

Comparison of Different Telemedicine Services to Pre-Evaluate Their Use in a New "Computational Hospital"

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Abstract. Future healthcare is transitioning toward a decentralization of patient care, in which personal care is increasingly moved at the patient home and surrounding areas, while hospitals concentrate primarily on procedures that cannot be performed elsewhere, such as surgeries or outpatient examinations. The healthcare system in the Liguria region (Italy) is currently developing a new Center for Computational and Technological Medicine (CMCT), which is intended to facilitate and support this transition. As a component of the strategic planning and design process, this study examines the development and organization of telemedicine services across a range of chosen Italian and European institutions that share similarities with CMCT in terms of scope and scale. We specifically focus on telemedicine services – how they are governed, their main fields of application. The analysis confirmed the growing importance of telemedicine as part of the new vision of medicine, in which the patient is at the center.

Keywords. Telemedicine, governance, CMCT, digital health

1. Introduction

Hospitals of the future will likely have fewer beds, larger outpatient plates dedicated to diagnosis, and facilities for surgical procedures. Patient care will increasingly be offered remotely, except for health services that require physical presence, such as invasive procedures (e.g., surgery). Therefore, if an extensive network of telemedicine is developed within Hospitals (both existing and under construction), then the idea of the Hospital of the Future takes more and more shape. This is the backdrop for Liguria Region's project regarding the new Center for Computational and Technological Medicine (CMCT) to be built at Erzelli in Genoa. Envisioned as a combination of research and clinical facilities, the CMCT is designed to collaborate with each other in such a way as to make translational research more effective: based on the real needs of patients, healthcare personnel and the entire community. In addition, the CMCT is designed to speed and facilitate the transition of a new technology from the laboratory

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environment to the clinical one for its application on patients. Thus, a continuous pathway from the specific medical need to the final use of the technology in the clinical setting would be desirable. The Center could then aspire to be a "delivery center" for telemedicine services, focusing on developing and providing "innovative experimental services".

Telemedicine must be governed by robust standards, just as there must be robust reporting to be effective. When embedded within the services of a hospital, this activity ideally has an impact on how the healthcare facility is governed, the healthcare staff, the physical structure of the building, the technologies, the economic and accounting aspects. Other aspects on which telemedicine is expected to have an impact are training of healthcare personnel and caregivers, change in the structure of the workday, change in the system of accounting and charging for services, and tighter assessments of health outcomes. The implementation of telemedicine services requires significant practical and organizational changes [1]. If telemedicine is embedded within preventive medicine, it may be appropriate to automatically classify patient information with smart technologies to determine when it is necessary to alert the patient to have a checkup. Digital health decreases costs for patients since they don't need any transport to the hospital; for this reason, it is a good choice for patients who live in remote areas [2]. At the same time, telemedicine allows doctors to provide more care to the patients, by reducing the time spent with rural assignments. Through this analysis, we compare several healthcare facilities in Italy and in/out Europe in order to study the method used to provide telemedicine services to their patients.

2. Methods

During the design phase of CMCT telemedicine services, we aim to analyze various European institutions that are relevant to our project. Our primary focus is on institutions that integrate research and clinical activities, with a strong emphasis on digital health and telemedicine services. In this initial study, we have examined a total of seven institutions: four in Italy, one in Germany, one in the Netherlands and one in Israel. These institutions have different governance structures, priorities, and healthcare system organizations. These institutions are:

- IRCCS San Raffaele Hospital;
- IRCCS Istituto Giannina Gaslini;
- IRCCS Humanitas Research Hospital;
- IRCCS Galeazzi - Sant'Ambrogio Hospital;
- Rambam Health Care Campus, Haifa, Israel;
- Amsterdam University Medical Centers (UMC);
- University Hospital of Tübingen.

All Italian institutions carry the designation "Istituto di Ricovero e Cura a Carattere Scientifico" (IRCCS), indicating their dual focus on healthcare and clinical research. We examined each institute through their respective websites, focusing our analysis on the telemedicine services offered (telehealth and telemonitoring) and how they are delivered. We have also conducted searches on Google Scholar: "Influence of hospital scientific management in telemedicine choices" and "Management of telemedicine" to obtain information about the telemedicine in the period from 2019 to 2023, and we excluded papers discussing specific diseases or studies conducted outside of Europe.

3. Results

The obtained results highlight the various approaches that individual institutions adopt to provide telemedicine services (Table 1).

San Raffaele Hospital offers a digital service enabling people to consult specialists directly from their houses. Booking is facilitated through a subscription-based platform. The services offered are televisit (online visits with possible exchange of documentation between patient and doctor), first visit (first patient access for a specific health problem for which a diagnosis is made), teleconsultation (long-distance consultations between doctors), second opinion (pertaining to diagnoses or a treatment plans), follow-up and control (understood as clinical monitoring), reminder for therapies or checkups, and exchange of documents with the doctor (prescriptions or reports), along with the utilization of storage space [3].

At the Gaslini Institute, teleconsultation, telemonitoring and televisit are available. These services were introduced to overcome time, cost, and geographic barriers. The offered patient services encompass televisit/videocontact for first opinions and guidance, televisit/videocontact for a second opinion, follow-up televisit/videocontact, privately and securely sending medical records to the specialist, sending documentation to the patient by the practitioner (clinical indications, medical reports, etc.) [4].

Humanitas Research Hospital applies telemedicine in different modalities, including televisit to perform an initial assessment, follow-up visit, examinations needed for pre-recovery, televisit with anesthesiologists for history taking, and teleconsultation. Additionally, the "Humanitas con te" smartphone application facilitates online report collection, appointment and specialist examination booking. This portal permits the viewing, saving, and printing of outpatient reports, laboratory tests, discharge letters, first aid reports and downloadable diagnostic images [5].

Galeazzi - Sant'Ambrogio Hospital offers televisit or online consultations (first consultation) either with a team or with a specialist for a second opinion. Remote support for check-ups and follow-ups is also available, alongside medical documentation exchange, therapy and/or check-up reminder, and digital health document archiving [6]. The Institute also provides home physiotherapy [7], catering to those who underwent orthopedic surgery or seek recovery and autonomy.

Within the Rambam Health Care Campus (HCC), the Rambam Innovation Center (RIC) which advocates for digital health [8]. Among its six units, one focuses on telemedicine, aiming for diverse applications.

In the European context, Amsterdam UMC offers remote specialist visits [9]. The telemedicine service is accessible through "My Dossier" website or smartphone application, enabling consultation of medical records, appointments, and reports.

Finally, the University Hospital of Tübingen initiated the "TeleCare" telemedicine project [10], aiming to enhance home care through involvement of nurses and family doctors. Additionally, telemedicine is used in mental health field through video consultations between doctors and patients.

Table 1. The telemedicine services that are available in the analyzed Institutes.

Hospitals	First visit	Teleconsultation	Second-opinion	Control	Follow-up
San Raffaele Hospital	X	X	X	X	X
Istituto Giannina Gaslini	X	X	X	X	X
Humanitas Research Hospital	X	X		X	

G.–Sant’ Ambrogio Hospital	X	X	X	X	X
Rambam HCC					
Amsterdam UMC	X				
University Hospital Tübingen		X			

4. Discussion

From both national and non-national experiences, the results regarding organizational differences can be summarized in a governance proposal for the CMCT. The Center could have a core solely for telemedicine, in which doctors become “doctors of the PC” and are no longer associated with physical hospital beds. In this scenario, each specialist would focus on patients within their own field of medicine (e.g., an ophthalmologist would exclusively treat eye patients). The main implication of this is the need to reevaluate the governance structure.

First and foremost, it’s important to determine whether the telemedicine core establishes an independent department within the hospital or if it’s integrated into an existing one. Alternatively, if the hospital’s organization is based on the “Intensity of treatment”, then telemedicine would also adhere to this framework. “Intensity of treatment” involves categorizing patients according to the severity of their condition: a high intensity level (such as intensive care units, sub-intensive care units, post-operative intensive care), a medium-intensity level (acute hospitalization in medical and surgical departments), and a third level (post-acute hospitalization, stabilization, and rehabilitation). The objective is to prioritize the patient’s need and consolidate what can be considered cross-cutting (focusing on the patient’s needs rather than just the doctor). In this context, telemedicine becomes essential for low intensity care and treatment, ensuring continuity of care within the community after the patient’s discharge [11].

Whenever a new technology is integrated into daily life, limitations often come to light; this holds true for telemedicine as well. The initial limitation is the absence of vital sign evaluation and the constraints on physical examinations [12]. Another concern for physicians is the potential loss of the personal rapport [12] established between patient and doctor during in-person medical consultations. To address this, hospitals often introduce telemedicine as an additional option for providing health care services [13], emphasizing the importance of training healthcare providers to establish a strong patient relationship even in remote settings [12]. Furthermore, there’s the challenge concerning the licensing of physicians to practice telemedicine across state borders [2]. The regulatory and legal implications surrounding telemedicine are factors, particularly in safeguarding patient data [14]; healthcare data, differently from other type of data, cannot be changed from the patient once stolen [15]. In this regard, security must be thoroughly studied; assessing security threats necessitates the involvement of experts and collaboration with doctors balancing utility, security, privacy, and compliance [16]. Given the potential life-threatening consequences of a cyberattack (e.g., Implantable Medical Devices (IMDs), which contain sensitive data vulnerable to hacking, and even the therapeutic functions could be disabled or reprogrammed) [14]. Hospitals need a systematic approach to identify security threats and diagnosing vulnerabilities, they should have appropriate tools to protect data shared and reduce risk of violations [15].

This analysis underscores that telemedicine, which saw significant development during the pandemic [17], is increasingly being integrated into hospital programs and is even part of the designs of new hospitals, such as CMCT.

5. Conclusions

The analysis has highlighted the significance of remotely delivered healthcare services, not only on a national level but also internationally, thereby creating a challenge for future medicine in many states. It can be argued that telemedicine service should also be a fundamental consideration during the design phase of new hospitals. This would enable a more effective and efficient organization and integration of the services. This approach to medicine is also well-aligned with the increasingly emerging concept of “patient at the center”: as medicine moves towards the patient, the patient no longer needs to travel to the hospital for checkups, examinations, or other services that do not require invasive interventions or specific biomedical instrumentation. This shift results in reduced overall healthcare system costs, shorter waiting times for patients to access healthcare services, and diminished risk of infection, particularly in the case of immunocompromised patients [10]. De-hospitalization through telemedicine is indeed encouraged, and proximity care is enhanced.

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