could spur the cultural transformation in the management which is needed to improve current health practices (Caceido, 2019; Occelli, 2015; van Dyk, 2014, van Gemert-Pijnen et al., 2011). Ultimately, it could become a core component of the regional health system for managing chronic illness and promoting healthy living.

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