

Survey on Telecardiology activities in Hospital and University Cardiology Facilities in Italy

Manuela Bocchino, Elvira Agazio, Cecilia Damiano, Giuseppe Di Lorenzo, Fabio De Paolis, Duilio Luca Bacocco, Fabrizio Ammirati, Alessio Nardini, Marco Silano

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Abstract

Background: Telemedicine enables the provision of health services at a distance using information and communication technologies and includes different types of services: telemonitoring, remote control, virtual visit or televisit, tele referral, teleassistance, medical teleconsultation, health professionals' teleconsultation and tele rehabilitation. There are not many studies in the literature investigating the use of telemedicine in cardiology in Italy.

Objective: Aim of this study is to illustrate the results of the survey on telemedicine in cardiology conducted by the Department of Cardiovascular, Endocrine-metabolic diseases and Aging of the Italian National Institute of Health. One of the ultimate objective of this mapping is to provide help in the future design and use of telemedicine services in cardiology in Italy.

Methods: The "Telehealth quality of care tool" (TQoCT), from the World Health Organization (WHO) was used as a model. A survey was disseminated through a link to operative units (OUs) of hospital and university cardiology identified through the 8th Census of Cardiological Structures in Italy, by ANMCO, from June 2024 to October 2024. The facilities were contacted by email and/or telephone. The survey was built through Microsoft Forms and composed of a questionnaire of 52 questions, divided into 6 sections. The analysis was carried out for the whole national territory and by geographical area.

Results: 443 hospitals were contacted; response rate is 56.7%. Overall, 78.9% of facilities report telemedicine initiatives, providing telemonitoring (64.6%), tele referral (52.5%), medical teleconsultation (47%), tele-visit (41.4%), health professionals' teleconsultation (32.3%) and tele rehabilitation (0.5%). The most frequently followed cardiovascular conditions are heart failure, ischemic heart disease and cardiac arrhythmias, especially atrial fibrillation. Fifty-one per cent of facilities use deliberations, procedures, protocols and/or informed consent for their activities and 46% of the reported services are paid. Lack of dedicated staff, complexity on organizational terms and lack of technological equipment in the structure are principals' health professionals' obstacles; lack of familiarity with technology is the principal one for patients.

Conclusions: There are still organizational and clinical limitations to resolve, in order to make telemedicine in cardiology an integral part of medical practice. The true challenge of Telecardiology probably is the integration of available technology with precise, concrete and simplified organizational models. As a tool, technology is fundamental, if only it is accessible and adequate. However, it must be integrated with new paths built according to the needs of the territory, patients and health personnel. Clinical Trial: The survey was submitted to the National Ethics Committee for Trials of Public Research Institutions and other public bodies with a national character (CEN), that approved the study on May, 17 2024, with protocol no. 0021567.

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Original Manuscript

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Keywords: Telemedicine, cardiology, survey, methodology, design.

Introduction

According to the definition of the World Health Organization (WHO), telemedicine is the "provision of health services by all actors using information and communication technologies (ICT) for the exchange of valid information for diagnosis, treatment and prevention of diseases where distance is a critical factor, in the interest of improving the health of individuals and their communities" [1].

Telemedicine therefore allows remote health services to be delivered using ICT devices without patients having to go to a healthcare facility. Telemedicine includes different types of services, such as telemonitoring, remote control, virtual visit or televisit, tele referral, teleassistance, medical teleconsultation, health professionals teleconsultation and tele rehabilitation.

In Italy, according to the mapping of experiences in telemedicine on the national territory drawn up in 2018 [2], telemonitoring and teleassistance represent 26% of the services, 43% of them concern the cardiology specialist field and 57% other specialists. Many Regions and Autonomous Provinces (AP) took note of the 2020 national guidelines and/or interim indications for telemedicine care services [3,4] through different documents, proposing and implementing local solutions. In the field of cardiology, recently the "National Consensus Document on telemedicine for cardiovascular diseases: indications for tele rehabilitation and telemonitoring" [5] was published. Although Telecardiology proved beneficial in terms of care, comfort and patient access, it still has limitations, both logistical and medical, to become an integral part of medical practice in the future [6].

In 2021, the Italian Association of Arrhythmology and Cardiac Stimulation (AIAC) released a survey entitled "Telecardiology and the use of remote monitoring of implantable Devices in Italy in light of the COVID-19 period". That survey aimed mainly to investigate the spread of remote monitoring of Cardiac Implantable Electronic devices (CIED) in Italy, in particular following the period of the health emergency [7]. Subsequently, in October 2023, the Italian National Institute of Health (ISS) collaborated on the "First national survey on telemedicine in private outpatient care", with the Luiss University, the Health Wellness and Resilience Observatory of the Bruno Visentini Foundation and the integrative health fund Fasdac [8]. This survey concerned the use of telemedicine within private outpatient facilities. Recently, the 8th Census of Cardiological Structures in Italy, by the National Association of Doctors and Hospital Cardiologists (ANMCO) reported some data about the spread of telemedicine in cardiology in Italy, regarding only the frequency of use of televisit services, telemonitoring, teleconsultation and tele referral. Census was conducted in 2022 and published at the beginning of 2024 [9]. At international level, the literature reports surveys on perceptions of health professionals about telemedicine during COVID-19 pandemics [10], and the acceptance of telemedicine in cardiology by specialists and general practitioners [11]. Currently, there are no dedicated surveys in the literature that investigate telemedicine services and their characteristics in cardiology in Italy.

Aim of the study

This study describes the results of the survey on Telecardiology in Italy, which was conceived, designed, and conducted by the Department of Cardiovascular, Endocrine-metabolic Diseases and Ageing of the ISS. The survey was addressed to the Operative Units (OUs) of hospital and university cardiology in the national territory both as listed by ANMCO and found by an online search.

Such mapping could in the future help the implementation of a national plan for telemedicine services in cardiology, and help create a telemedicine network to support continuous improvement of national and regional strategies.

Methods

This report was conducted in adherence to the CROSS checklist (12). The "Telehealth Quality of Care Tool" (TQoCT) [13] was also consulted. Based on previous recommendations and scoreboards, WHO developed a tool that serves both as a guide and as self-assessment to improve the quality of telemedicine services, useful at local, regional and national level.

The survey, digitally composed using Microsoft Forms, is based on a questionnaire of 52 questions,

divided into 6 sections: a) Facility information (six questions); b) Presence of telemedicine projects (one question); (c) Type of telemedicine services (twenty-seven questions) defined according to the 2020 State-Regions Agreement [4]; d) Governance, safety and accessibility (twelve questions); e) Volumes and patient centrality (four question); f) Obstacles to services' development and implementation (two questions).

Considering the 52 total questions, 18 are multiple-choice; eleven include a text description field, four of which are dedicated to the description of the structure. Sixteen require a single answer, while six require date entries. One question requires numerical data. The complete questionnaire is available in the supplementary material.

Recruitment

The questionnaire was disseminated, according to three levels of intervention:

- e-mail with cover letter sent to the Health Departments of the Regions and AP;
- e-mail with a cover letter addressed to the Directors of the OUs of hospital and university cardiology;
- phone contact with the Directors of the OUs of cardiology hospitals and universities.

An ISS e-mail account was specifically created for the survey (surveytelecardiologia@iss.it), as well as the cover letters.

The institutional e-mails of the Directors of the OUs were used as contact details, unless they had explicitly requested to send them to their personal address e-mail; the publically available phone numbers of the OUs or numbers voluntarily provided by Directors themselves were used as telephone contact. The survey started on June, 14 2024 and ended on October, 18 2024.

To ensure widespread territorial coverage, several scientific societies were involved in the survey dissemination, by sending e-mail with cover letter to societies' Presidents. In particular, the Italian Society of Cardiology (SIC), the Italian Association of Arrhythmology and Cardiac Pacing (AIAC), especially the Women & Arrhythmology Area, the Latium section of the Italian Society of Telemedicine (SIT), and the Italian Society of Digital Medicine (SIMeDi) actively contributed to the study.

The Microsoft forms template was designed to ensure that the IP addresses of the computers used to complete the survey were not recorded. For each participating facility, the Microsoft forms application created a unique ID and collected information on start time and completion time of data entry. The data controller was ISS, as well as the participating centres. The activity did not collected personal data; in any case, the information and consent to participate in the study was an integral part of the form accessed through the link sent to participate in the survey itself.

Statistical Analysis

Statistical elaboration of the collected data was performed using R software (version 4.0.3) both on a national level and by geographical area. In particular, Regions and AP were divided into the three macro-areas of "north" (Aosta Valley, Piedmont, Liguria, Lombardy, Trentino-Alto Adige, Veneto, Friuli-Venezia Giulia and Emilia-Romagna), "centre" (Tuscany, Marche, Umbria, Latium and Abruzzo) and "south and islands" (Molise, Campania, Puglia, Basilicata, Calabria, Sicily and Sardinia).

Results

Out of 443 facilities contacted, 251 responded, with a response rate of 56.7%. Table 1 shows the distribution of contacted and responding centres, along with their response rates, reported by Region/ AP and geographical areas.

Table 1. Contacted centres and responding centres, reported by Region/AP and geographical area. Information reported as N (%).

Region	Contacted centres	Responding centres
Abruzzo	13	0
Basilicata	4	1 (25.0)
Calabria	14	7 (50.0)
Campania	46	12 (26.1)
Emilia-Romagna	29	19 (65.5)
Friuli-Venezia Giulia	8	5 (62.5)
Lazio	47	36 (76.6)
Liguria	19	13 (68.4)
Lombardy	60	36 (60.0)
Marche	13	5 (38.5)
Molise	4	1 (25.0)
Piedmont	31	25 (80.6)
Puglia	29	14 (48.3)
Sardinia	10	9 (90.0)
Sicily	41	19 (46.3)
Tuscany	30	22 (73.3)
Trentino-Alto Adige	5	3 (60.0)
Umbria	8	5 (62.5)
Aosta Valley	1	1 (100.0)
Veneto	31	18 (58.1)
Geographical area		
North	184	120 (65.2)
Centre	98	68 (69.4)
South and islands	161	63 (39.1)
Total	443	251 (56.7)

The mean time to complete the survey was 12 ± 5 minutes (expressed as mean $\pm$ SD, standard deviation). About half of the responding facilities were part of hospitals directly managed by local health companies, followed by hospital and university companies (Table 2).

Table 2. Distribution of the type of hospital structure, at national level and by geographical area. Information reported as N (%).

Geographical area	Hospital run by the local health company	Independent Hospital	University Hospital	University Polyclinic	Other	Total
North	49 (40.8)	41 (34.2)	16 (13.3)	2 (1.7)	12 (10.0)	120
Centre	38 (55.9)	10 (14.7)	5 (7.3)	8 (11.8)	7 (10.3)	68

South and islands	36 (57.1)	13 (20.6)	12 (19.1)	0	2 (3.2)	63
Total	123 (49.0)	64 (25.5)	33 (13.1)	10 (4.0)	21 (8.4)	251

Presence and characteristics of telemedicine services.

In total, 198 facilities (78.9%) reported telemedicine initiatives; details by geographical areas are shown in Table 3.

Table 3. Facilities using telemedicine by geographical area. Information reported as N (%).

Use of telemedicine	North	Centre	South and islands	Total
Yes	101 (84.2)	53 (77.9)	44 (69.8)	198 (78.9%)
No	19 (15.8)	15 (22.1)	19 (30.2)	53 (21.1%)
Total	120	68	63	251

Since the same facility could perform more than just one telecardiology service, respondents were able to answer this question having multiple-choice options. We found that the majority of facilities provide telemonitoring services (64.6%), followed by tele referral (52.5%), medical teleconsultation (47%), televisit (41.4%), health professionals teleconsultation (32.3%) and tele rehabilitation (0.5%). Table 4 shows the breakdown by geographical area.

Table 4. Telemedicine services provided by facilities using telemedicine, reported by geographical area. Information reported as N (%).

Telemedicine service	North (101 centres)	Centre (53 centres)	South and Islands (44 centres)	Total (198 centres)
Televisit	50 (49.5)	24 (45.3)	8 (18.2)	82 (41.4)
Medical Teleconsultation	52 (51.5)	28 (52.8)	13 (29.6)	93 (47.0)
Health professionals Teleconsultation	31 (30.7)	21 (39.6)	12 (27.3)	64 (32.3)
Telemonitoring	73 (72.3)	34 (64.2)	21 (47.7)	128 (64.6)
Tele referral	54 (53.5)	27 (50.9)	23 (52.3)	104 (52.5)
Tele rehabilitation	8 (7.9)	2 (3.8)	0	10 (0.5)

Table 5 reports the cardiovascular diseases that are most commonly followed through different telemedicine services: patients suffering from heart failure, or carriers of CIED, or who need to compile therapeutic plans related to cardiovascular diseases, but also patients with ischemic heart disease and cardiac arrhythmias, especially atrial fibrillation.

The televisit is often used to follow-up of heart failure, for the remote control of CIED and for the compilation of therapeutic plans of the drugs monitored by the Italian Agency of the Drug (AIFA). All the other conditions considered, i.e., ischemic heart disease, hypertension, rare cardiological diseases, syncope, valvular heart disease and congenital diseases seem to be managed less frequently by telemedicine services. Medical teleconsultation, which enables doctors to compare each other remotely, is associated mainly with heart failure, ischemic heart disease and atrial fibrillation,

whereas health professionals' teleconsultation is adopted by the health personnel mainly for patients suffering from heart failure, carriers of CIED or with arrhythmic pathologies. Telemonitoring is mainly used in patients with CIED, to lesser extent patients with wearable devices, or at least not implantable, suffering from heart failure and atrial fibrillation. Finally, heart failure and ischemic heart disease are the pathologies for which tele rehabilitation is most often used. Further details on the geographical distribution of the different telemedicine services according to the pathology followed can be found in Table 1 and Table 2 of the supplementary material.

Table 5. Cardiovascular diseases for which a national telemedicine service is provided in facilities using telemedicine. Information reported as N (%). Total respondents equal to N=198. CIED: cardiac implantable electronic device.

Disease	Televisit (82 centres)	Medical Teleconsultation (93 centres)	Health professionals Teleconsultation (157 centres)	Telemonitoring (128 centres)	Tele rehabilitation (10 centres)
Ischemic heart disease	19 (23.2)	51 (54.8)	16 (10.2)	6 (4.7)	5 (50)
Congenital heart disease	1 (0.1)	16 (17.2)	1 (0.06)	-	1 (10)
Valvular heart disease	3 (3.7)	32 (34.4)	6 (3.8)	1 (0.8)	3 (30)
Remote control CIED	55 (67.1)	36 (38.7)	37 (23.6)	90 (70.3)	-
Atrial fibrillation	20 (24.4)	39 (41.9)	16 (10.2)	46 (35.9)	-
Arterial hypertension	8 (9.8)	21 (22.6)	6 (3.8)	5 (3.9)	-
Rare diseases in cardiology	8 (9.8)	14 (15.1)	3 (1.9)	3 (2.3)	1 (10.0)
Arrhythmic disorders	15 (18.3)	35 (37.6)	17 (10.8)	41 (32.0)	2 (20.0)
Treatment plans for cardiovascular diseases	40 (48.8)	-	-	-	-
Non-cardiological diseases	-	12 (12.9)	4 (2.5)	-	-
Heart failure	64 (78)	64 (68.8)	40 (25.5)	69 (53.9)	8 (80.0)
Syncope	8 (9.8)	26 (28)	14 (8.9)	41 (32.0)	-

Tele-referral of cardiological instrumental examinations is primarily used for the remote interpretation of electrocardiograms (ECG), particularly within hospital-to-territory, intra-hospital and emergency network settings. This service is also used for remote control of CIED, to a lesser extent for other instrumental examinations such as echocardiography, cardiac rhythm and blood pressure monitoring. Further details are shown in Table 6.

Table 6. Services that involves the use tele-referral, at national level and by geographical area. CIED: cardiac implantable electronic device; ECG: electrocardiogram.

Service	North (54 centres)	Centre (27 centres)	South and islands (23 centres)	Total (104 centres)
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Remote control CIED	34 (63)	14 (51.8)	8 (34.8)	56 (53.8)
Emergency ECG (network 118)	38 (70.4)	9 (33.3)	15 (65.2)	62 (59.6)
Intra-hospital ECG	41 (75.9)	19 (70.4)	21 (91.3)	81 (77.9)
Hospital-territory ECG	42 (77.8)	13 (48.1)	7 (30.4)	62 (59.6)
Echocardiogram	5 (9.3)	1 (3.7)	3 (13)	9 (0.9)
ECG Holter monitoring 24 hours	9 (16.7)	8 (29.6)	5 (21.7)	22 (21.8)
ECG monitoring through other devices	7 (13)	3 (11.1)	3 (13)	13 (12.5)
Outpatient monitoring of blood pressure	1 (1.8)	6 (22.2)	3 (13)	10 (9.6)

For some telemedicine services, additional elements were investigated: i.e. the facilities (hubs and spoke) in which the medical teleconsultation is carried out by and number and skills of the health personnel involved in teleconsultation and telemonitoring.

The medical teleconsultation is carried out mainly with other regional hospitals and with general practitioners and/or free choice paediatricians, followed by the OUs of the same hospital (Table 7). There is still little interaction between regions, although this is present in greater percentage in the regions of central Italy; in the south, the interaction with territorial cardiology prevails, rather than with general medicine.

Table 7. Facilities in which medical teleconsultation is carried out, at national level and by geographical area. Information reported as N (%). OUs: operative units.

Type of structure	North (52 centres)	Centre (28 centres)	South and islands (13 centres)	Total (93 centres)
National hospitals or referral centres for pathology	7 (13.5)	5 (17.9)	1 (7.7)	13 (14)
Regional hospitals	27 (51.9)	13 (46.4)	6 (46.1)	46 (49.5)
Territorial cardiology clinics	7 (13.5)	2 (7.1)	6 (46.1)	15 (16.1)
Specialist non-cardiological territorial	4 (7.7)	1 (3.6)	0	5 (5.4)
General practitioners and/or free choice paediatricians	27 (51.9)	5 (17.9)	3 (23)	35 (37.6)
Private or private/contracted facilities	5 (9.6)	1 (3.6)	3 (23)	9 (9.7)
OUs of the same hospital	9 (17.3)	15 (53.6)	9 (69.2)	33 (35.5)

Hub centres account for 30.1%, spoke centres 39.8%, the remaining work as both hub and spoke centres (details by geographical area in Table 8).

Table 8. Type of centres, reported by geographical area.

Type of structure	North (52 centres)	Centre (28 centres)	South and Islands (13 centres)	Total (93 centres)
Hub	13 (25.0)	8 (28.6)	7 (53.8)	28 (30.1)
Spoke	22 (42.3)	11 (39.3)	4 (30.8)	37 (39.8)

Both	17 (32.7)	9 (32.1)	2 (15.4)	28 (30.1)
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The health professionals' teleconsultation service is primarily conducted by nurses, followed by cardio-circulatory pathophysiology technicians and, in a lower percentage, by doctors, physiotherapists and bioengineers. Details can be found in Table 9.

Table 9. Staff providing health professionals teleconsultation service, at national level and by geographical area. Information reported as N (%).

	North (31 centres)	Centre (21 centres)	South and Islands (12 centres)	Total (64 centres)
Bioengineers	0	2 (9.5)	2 (16.7)	4 (6.2)
Cardiologist	0	0	2 (16.7)	2 (3.1)
Physiotherapist	1 (3.2)	0	1 (8.3)	2 (3.1)
Nurses	26 (83.9)	13 (61.9)	7 (58.3)	46 (71.9)
Doctors	4 (12.9)	4 (19)	3 (25)	11 (17.2)
Doctors-radiology technicians	1 (3.2)	0	0	1 (1.6)
Cardio-circulatory pathophysiology technicians	8 (25.8)	6 (28.6)	2 (16.7)	16 (25)

Telemonitoring is primarily managed by doctors and, to a lesser extent, by nurses and cardio-circulatory pathophysiology technicians (Table 10). In particular, the nursing staff performs more telemonitoring services in the north than in the centre and south; as regards cardio-circulatory pathophysiology technicians, they are more involved in the north and centre, less in the south (19%).

Table 10. Personnel performing telemonitoring services, at national level and by geographical area. Information reported as N (%).

	North (73 centres)	Centre (34 centres)	South and Islands (21 centres)	Total (128 centres)
Nurses	55 (75,3)	14 (41,2)	13 (61,9)	82 (64)
Doctors	51 (69,9)	23 (67,6)	16 (76,2)	90 (70,3)
Cardio-circulatory pathophysiology technicians	26 (35,6)	15 (44,1)	4 (19)	45 (35,2)

Governance, safety and accessibility of health care workers.

Of the total services, only 46% are subject to a fee. The fee mainly concerns televisit and remote control (i.e., remote control of the CIED) and then, to a lesser extent, telemonitoring, teleconsultation and other services (Table 11).

Table 11. Presence of fees for telemedicine services and service types for which a fee exists, at national level and by geographical area. Information reported as N (%). CIED: cardiac implantable

electronic device.

	North (101 centres)	Centre (53 centres)	South and islands (44 centres)	Total (198 centres)
Charges				
Yes	56 (55.4)	27 (50.9)	8 (18.2)	91 (46.0)
No	45 (44.6)	26 (49.1)	36 (81.8)	107 (54.0)
Services subject to charges				
Renewal of treatment plans	0	0	1 (12.5)	1 (1.1)
Health professionals teleconsultation	5 (10.9)	2 (7.4)	0	7 (7.7)
Medical teleconsultation	8 (14.3)	4 (57.1)	0	12 (13.2)
Remote control (CIED)	32 (57.1)	10 (37)	5 (62.5)	47 (51.6)
Telemonitoring	16 (28.6)	2 (7.4)	2 (25)	20 (22)
Tele rehabilitation	4 (7.1)	0	0	4 (4.4)
Televisit	31 (55.3)	23 (85.2)	5 (62.5)	59 (64.8)
I don't know	1 (1.8)	1 (3.7)	0	2 (2.2)
Total centres with charging	56	27	8	91

Considering the facilities that provide telemedicine services, in 51% of cases, company deliberations, specific procedures, operational protocols and/or informed consent are used. In 43.4% of the cases, the structure did not prepare any of the documents mentioned above for the personnel address (Table 12). For more detailed information on the type of documents adopted, please consult the Table 3 in supplementary material.

Table 12. Presence in the facilities using telemedicine of deliberations, procedures, protocols, informed consent, at national level and by geographical area. Information reported as N (%).

	North (101 centres)	Centre (53 centres)	South and islands (44 centres)	Total (198 centres)
Yes	57 (57,4)	26 (49,1)	17 (38,6)	101(51)
No	40 (39,6)	22 (41,5)	24 (54,6)	86 (43,4)
I don't know	2 (2)	5 (9,4)	0	7 (3,6)
Other	1 (1)	0	3 (6,8)	4 (2)

From a technological point of view, 52% of centres use devices (47.5% in the north, 50.9% in the centre and 63.6% in the south), which are medical devices in 86.4% (87.5% in the north, 88.9% in the centre and 82.1% in the south), although there is still a proportion of health personnel (on average 11.7%) who did not answer this question. Table 13 shows the device types used; for further details on device types refer to the Table 4 in supplementary material.

Table 13. Devices used in telemedicine facilities, nationally and by geographical area. Information reported as N (%). ECG: electrocardiogram.

Device	North (101 centres)	Centre (53 centres)	South and islands (44 centres)	Total (198 centres)
Implantable device ^a	28 (27.7)	15 (28.3)	13 (29.5)	56 (28.3)
Device for monitoring basic clinical parameters ^b	59 (58.4)	35 (66)	44 (100)	138 (69.7)
ECG	18 (17.8)	12 (22.6)	18 (41)	48 (24.2)
Ultrasound	0	1 (1.9)	1 (2.3)	2 (1)
Event recorder	0	1 (1.9)	0	1 (0.5)
Spirometer	3 (2.3)	1 (1.9)	0	4 (2)
Other	1 (1)	0	0	1 (0.5)

^aImplantable devices: Hemodynamic monitoring devices, Loop recorder, pacemaker also biventricular, defibrillators also biventricular; ^bDevice for monitoring basic clinical parameters: physical activity, sleep, weight, heart rate, blood pressure, glycaemia, body composition and hydration status of the body, pulse oximetry, temperature and respirator frequency.

An interesting aspect concerns the healthcare workers' accessibility to telemedicine services. Only 28.3% of respondents have a telemedicine centre in the facility with dedicated staff (32.7% in the north, 24.5% in the centre and 22.7% in the south). The facility or OUs provides training for health personnel to start telemedicine services in 56.1% of cases (63.4% in the north, 45.3% in the centre and 54.5% in the south). Only 19.7% of the facilities are able to collect data.

Patient centricity

Most facilities treat a number of patients ranging from 100 to 500 annually; details are given in Table 14.

Table 14. Patients followed yearly through telemedicine, at national level and by geographical area. Information reported as N (%).

Patients treated in telemedicine	North (101 centres)	Centre (53 centres)	South and Islands (44 centres)	Total (198 centres)
0 - 100	13 (12.9)	13 (24.6)	11 (25.0)	37 (18.7)
101 - 500	62 (61.4)	33 (62.2)	29 (65.9)	124 (62.6)
> 500	26 (25.7)	7 (13.2)	4 (9.1)	37 (18.7)

The majority of facilities reports adequate information services provided to patients, and communication is mostly personalized at the start of the patients' treatment (41.8% of cases); information services include informative brochures, face-to-face meetings or digital material. In 25.5% of cases none of these instruments is provided. The detail, at national level and by geographical areas, is illustrated in Figure 1 and Figure 2.

Only in 20.2% of the cases there is a patient satisfaction assessment carried out through questionnaires (67.5% of the cases) or interviews (32.5% of the cases).

Barriers to the adoption of telemedicine tools

The obstacles to the development of telemedicine are reported in Table 15. The most reported problems are lack of dedicated personnel, organizational complexity and lack of technological endowments available in the structures. There are also regulatory problems, relating to the lack of clear and simple rules for all, and technological barriers, such as poor connectivity and poor digital information of staff. Considering these barriers, data on facilities not providing telemedicine services are similar to those regarding all the other facilities.

Table 15. Obstacles encountered in the adoption of telemedicine services, at national level and by geographical area. Information reported as N (%). GDPR: General Data Protection Regulation.

	Geographical area			Use of telemedicine		Total (251 centres)
	North (120 centres)	Centre (68 centres)	South and islands (63 centres)	No (53 centres)	Yes (198 centres)	
No obstacle	5 (4.2)	4 (5.9)	2 (3.2)	1 (1.8)	10 (5.0)	11 (4.4)
Lack of relevant legislation	26 (21.7)	15 (22.1)	17 (27.0)	7 (13.2)	51 (25.7)	58 (23.1)
Complexity in organisational terms	63 (52.5)	37 (54.4)	35 (55.6)	23 (43.4)	112 (56.6)	135 (53.8)
Complexity in the application of GDPR	15 (12.5)	5 (7.4)	9 (14.3)	2 (3.8)	27 (13.6)	29 (11.6)
Complexity in the application of specific legislation	16 (13.3)	4 (5.9)	8 (12.7)	7 (13.2)	21 (10.6)	28 (11.2)
Mistrust and lack of confidence in telemedicine by the health establishment	7 (5.8)	3 (4.4)	6 (9.5)	2 (3.8)	14 (7.1)	16 (6.4)
Data fragmentation and non-interoperability of systems	26 (21.7)	17 (25.0)	17 (27.0)	6 (11.3)	54 (27.3)	60 (23.9)
Lack of technological equipment in the structure	44 (36.7)	34 (50.0)	24 (38.1)	23 (43.4)	79 (39.9)	102 (40.6)
Lack of adequate infrastructure and Internet connectivity	28 (23.3)	17 (25.0)	18 (28.6)	8 (15.1)	55 (27.8)	63 (25.1)
Lack of dedicated staff	64 (53.3)	38 (55.9)	47 (74.6)	30 (56.6)	119 (60.1)	149 (59.4)
Cost in economic terms	21 (17.5)	7 (10.3)	11 (17.5)	8 (15.1)	31 (15.6)	39 (15.5)
Internal bureaucratic	19 (15.8)	6 (8.8)	11 (17.5)	5 (9.4)	31 (15.6)	36 (14.3)

procedures inappropriate to the theme						
Poor digital training of staff	12 (10.0)	12 (17.6)	10 (15.9)	5 (9.4)	29 (14.6)	34 (13.5)
Lack of staff willingness or cooperation	6 (5.0)	7 (10.3)	6 (9.5)	4 (7.5)	15 (7.6)	19 (7.6)

Considering the obstacles to the development of telemedicine encountered by patients, emerges lack of familiarity with technology, followed by difficulty in using software and devices, lack of information and poor home internet connection. The distrust towards these new services concerns 18.7%. Details are shown in Figure 3 and Figure 4.

Discussion

Principal Results

Survey results allow several considerations. First consideration concerns the response rate (56.7%), which, although not optimal (56.7%), allowed the information of interest to be obtained from a considerable number of centres. Connection, cooperation and dialogue between institutional organisations, which monitor and carry out research, and operational structures on the ground remain fundamental aspects to understand the critical points and solve them to build paths adapted to the needs and to achieve results. The most widely used telemedicine services and the diseases treated with telemedicine confirm that telemedicine can ensure better homecare in the most chronic cases. This is essential in order to check early signs of instability or poor adherence to therapy, to intercept the early stages of clinical deterioration and to change the intervention strategy, when the patient is still asymptomatic, before the acute event, can reduce access to the Emergency Room and admissions. Furthermore, there is a clear demand for greater professional interaction, which could accelerate the diagnostic and therapeutic process. However, this remains mainly a local and regional aspect, less national and therefore interregional, with some exceptions.

There are still significant unresolved issues that limit the spread of telemedicine services, not only in the cardiology field. The first concerns the reimbursement of telemedicine services: if these services cannot be reported or charged, the work is not fully recognized, making it difficult to justify the need for dedicated staff, which represents a major obstacle to development. Additional obstacles are the resulting organizational complexity, also linked to the lack of appropriate organizational models supported by the presence of procedures and operational protocols that address and protect health personnel and patients. Last but not least, the lack of adequate technological equipment remains a critical issue.

The centrality of the patient remains a fundamental aspect. The data collected suggest that is a need to properly inform patients about these new services and methodologies. This is fundamental in order to achieve good therapeutic adherence, increase patient empowerment and engagement, to make the patient and caregiver understand how much it can improve the quality of life and therefore increase the therapeutic continuity and avoid possible related risks. Despite some geographical variability, the relatively low percentage of mistrust towards these new services (18.7% national, 14.2% north, 16.2% centre and 27% south) suggests that much was invested in recent times for the centrality of the patient and information to the patient and caregiver, probably obtaining good outcomes. Results show that still 25% of patients are not properly informed; it is necessary to supplement this data with evidence that some of the services provided (tele reporting of ECG, for example, or certain instrumental examinations) do not require detailed information to the patient on the functioning of

the service itself. Unfortunately, it was not possible to make a sub-analysis to check in detail whether this percentage of "inadequate" information was related to these services, since the question relating to patient information was related to the Telecardiology service in general and, therefore, to all services. Apart from this possible correlation, this lack of information to the patient justifies those which are the main obstacles identified, the low familiarity and the difficulty in using the essential technologies and, the lack of information on the services provided.

Limitations

The survey has some limitations regarding planning and dissemination: since it was not possible to disseminate the survey through the regional health departments, we contacted directly the facilities as described in the methodology section; thus, there is the possibility that we failed to contact some structures. In addition, considering the 11 questions that included a text description field, seven of them asked to specify the cardiovascular diseases treated using telemedicine services. Due to the variety and dispersion of responses, it was difficult to elaborate answers to those questions; therefore, we decided to limit the analysis only to major cardiovascular pathologies, without providing further details. A final consideration concerns the remote referral: this service was investigated only in relation to instrumental examinations (ECG, echocardiogram, monitoring of heart rhythm and blood pressure, etc.), without considering other services, televisit and teleconsultation, for which tele referring is provided.

Additionally, we cannot exclude that facilities using telemedicine services were more likely to participate in the survey compared to those without a telemedicine service. Finally, as this is a survey-based study, answers to some questions may be affected by inaccuracies due to self-report bias or interpretation of the questions. Fortunately, the percentage of this event was very low.

Conclusions

There are still organizational and clinical limitations in the application of telemedicine in cardiology, one of the first field to use these services in the real-life patient's management; telemedicine in cardiology is not yet an integral part of medical practice. In fact, it appears that the spread in Italy is still limited because of some structural and organizational barriers. Mainly, there is a lack of dedicated staff to manage and implement telemedicine services; sometimes there are no clear rules and regulations on the uniform and safe adoption of these technologies at national level or information about them. Finally, despite their wide availability, usually technologies are not well integrated into care pathways. These results confirm that the true challenge of Telecardiology is the integration of available technology with precise, concrete and simplified organizational models. As a tool, technology is fundamental, only if it is accessible and adequate and it must be integrated with new paths built according to the needs of the territory, patients and health personnel. Fundamental aspects are the reporting procedures and operating protocols, to establish who does what, and how, and with the availability of dedicated personnel adequately trained and able to inform patients and caregivers.

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units within the same hospital).

Conflicts of Interest

None declared.

Abbreviations

AIAC: Italian Association of Arrhythmology and Cardio stimulation
ANMCO: National Association of Doctors and Hospital Cardiologist
AP: Autonomous Provinces
CEN: National Ethics Committee
CIED: Cardiac Implantable Electronic Device
ECG: Electrocardiogram
GDPR: General Data Protection Regulation
ICT: Information and Communication Technologies
ISS: Italian National Institute of Health
OUs: Operative Units
SIC: Italian Society of Cardiology
SIMeDi: Italian Society of Digital Medicine
SIT: Italian Society of Telemedicine
TQoCT: Telehealth Quality of Care Tool
WHO: World Health Organization

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Supplementary Files

Figures

Multimedia Appendixes

Supplementary material.

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