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Research article

Healthcare professionals' beliefs, attitudes, and thoughts toward cardiopulmonary telerehabilitation: A mixed-methods study

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ABSTRACT

Healthcare professionals' opinions, attitudes, and thoughts toward new digital healthcare are often overlooked. However, they play a crucial role in accepting new digital care strategies. This research aimed to understand the perceptions of cardiopulmonary rehabilitation professionals towards telerehabilitation by conducting a mixed-method study at various Fondazione Don Carlo Gnocchi centers in Italy. A total of 14 healthcare workers, including 7 experts in telerehabilitation, participated through surveys and semi-structured focus groups, covering 12 thematic areas derived from the Theoretical Domains Framework (knowledge; professional role; beliefs about capabilities; beliefs about consequences; optimism; reinforcement, goals; memory, attention, and decision process; environmental context and resources; social influences; emotions; ideal patient's profile). Participants (mean age = 45.00 ± 9.06; M:F = 3:11) shared diverse experiences and views on telerehabilitation. All participants had a good knowledge of telerehabilitation. While non-experts indicated technological expertise and preserved cognitive level as a prerequisite for telerehabilitation use, experts believed that no ideal patient exists and that all people can benefit from it. They converged in defining it as a new delivery path of rehabilitation with the same objective of face-to-face rehabilitation services, enhancing the patient's quality of life. Environmental, infrastructural, and institutional resources are needed to enhance accessibility. Positive attitude, optimism, and expectation were reported, but uncertainties about how to manage safety issues and increased workload were mentioned. The study showed a complex picture of staff rehabilitation beliefs about telerehabilitation. Overall, telerehabilitation was considered a great opportunity for patients who face barriers to in-person clinical interventions.

1. Introduction

Technological progress and digital breakthroughs constitute a force of change in healthcare systems [1], redefining care models and transforming care paths. Especially, new digital platforms, smart and medical devices allow for delivering health services out of

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the clinics and hospitals, such as in patients' homes and local communities. This migration of care from the hospitals' walls to the territory brings several advantages: the patient is taken in charge in his daily life context by a multidisciplinary team, accessing a healthcare networking platform [2], with an empowered role as "citizen patients" in the local communities [3,4] bypassing accessibility constraint issues that usually impact the in-clinic health services [5,6]. New digital health solutions also can answer the increasing need for health services in front of healthcare system overburdened issues. In particular, telerehabilitation (TR) solutions enable the provision of treatment at a distance, scaling up a highly specialized hospital-based service to a broader population in everyday life context [7]. This is especially relevant for cardiopulmonary conditions. Specifically, chronic obstructive pulmonary disease, heart failure, and acute myocardial infarction belong to 25 clinical conditions with the highest prevalence and number of associated years lived with disability for which rehabilitation is a key intervention [6]. Overall, cardiopulmonary conditions affect over 150 million globally, positioning at the top of the list of prevalent non-communicable diseases [8]. Several research works converge in supporting that a comprehensive rehabilitative approach in addition to valuable pharmacological therapies appears to be an effective solution to prevent exacerbations, increase exercise tolerance and quality of life, and reduce hospital readmission rate and mortality [9,10]. Two recent meta-analyses supported TR in cardiopulmonary conditions [11,12], as a safe treatment with minimal adverse events that promotes adherence and improves functional capacities.

Despite the advantages of TR in cardiopulmonary disease, the transition from traditional hospital-centric rehabilitation to an innovative strategy of care delivered at a distance through technologies represents a significant change of direction, plausibly impacting all involved end users' routines. In fact, the sense-making experience related to new rehabilitation models as well as individual factors, such as attitudes toward technologies, could influence the adoption and acceptance of new digital intervention strategies [13]. In this context, qualitative and quantitative research has begun to investigate how TR is experienced from the perspective of patients and health professionals [13]. Most studies have focused on the patient's perspective, supporting the good satisfaction, usability, and acceptability of TR systems [14,15]. From the health professionals' perspectives, instead, fewer studies were conducted and identified the role of barriers able to contrast the acceptability of new TR strategies. Among these, lack of organizational support and resources, TR perceived usefulness, and constraints have been reported [13,16–19]. It is well-known that frontline staff's attitudes, thoughts, and beliefs toward new TR solutions have a significant role in adopting and accepting new health intervention paths [20,21]. Therefore, deepening the staff's perceptions is relevant to identify and overcome the potential barriers contrasting with the recent digital health transition.

Although the delivery of technology-enhanced remote rehabilitation services emerged more than 30 years ago, it remained largely underutilized despite growing evidence of its potential [22]. Only in 2020, the COVID-19 pandemic resulted in a significant shift in the adoption of TR which represented a safe and valid alternative service delivery model to traditional in-person treatment during the global pandemic [22,23] to ensure that persons with disabilities had equal access to healthcare services. However, after initial enthusiasm, the end of the emergency by COVID-19 is resulting in a return to previous face-to-face rehabilitation models and the progressive abandonment of the TR [22]. In this context, studies that understand how rehabilitation staff perceive TR, including its barriers and issues, appear as a priority in order to urge professionals not to abandon digital health opportunities, but to adopt and implement TR effectively [24].

Therefore, the present study aimed to investigate the beliefs, attitudes, and thoughts toward TR of Italian healthcare personnel involved in cardiopulmonary rehabilitation. To reach a multilevel comprehension of the rehabilitation staff's point of view toward TR, we focused on both the perspectives of people who were familiar with TR and those who did not.

2. Materials and method

To this aim, a multi-site prospective mix-method (qualitative-quantitative) cross-sectional study was conducted in Italy from January to June 2022. In detail, the study involved cardiopulmonary rehabilitation frontline staff, both TR experts and non-experts by gathering the thoughts of rehabilitation professionals in 12 domains of the Theoretical Domains Framework (TDF). The TDF was used to understand what dependencies or factors should be in place for the Italian hospitals to adopt TR or implement the practice effectively.

2.1. Participants

Participants of the present study (n = 14) were the rehabilitation staff of the Fondazione Don Carlo Gnocchi ONLUS (FDG) in Italy. FDG is a multi-site foundation that carries out its rehabilitation activities under the accreditation regime with the Italian National Health Service in 28 Centers across 9 Italian regions. In this study, the six centers dealing with cardiopulmonary rehabilitation have been involved: IRCCS "Santa Maria Nascente" (Milan), "E. Spalenza – Don Gnocchi" (Rovato, Brescia), IRCCS "Don Carlo Gnocchi" (Florence), "S. Maria ai Servi" (Parma), "S. Maria alla Pineta" (Marina di Massa, Massa-Carrara) and "S. Maria della Pace" (Rome).

All staff members of the clinics currently involved in cardiopulmonary rehabilitation and/or TR were invited to take part in the study. Subjects covered the following professions in the clinic: cardiologist, pulmonologist, physiotherapist, psychologist, nurse, occupational therapist, and computer scientist (involved in telemedicine platforms management). The inclusion criteria were the following: *i)* working in a rehabilitation center; *ii)* as a staff of the multidisciplinary rehabilitation service; *iii)* for cardiopulmonary interventions. Fig. 1 depicts the flowchart of the study methodology.

The participants were enrolled during the periodical meetings of the Don Gnocchi Foundation rehabilitation unit by the head of the cardiopulmonary department. Before being involved in the study, each subject read and signed the written informed consent.

2.2. Data collection instrument and process

Subjects were invited to complete a questionnaire on their technological expertise. Also, they were asked to complete a survey (open and closed questions) and participate in a focus group session aimed at exploring their subjective perspective and sense-making toward cardiopulmonary TR diffusion and integration into the healthcare system. The survey questions and the focus group interview guide were based on 12 themes adapted from the theoretical domains' framework [25] (see Table 1 for details on the survey's and the focus group's questions and Fig. 1 for the flow chart of the methodology). Globally, participants were asked for 2 h of availability.

All subjects completed a 12-item *ad-hoc* questionnaire on technological expertise exploring the individuals' familiarity and perceived competence in the use of technologies in the last year [26–29]. For each technology (smartphone, tablet, internet, social network, games, apps), subjects were invited to rate on a 5-point Likert scale the level of their frequency of use and the level of their perceived skills in the use. Two total scores were obtained by separately averaging the score of frequency of use and perceived skills items (range 1–5). A higher score indicated a greater technology frequency of use/perceived competence (see Supplementary Material, S1).

To investigate the beliefs, attitudes, and thoughts toward TR according to the TDF [25], 12 domains were assessed. Specifically, 11 domains were adapted from the TDF (*knowledge; professional role and expertise; beliefs about capabilities; optimism; beliefs about consequences; reinforcement; goals; memory, attention, and decision process; environmental context and resources; social influences; emotions),* and one additionally domain (*ideal TR patient profile)* were evaluated with the following tools (see Table 1):

- An online survey on *knowledge*, *professional role, and expertise* in TR including both open-ended and closed-ended questions. To explore the *knowledge* of TR, subjects were invited to report a brief definition of "telerehabilitation" (open-ended answer) and to indicate the ideal TR population target (closed-ended answer). To investigate the *professional role and expertise* in the field of TR, participants were asked to detail the number of years of telemedicine and/or TR experience and the type of TR (synchronous - asynchronous - mixed) they eventually experienced. Finally, subjects were invited to rate their skills in the field of TR on a 10-point Likert scale (see Supplementary Material, S2);
- a focus group interview session of 1.5 h lasting in a quiet meeting room in the clinical center. The focus group discussion was conducted by a psychologist (moderator) and a physician (note-taker). It consisted of a semi-structured interview, whose guide was implemented based on 10 themes (see Table 1). The semi-structured interview guide was implemented during three roundtable meetings of TR experts, which were focused on interview themes' selection, guide testing, and refinement. Before starting to discuss the focus group topics, the moderator invited participants to introduce themselves. Then, the moderator introduced each focus group theme and encouraged subjects to share their perspectives with the other participants. Based on the point of view shared by

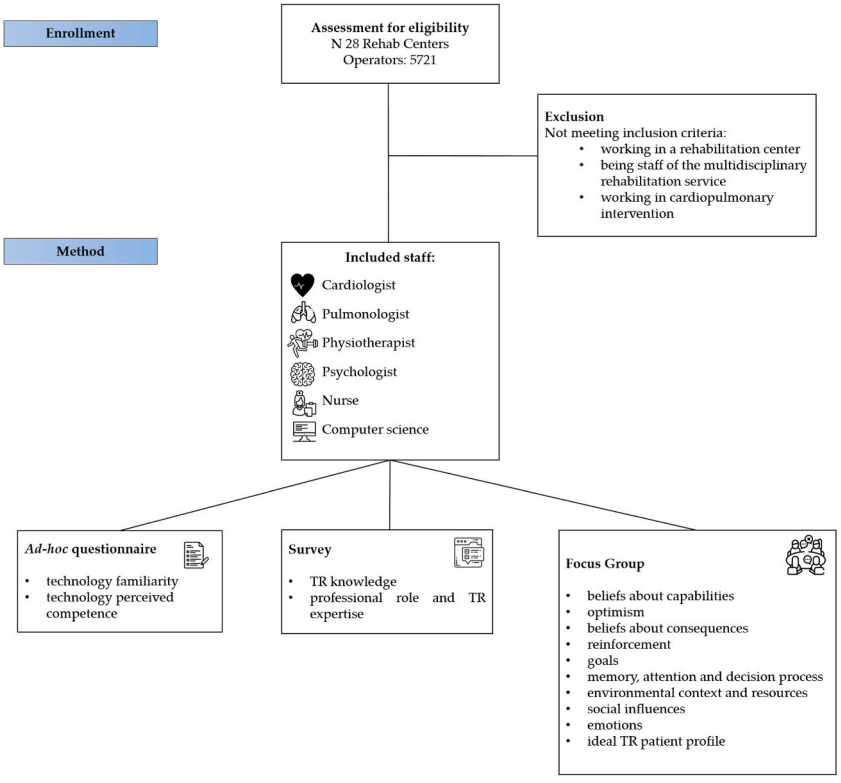

Fig. 1. Flow chart of the methodology of the study.

Table 1
The Theoretical Domains' Framework (TDF) and related questions adapted from Cane et al. (2012).

	TDF Domains	Questions	Survey	Focus Group
1	Knowledge	*What is TR?* *What is the TR population target?*	x	
2	Professional role and expertise	*How many years did you work in the TR field?* *Which type of TR did you experience (synchronous/asynchronous/mixed)?*	x	
3	Beliefs about capabilities	*Reflect on what skills are necessary to deliver and/or benefit from the TR. Which are the ones you believe to own?*		x
4	Optimism	*Think about how TR could make a difference for patients based on what you experienced, believe, and learned*		x
5	Beliefs about consequences	*Reflect on which are the TR facilitators and barriers*		x
6	Reinforcement	*Think about which factors may motivate you to use TR*		x
7	Goals	*Think which kind of goals you can achieve with TR*		x
8	Memory, attention and decision process	*Think about aspects that differentiate TR from conventional rehabilitation and that may constitute difficulties in terms of the increased requirements of attention, memory, and decision-making load*		x
9	Environmental context and resources	*Think about the resources needed to deliver TR and which are the ones currently available in your workplace*		x
10	Social influences	*Reflect on the attitudes your colleagues/managers have toward TR*		x
11	Emotions	*Think about the feeling you experience/may experience when you deliver/think about the possibility of delivering TR*		x
12	Ideal TR patient profile	*Think about the ideal patient profile who benefits from TR*		x

the participants, additional sub-themes to discuss were suggested. The session was tape-recorded, and then the registration was verbatim transcribed.

2.3. Data analysis

To summarize the participants' characteristics and technological expertise, descriptive statistics were run using Jamovi software (The Jamovi project, 2022; version 2.3; www.jamovi.org), and means, medians, standard deviations, and frequencies were reported. Similarly, closed-ended questions of the survey were quantitatively analysed by running summary statistics.

To explore clinicians' beliefs, attitudes, and thoughts toward cardiopulmonary TR, survey open-ended answers and the verbatim transcription of the focus group were qualitatively analysed by two psychologists (Ph.D.) working in an Italian clinical setting with a research background mainly on rehabilitation and TR, by adopting a content analysis approach. In detail, after familiarization with the data (survey open-ended answers and focus group verbatim transcription), the two researchers (raters) identified coding units and classified them into the 12 domains of the interview guide (*knowledge; professional role and expertise; beliefs about capabilities; optimism; beliefs about consequences; reinforcement; goals; memory, attention, and decision process; environmental context and resources; social influences; emotions; ideal TR patient profile)* in a double-blind modality. Then, to assure reliability, inter-rater agreement was computed and Cohen's k = 0.64 suggested substantial agreement between raters [30]. Disagreements were discussed and collegially resolved. Finally, for each of the 12 domains, sub-themes were extracted and synthesized stratifying results for TR experts and non-experts.

Table 2
Main characteristics of the participants.

	Subjects [$n = 14$]
Age (Mean ± SD)	45.00 ± 9.06
Sex (M:F)	3:11
Technological expertise (Mean ± SD)	
familiarity	4.00 ± 0.60
competence	4.12 ± 0.62
Profession (%)	
cardiologist	29
pulmonologist	14
physiotherapist	14
psychologist	29
nurse	7
computer science	7
TR Experience (%)	
expert	50
non-expert	50

M = male; F=Female; n = number; SD= Standard Deviation.

2.4. Ethical considerations

The research was conducted in line with the Helsinki Declaration's ethical principles and was reviewed and approved by the Don Gnocchi Foundation Ethics Committee.

The methodology of the study is also depicted in Fig. 1.

3. Results

3.1. Participants' characteristics and technological expertise

Nineteen health professionals answered the invitation to take part in the research. Among these, 14 cardiopulmonary rehabilitation experts (3 males, mean age = 45.00) participated in the study. Specifically, n = 8 subjects from the IRCCS "Santa Maria Nascente"; n = 2 from the "E. Spalenza – Don Gnocchi"; n = 1 from the IRCCS "Don Carlo Gnocchi"; n = 1 from the "S. Maria ai Servi"; n = 1 from the "S. Maria alla Pineta" and n = 1 from the "S. Maria della Pace". Table 2 and Fig. 2 (panel A) show the main characteristics of the participants. Globally, the subjects reported a high familiarity and competence in technology use (i.e., technology usage twice/three times a week; they judged themselves as competent) (see also Suppl. Material, S3).

3.2. Domain 1: knowledge

The survey's results showed that participants defined TR as how "*rehabilitation" (50 %)/* "*treatment*" *(14 %)* is provided "*at a distance" (36 %)* through "*technological tools"* (36 %), "*at the patient's home*" *(14 %)*, "*improving quality of life" (14 %), enhancing symptoms management and psychophysical functions, and preventing exacerbations and hospitalizations" (7* %).

Other aspects related to TR were that it constitutes "*digital medicine*", "supported *by clinical evidence*", that allows "*overcoming the limits related to space, time and accessibility*" eventually occurring when a rehabilitation service takes place on-site.

Among cardiopulmonary clinical conditions, Chronic Obstructive Pulmonary Disease was indicated as the best TR target (26 %), followed by Chronic Heart Failure (21 %), Coronary Artery Disease (21 %) and post-Covid conditions (21 %), after surgery conditions (11 %). No participants indicated Post heart-lung transplant, Interstitial lung disease, Left Ventricular Assist Device, and Peripheral vascular disease as ideal TR targets.

3.3. Domain 2: professional role and expertise domain

The participants who were involved in delivering TR (50 %), reported having a mean experience of 6 years (±2.81), with a minimum experience of at least 2 years (TR experts). They all provided both synchronous (online) and asynchronous (offline) TR modalities. When rating their perceived competence with TR, participants provided, on average, a score of 7.86 ± 1.95.

The rest of the group, who were not familiar with TR (TR non-experts), reported a mean experience in conventional cardiopulmonary rehabilitation of 8 years (±9.86). However, considering the wider field of telemedicine, two participants reported having provided teleconsultation during the COVID-19 pandemic period.

Table 3 reports a summary of the main findings that emerged during the focus group categorized by domains of the interview guide. Results are also summarized in Fig. 2.

3.4. Domain 3: beliefs about capabilities

TR experts agreed that, contrarily to people's beliefs, a high level of technological expertise and young age do not constitute

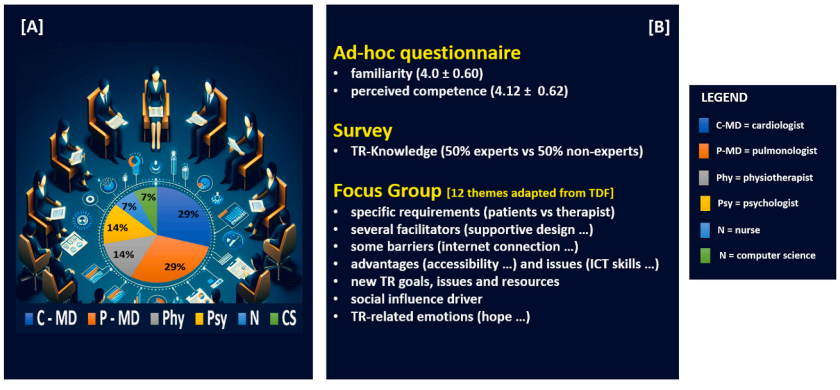

Fig. 2. Participant's characteristics, technological expertise, beliefs, attitude and thoughts toward TR results. Panel A reports the characteristics of the subjects recruited, panel B depicts the main results of the *ad-hoc* questionnaire, survey, and focus group.

Table 3
A summary of the main findings emerged from the focus group.

THEME	CODE	
Belief about capabilities	Patient requires …	Technological expertise (NE)
		Preserved cognitive functions (NE)
		Nothing (E)
	Therapist requires …	Minimal Technological expertise (ALL)
		Relational and communicative skills (E)
		Cognitive Flexibility (E)
Beliefs about consequences/Reinforcement	TR is facilitated by …	Platform design supporting the clinic-home communication (ALL)
		Protocol transferability to patient's home setting (ALL)
		Relational and communicative skills (E)
		Training on technologies use for patients before TR program at home (E)
		Institutional procurement strategies favoring TR (NE)
		Caregivers support at home (NE)
		Available ICT support (NE)
	TR is hindered by …	Management of safety issues (ALL)
		Weak internet connection (E)
		Perceived work overload burden (E)
		Reduced dedicated place, time, and personnel (E)
Optimism	advantages of TR are …	Increased accessibility (ALL)
		Enhanced self-efficacy (E)
		Enhanced PA at home (E)
Goal	TR aims to …	Scale up rehabilitation to a broader target (E)
		Increasing the patient's quality of life (NE)
Memory, attention, decision process	TR introduces …	Redefinition of working method (E)
		New skills to learn (E)
		Time-consuming decision-making (E)
		Cognitive load and fatigue (E)
Environmental context and resources	Environmental resources are …	Adequate devices (ALL)
		Stable Internet Connection (ALL)
	Infrastructural resources are …	Dedicated rooms (E)
	Institutional resources are …	Time (E)
		Dedicated Staff (E)
		Staff Education Training in TR (NE)
Social influence	A social influence driver is the …	Head Department (NE)
Emotion	Emotions related to TR are …	Hope (E)
		Curiosity (NE)
		Fear (ALL)
Ideal patient	The ideal profile includes	Chronic disease conditions (NE)

TR=Telerehabilitation; E = experts; NE=Non-Experts; ICT = Information and Communications Technology; PA = physical activity.

patients' prerequisite to benefit from TR (*"From the user point of view […] the technological expertise could be, somehow, very elementary […] I think it's something possible even for old people"*). In contrast, TR non-experts presumed patients' specific requirements for the TR effect, such as "*good technological expertise and preserved cognitive functions"*.

Considering the therapists delivering the treatment, both TR experts and non-experts strengthened the need for "*a little bit of familiarity with technology*" to "*properly respond to various technological issues which may occur."*

Moreover, TR experts highlighted the therapist's need for relational and communicative skills (such as empathy) as a critical feature for the successful treatment at a distance, as well as the knowledge of the patient's disease (*[…] they must also have a minimum of savoir-faire to patients because when you relate to people through a monitor, it is somehow more complicated […] So I think, even training on psychological skills for the staff may be interesting and useful […]. "*). Finally, they shed light on the importance of the therapist's flexibility in approaching the new rehabilitation solution *("a little flexibility is certainly needed to perform your usual work activities with a different method […]"*).

3.5. Domain 4: optimism

Both TR experts and non-experts mentioned the TR advantage compared to in-clinic interventions in terms of increased accessibility to the rehabilitation (*"… an opportunity for patients unable to be reached due to the limited capillarity that cardiac rehabilitation […] no travel times, no caregiver organizational issues … when the patient is not autonomous, someone who goes with him […]"*). For the TR experts, in fact, "*TR fits better into the patient's life"*, and facilitates physical activity at home so that the continuity of care is not perceived as an effort. In this framework, the therapist is an external point of reference that accompanies the patient until he becomes independent ("*I teach you to walk; then you will walk alone"),* promoting the patient's self-efficacy ("*[…] the sense of self-efficacy provides them great motivation to carry on with the home care path"*). Participants, additionally, claimed to have "*high expectations*" toward TR such as being "*able to treat more patients and have an impact on public health, even simpler with secondary prevention, which is particularly important."*

3.6. Domain 5: beliefs about consequences

Among TR facilitators, all participants highlighted the TR platform design in such a way that it supports a double-loop communication between the patient's home and the clinic ("*… allows you to manage all activities of the patient […] … to manage the patient "all-around", not only to deliver the task […] being able to talk to health personnel, not necessarily doctors … this greatly reassured the patient")*. Also, the flexibility of rehabilitation activities and devices such that they can fit with patients' home space and logistic issues (*"[…] a more suitable protocol for the logistic situation at home … adequacy of the rehabilitation protocols")* was implicated. Moreover, TR experts stated the importance of performing on-site training aimed at the TR system familiarity before starting the intervention, as well as dedicated support in the initial stage of the program ("*in-person training, on-site, and good support in the following days and weeks […]")*. Also, they mentioned relational and communication skills training for the therapist to make them prepared "*[…] to relate to patients in telemedicine and TR"*. Differently, TR non-expert identified as a facilitator the presence of a caregiver supporting the TR program at home (*"[…] the* role *of the caregiver is fundamental because he/she supports, in collaboration with the clinician, the patient"),* and the availability of *"the technical contact"* (help-desk) for both clinicians and patients. Finally, the role of the institution procurement that motivates to carry out TR and supports personnel was reported as crucial (*"if there is an adequate organization behind, also the motivation of doing TR will be positively influenced […]")*.

Concerning the TR barriers, both TR experts and non-experts identified the impossibility of prompt intervention in case of emergency or adverse event during the intervention *("[…] if the patient has a hypertensive crisis in front of me, I have everything available from a therapeutic intervention … drugs, and all to check that the situation is back. At home, I can only ask the patient "What do you have in the medicine cabinet, and take this therapy rather than the other one". I would have to adapt first andthen involve the doctor […] The solution to the problem is less immediate")*. In addition, the TR experts report the weak internet connection as a potential barrier *("… you struggle to follow what they say, they struggle to hear you, it becomes more complex")*. Also, for the therapist, working online with multiple patients simultaneously may result in mental fatigue and workload (*"[…] following a group of patients required a cost in terms of mental fatigue, more than following them individually throughout the day")*. Finally, the absence of "*dedicated place, time, and personnel"* for TR is mentioned.

3.7. Domain 6: reinforcement

Factors identified as reinforcement overlapped with facilitators and were reported mainly by TR non-experts, such as the presence of an organization supporting the TR approach. Also, the possibility for the therapist to monitor the patient's activity in the continuity of care was mentioned as an additional reinforcement.

3.8. Domain 7: goals

TR experts and non-experts listed distinct goals related to TR. Experts underlined that TR allowed to scale up the rehabilitation to a broader clinical population, carrying out "*controlled and modulated activities even outdoors … using the street, the park or any available space",* increasing the patient's adherence by acting on the autonomy achievement ("*when we give them autonomy, they are more likely to continue to do this activity in real life; if instead we keep them too much under control, when this control attenuates, the activity we have set probably also ends")*. Instead, the TR non-experts mentioned the wider TR goal as "*increasing the patient's quality of life, reducing the number of hospitalizations and exacerbations […]."*

3.9. Domain 8: memory, attention, and decision process

Only TR experts provided clues about effort related to the redefinition of the working method and learning new skills (e.g., using a telemedicine platform), for which flexibility is required. In fact, "*when you face something new, at first you need time to learn, […] at first you need elasticity allowing to visualize things or organize them differently you are used to"*. Moreover, they highlighted that the decision-making process in TR included a more time-consuming demand (*"[…] the decisions made are not as immediate as when I have the patient at hand […]")*. Furthermore, the large number of patients that can be treated in TR may lead the therapists to experience cognitive load and psychological fatigue.

3.10. Domain 9-10: environmental context and resources and social influence

Both TR experts and non-experts identified environmental, infrastructural, and institutional resources as necessary to support the TR provision.

Environmental resources: all subjects agreed on the crucial role of TR devices, feasible for the patients' home such as "*pedals rather than other tools that patients may already have at home […]"* and "*a stable internet connection […] when you are connected with several patients."*

Infrastructural resources: TR experts reported the relevance of a "*dedicated place"* in the clinic to perform TR. Additionally, the need for interoperable ICT (Information and Communications Technology) systems has been mentioned.

Institutional resources: TR experts mentioned the need for "*dedicated time and staff"* as significant resources, especially in the first period of a TR program, then "*everything can be performed more easily, and times optimized […]."* Finally, TR non-experts identified the importance of institutional support in terms of investing in education ("*staff training*") in TR, with special attention to each professional

role (*"I don't know what role the nurse will have in TR … I imagine that we need to understand well what the role of the nurse could be […]"*).

Social influence: TR experts reported a positive attitude toward TR, even if they mentioned a risk of a possible increment in the workload. *"[…] it's a further load in a daily task that is already saturated […]."*. The TR non-experts, instead, strengthen the role of the institution and the employer in introducing, promoting, and supporting TR solutions in clinical practice: "*Our head will be an important locomotive driving to use TR.*"

3.11. Domain 11: emotion

TR experts reported that when they think about TR, they feel hopeful about the potential to reach more patients. Similarly, the TR non-experts mentioned being intrigued to experience TR. However, both TR experts and non-experts stated to feel afraid. Specifically, experts reported being afraid mainly for two issues: 1) the management of adverse events eventually occurring during TR sessions (*"[…] when you see the patient feel bad in the clinic, you are not particularly relaxed … but, when you see him feeling sick on the other side of the monitor …. […]"),* and *2)* the possible increment of workload related to the TR (*"probably at the end of the day you feel with a load on your shoulders … quite challenging").* Instead, non-experts mentioned being afraid of *1)* treatment adherence issues, and 2) the reduced patient's socialization *("the patient is there alone and does not come out and we do not let him out and do not socialize").*

3.12. Domain 12: TR ideal patient

Finally, when reflecting on the TR patient profile, the TR experts strengthened that there is no ideal patient profile ("*[…] for me, TR could be effective in all patients who have had an event […]"*). In contrast, for non-experts, TR patients should be chronic, since acute patients "*usually have a level of gravity for which it becomes more difficult to manage them at a distance"*.

Fig. 2 (panel B) summarizes the main results.

4. Discussion

In recent years, new technology for healthcare has made great strides in supporting the transition of care service out of the clinic thanks to telemedicine strategies [31]. In the field of rehabilitation, new care paths are starting to be adopted to offer a tele-supervised continuity of care at home using TR platforms, with the potential to extend the rehabilitation service to a broader target population [7]. However, healthcare professionals' beliefs, attitudes, and thoughts toward TR are relevant issues, often overlooked. In fact, healthcare professionals are part of a radical change in the rehabilitation service daily work routine and the acceptance of new health intervention pathways may be not easy [20,21,32], especially in the Italian context where the integration and regulation of telemedicine pathways is still an ongoing process. In the present study, we aimed to understand the cardiopulmonary rehabilitation experts' beliefs, attitudes, and knowledge toward TR strategies in the Italian context for identifying barriers that could counteract the recent digital health transition. To this aim, a survey and a focus group were administered to cardiopulmonary rehabilitation experts.

Our study showed a complex picture of beliefs about TR strategies for the intervention of rehabilitation experts, including both positive expectations and uncertainties. The main themes were related to a shared understanding of what TR is and its ideal target; the TR strengths and criticalities in terms of accessibility; and the barriers and enablers in using TR in the clinical setting.

4.1. What is TR and its ideal target?

Concerning our first main theme, we observed that the perceptions of participants toward TR were related to a correct knowledge of what TR strategies are. In fact, even if not all the participants were familiar with TR in their daily routine, our group of rehabilitation experts defined it as a new delivery path (how) of rehabilitation (what) with the same goal of the face-to-face rehabilitation services, improving the patient's quality of life. Also, the professionals converged on which is the best TR target, indicating Chronic Obstructive Pulmonary Disease, followed by Chronic Heart Failure, Coronary Artery Disease, and post-Covid conditions. These conditions fit with the cardiopulmonary diseases reported by the systematic analysis of the Global Burden of Disease Study 2019 on the list of conditions with the highest number of years lived with disability and rehabilitation needs [6]. In this context, rehabilitation experts' expectations include the potential role of TR paths in handling and intervening in the huge need for rehabilitation services for these increasing chronic cardiopulmonary diseases, according to recent experts' roundtable positions in the Italian context [33]. TR is seen as an opportunity for patients unreachable with in-clinic interventions, reducing the barriers for frail and less independent persons to access consultations and treatments [23].

Moreover, the rehabilitation staff split in two about the patient's capabilities needed to receive a TR treatment. TR experts were confident that no requirements are needed to benefit from TR and, basically, all the patients may be involved. Instead, non-experts believed that preserved cognitive functioning and technological expertise are relevant prerequisites to access to TR. Without previous experience in TR delivery, the staff focused on usability constraints potentially linked with telemedicine technological systems. Interestingly, recent evidence exploring the role of usability factors on the intention to take part in TR in patients with Chronic Obstructive Pulmonary Disease and Chronic Heart Failure revealed that the only level of perceived usefulness of the treatment, and not the ease-of-use experience, significantly impacted the behavioral intention to use a telemedicine system [15]. As suggested in the focus group, a special focus should be given to TR system familiarity training before starting the intervention to handle ease-of-use issues. Moreover, the treatment's usefulness perception should be investigated to monitor patient compliance.

4.2. Accessibility

Moving to the accessibility issues at the rehabilitation staff level, all the participants indicated the need to own the least technological skills. This belief is in line with the high complexity of the TR platform clinician side, which is likely to be more sophisticated than the patient side. In this regard, co-designing the technological platform with end-users, both patients and clinical staff, may help to avoid technological constraints [34]. Also, as mentioned in our study, the presence of ICT-dedicated support in the initial stage of the program for the staff may be a solution for TR non-experts. Interestingly, from the clinician side, relational skills have been reported as substantial in TR as well as the knowledge of the patient's disease. In fact, the communication between the therapist and the patient may be handled differently in a telemedicine system than in a face-to-face interaction, and the staff should be prepared. A previous qualitative study exploring the patient's perspectives on tele-visits and tele-interventions in older people reported positive therapeutic relationships as a main theme [35]. However, to date, no relation and communication skills training, such as suggested by our participants in the study, are usually proposed to the staff before delivering TR, and more focus may be given in the future. Finally, another relevant skill needed to efficiently use the TR system mentioned was cognitive flexibility. The utilization of new tools, systems, and pathways in the daily routine includes a necessary initial re-learning and re-definition of procedures before automatizing a work method. This issue carries with memory and executive demands therapists have to cope with. In this regard, the experts' group told their experience with efforts related to the redefinition of the working method and learning new skills.

4.3. TR barriers and enablers

Although our study found that health professionals in general had a positive attitude toward TR, seeing it as a way to scale up rehabilitation to a broader clinical population, both TR barriers and enablers emerged during the analysis. As previously said and widely demonstrated in the literature [23,36], the technology represents a facilitator of TR but, at the same time, a barrier to successful participation. In this regard, participants underlined the critical role of how the TR platform has been designed, supporting the need for a double-loop communication between the patient's home and the clinic [37]. The platform must be conceived with high granularity to allow professionals to manage all activities of the patient, not only to deliver the task. Indeed, the possibility for the therapist to monitor the patient's activity in the continuity of care is mentioned as reinforcement in adopting TR. Furthermore, the double-loop communication should ensure patients have a link with health personnel, greatly reassuring them not to be abandoned. Moreover, in using TR, it is important to pay attention to limited technical resources, the absence of devices at home, and slow Internet bandwidth.

In addition, rehabilitation staff split in two about the barriers to using a TR approach. The non-experts mentioned being afraid of treatment adherence issues and reduced patient socialization. The adherence rate to treatment is a critical aspect of a rehabilitation program since an attendance decrement plausibly impacts the efficacy of the program [38]. For this reason, one of the hot topics is the design of innovative solutions able to engage and motivate patients to continue with rehabilitation at home [39]. On the other side, TR experts underlined the impossibility of intervening promptly in case of an emergency during the treatment. The topic of safety is particularly relevant in cardio-pulmonary rehabilitation since serious adverse events (e.g., cardiopulmonary arrests, arrhythmias) are estimated to occur in about 1 per every 50,000 patient-hours during center-based rehabilitation [9,40]. The concern grows when the patient is at home alone as in the TR program. However, several reviews demonstrated confident findings in favor of TR [11,12,41,42]. Studies showed that there was no significant increase in adverse events between participation in cardiac TR compared with no rehabilitation or home-based treatment [11]. A recent systematic review showed that 6 of seven studies that investigated the safety issue related to TR in COPD reported an absence of or minimal adverse events [12]. These interesting results have been supported by a further review of studies on TR in patients with CHF [11]. Among the 4 studies that recorded adverse events, all reported minimal side effects. Interestingly, the results favored the TR approach compared to home-based treatment by reporting minimal adverse events and high adherence (86 %) to the treatment. These results suggest TR for COPD and CHF patients as a suitable and safe approach. Considering the crucial role of safety in treating fragile patients and in light of a translational perspective, these findings are promising. However, adverse events in TR still remained an overlooked issue. Therefore, further evidence on the safety constraints related to TR is needed.

Among the TR barriers, working with multiple patients simultaneously may result in psychological fatigue and excessive workload for clinicians. In this context, the institution should play a crucial role in promoting TR and supporting personnel with dedicated places, time, staff, and training. At the same time, the TR-related regulations are still in definition. Recently, the Italian Ministry of Health published the "Organizational guidelines containing the digital model for the implementation of home care" in which the definition of TR, application areas, and conditions for delivery were detailed. However, to date, there is still no defined reimbursement plan for TR services; this makes its use within clinical practice complex.

4.4. Limitations and conclusion

Although this study offered a comprehensive exploration of the Italian rehabilitation experts' perspectives on TR, it is not exempt from limitations. Firstly, it included a small sample size: 14 health professionals to represent Italian FDG cardiopulmonary rehabilitation staff. Also, due to the small number of participants, we included in the study all people who accepted to take part in the focus group, adopting a consecutive enrolment and not a randomized approach, plausibly introducing a selection bias. Also, the study was conducted only in FDG centers in Italy and does not focus on eventual cultural and demographic differences in healthcare staff perspective toward TR. We used an *ad-hoc* questionnaire to evaluate the participants' technological expertise. Although this tool has

been previously adopted in several studies [26–29], no evidence of its reliability and validity is still available. Future studies will focus on the validation of this questionnaire in a wide population.

Overall, participants' beliefs, attitudes, and thoughts highlight the need for considering four main components when facing TR: technology system design, end users' beliefs, accessibility issues, and the role of the institution. TR is seen as a great opportunity for patients unreachable with in-clinic interventions from both TR experts and non-experts who supported being intrigued by the TR experience. It is important since the success of TR depends significantly on the frontline staff's attitude and beliefs toward it. Moreover, TR assumes a paradigm shift in which the therapist is an external point of reference that accompanies the patients until they become independent, promoting their self-efficacy, with a view to the continuity of clinic-home care: "*I teach you to walk; then you will walk alone*". Given the complex picture of expectancies and uncertainties toward the TR approach for cardiopulmonary interventions, institutions may play an active role in this paradigm shift, by adopting educational, financial, and management strategies able to support the frontline staff.

CRediT authorship contribution statement

Francesca Borgnis: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization. **Sara Isernia:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization. **Federica Rossetto:** Writing – review & editing, Data curation. **Chiara Pagliari:** Writing – review & editing, Data curation. **Monica Tavanelli:** Writing – review & editing, Supervision. **Lorenzo Brambilla:** Writing – review & editing, Supervision. **Francesca Baglio:** Writing – review & editing, Writing – original draft, Supervision, Funding acquisition, Conceptualization.

Ethics approval

The study has been approved by the Ethical Committees of IRCCS Fondazione Don Carlo Gnocchi, Milan, Italy (protocol n° 3_2_2021). Informed written consent will be obtained from all participants before the study initiation.

Data availability statement

Data will be made available on request.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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