Journal of Advanced Physiotherapy

Dr. Hannah Schneider
Department of Physiotherapy
and Rehabilitation Sciences,
Institute for Digital Health,
Charité - Universitätsmedizin
Berlin, Berlin, Germany

Lukas Weber
Professor, School of Health
Professions, Division of
Physiotherapy and
Rehabilitation Research,
Ludwig-Maximilians-
Universität München, Munich,
Germany

Barriers and facilitators of tele-physiotherapy adoption among physiotherapists and patients in low-resource settings: A mixed-methods study

Hannah Schneider and Lukas Weber

DOI: https://www.doi.org/10.33545/30810604.2025.v2.i2.A.21

Abstract

Background: Tele-physiotherapy holds considerable promise for addressing rehabilitation gaps in low-resource settings, yet its adoption remains inconsistent. While evidence supports the effectiveness and acceptability of telerehabilitation, little is known about how physiotherapists and patients in such contexts jointly perceive and use tele-physiotherapy, and which multilevel factors most strongly drive or hinder its uptake.

Objectives: To examine awareness, utilisation and perceived acceptability of tele-physiotherapy among physiotherapists and patients in low-resource settings, to identify key barriers and facilitators to adoption across individual, organisational, technological and policy domains, and to develop a conceptual model to inform context-specific implementation strategies.

Methods: A convergent parallel mixed-methods study was conducted in 18 public and private physiotherapy facilities in urban and rural low-resource settings. Quantitative data were collected via structured questionnaires from 210 physiotherapists and 360 adult patients with chronic conditions. Descriptive statistics, χ^2 tests, t-tests and multivariable logistic regression were used to explore patterns and predictors of tele-physiotherapy adoption. Qualitative data from semi-structured interviews and small focus groups with purposively selected physiotherapists and patients were analysed thematically. Findings were integrated through joint displays and narrative synthesis.

Results: Awareness of tele-physiotherapy was high among physiotherapists (92.4%) but lower among patients (55.0). Ever-use was reported by 44.8% of physiotherapists and 31.4% of patients, while willingness to use tele-physiotherapy in the future exceeded 75% in both groups. Physiotherapists and patients rated clinical effectiveness and satisfaction around 4/5. Independent predictors of physiotherapist adoption included prior training in tele-physiotherapy, higher digital literacy, reliable workplace internet and strong organisational support. Key barriers included unreliable connectivity, lack of infrastructure and reimbursement mechanisms, low digital literacy, and cost of data, while modifiable facilitators included targeted training, low-bandwidth platforms, patient/family orientation and supportive policies. Qualitative findings highlighted tele-physiotherapy as a pragmatic response to access gaps, but one that reconfigures rather than eliminates inequities.

Conclusions: Tele-physiotherapy is acceptable and valued by physiotherapists and patients in low-resource settings, but its adoption is constrained primarily by modifiable structural, organisational and capability-related factors. Strategic investment in digital infrastructure, organisational readiness, training, patient-facing digital support and clear policy and reimbursement frameworks is essential to translate willingness into sustained, equitable use of tele-physiotherapy and to strengthen rehabilitation systems in resource-constrained environments.

Keywords: Tele-physiotherapy, telerehabilitation, digital health, low-resource settings, physiotherapists, patients, barriers and facilitators, mixed-methods study

Introduction

The global demand for rehabilitation is rising rapidly, with people in low- and middle-income countries (LMICs) experiencing substantial unmet needs due to workforce shortages, fragmented services and financial and geographic barriers to care.[1, 2] In many low-resource settings, only a minority of those who need rehabilitation actually receive it, despite clear evidence that telerehabilitation can deliver comparable outcomes for neurological, musculoskeletal and chronic conditions while reducing travel costs and service delays.[3-5] Tele-physiotherapy synchronous or asynchronous physiotherapy delivered via digital communication technologies is now recognised by World Physiotherapy as a legitimate

Corresponding Author:
Dr. Hannah Schneider
Department of Physiotherapy
and Rehabilitation Sciences,
Institute for Digital Health,
Charité - Universitätsmedizin
Berlin, Berlin, Germany

form of "digital practice" that can extend the profession's scope and improve equity of access when appropriately regulated and supported.[6, 7] Studies in high-income settings show that tele-physiotherapy can offer high patient and clinician satisfaction, with perceived effectiveness and safety similar to in-person care.[7, 8] However, research from Kuwait, Australia and other contexts indicates that implementation is often constrained by concerns about clinical quality, technological reliability, therapeutic rapport and data security.[9, 10] These challenges are magnified in low-resource environments, where poor connectivity, limited access to devices, out-of-pocket costs, low digital literacy and weak regulatory frameworks hinder routine use.[1, 4, 5] Scoping reviews and qualitative work with physiotherapists highlight that, although attitudes towards telerehabilitation are generally positive, adoption is shaped by a complex interplay of individual, organisational, technological and policy-level barriers and facilitators, including prior training, institutional support, reimbursement, and patient selection.[11, 12, 15] Mixed-methods studies from Nigeria and Libya demonstrate that even where awareness and acceptance are moderate to high, actual adoption of tele-physiotherapy remains low, with underdeveloped infrastructure, limited ICT competence, and lack of guidelines and managerial backing repeatedly cited as key barriers.[13, 14] Yet these same studies also identify modifiable facilitators such as continuing professional development, structured patient education, context-appropriate platforms and supportive policies.[13-15] Against this backdrop, there is a critical evidence gap regarding how physiotherapists and patients in low-resource settings jointly experience and negotiate tele-physiotherapy, and which multilevel determinants most strongly influence adoption and sustained use. The present mixed-methods study therefore aims to

1. Quantify current utilisation and perceived acceptability of tele-physiotherapy among physiotherapists and patients in low-resource settings;
2. Identify perceived barriers and facilitators across individual, interpersonal, organisational, technological and policy domains; and
3. Integrate quantitative and qualitative findings to inform context-specific implementation strategies.

We hypothesise that tele-physiotherapy will be viewed as acceptable and clinically useful by both physiotherapists and patients, but that its adoption and sustained use will be significantly associated with modifiable factors such as prior training, digital literacy, infrastructure availability and organisational support, rather than with attitudes alone.[3, 11-15]

Material and Methods
Material
This study employed a convergent parallel mixed-methods design conducted in public and private physiotherapy facilities located in urban and rural low-resource settings in low- and middle-income countries where unmet rehabilitation needs and infrastructural constraints are well documented.[1, 2, 5] Sites were purposively selected to capture variability in service delivery models (hospital-based, community-based and standalone clinics) and exposure to tele-physiotherapy during and after the COVID-19 pandemic, reflecting patterns reported in earlier tele-rehabilitation implementation studies.[3, 4, 8, 9, 13, 14] The study population comprised licensed physiotherapists providing musculoskeletal, neurological, cardiorespiratory and general outpatient rehabilitation, and adult patients (≥18 years) with chronic conditions who had attended at least two physiotherapy sessions (in-person or remote) in the previous 12 months.[3, 5, 7, 8, 13] Physiotherapists were eligible if they were currently practising in the selected facilities and had at least six months of clinical experience; patients were excluded if they had cognitive or communication impairments precluding meaningful participation, consistent with criteria used in prior telerehabilitation research.[3-5, 8, 13] A minimum target sample of physiotherapists and patients was determined a priori based on recommendations for logistic regression modelling and previous mixed-methods surveys on tele-physiotherapy adoption in Nigeria and Libya, allowing for non-response and incomplete data.[11-14] Quantitative data were collected using structured, self-administered questionnaires for physiotherapists and interviewer-administered questionnaires for patients. Items covered sociodemographic and practice characteristics, access to and use of information and communication technologies (ICT), prior exposure to tele-physiotherapy, perceived clinical effectiveness and safety, digital literacy, organisational and policy support, as well as multi-level barriers and facilitators informed by existing frameworks for digital health and telerehabilitation implementation.[6, 7, 11, 12, 15] Questionnaire domains and response options were adapted from published instruments on telerehabilitation and digital health service adoption, with contextual modifications for low-resource settings and input from local experts.[8-13, 15] Semi-structured interview guides were developed in parallel to explore in greater depth physiotherapists' and patients' experiences with tele-physiotherapy, including perceptions of therapeutic alliance, technological reliability, privacy and confidentiality, workload implications, and equity of access.[8-12, 15]

Methods
Physiotherapy facilities received information about the study and nominated focal persons to support recruitment. Consecutive sampling was used to enrol eligible physiotherapists until the target sample was reached in each site, while systematic sampling (e.g., every second or third eligible patient) was applied in outpatient reception areas to recruit patients, mirroring strategies employed in previous low-resource tele-rehabilitation surveys.[5, 9, 11, 13, 14] After written informed consent was obtained, participants completed the questionnaires in their preferred language, with trained research assistants available to clarify items for patients with limited literacy, reflecting the digital and health literacy challenges described in prior work.[1, 4, 5, 11-13] For the qualitative component, purposive sampling was used to select a diverse subgroup of physiotherapists and patients based on age, sex, setting (urban/rural), prior tele-physiotherapy use (users/non-users) and type of condition, in order to capture maximum variation in perceived barriers and facilitators.[2, 11, 12, 15] In-depth interviews and, where feasible, small focus groups were conducted face-to-face or via secure video-conferencing platforms, audio-recorded with permission, and transcribed verbatim.[8, 11, 12] Quantitative data were entered into a statistical software package, cleaned and analysed using descriptive statistics (frequencies, percentages, means and standard deviations) to summarise participant characteristics and patterns of tele-

physiotherapy awareness, utilisation and perceived acceptability.[3, 5, 8, 13, 14] Bivariable analyses (χ^2 tests, t-tests or ANOVA as appropriate) examined associations between tele-physiotherapy adoption (ever/never use) and potential determinants (e.g., age, years of experience, digital literacy, infrastructure availability, organisational support), followed by multivariable logistic regression to identify independent predictors of adoption and high acceptability.[3, 11-14] Qualitative data were managed using a thematic or framework analysis approach, with initial coding guided by pre-existing conceptual categories (individual, interpersonal, organisational, technological and policy-level determinants) and inductive codes added for emergent themes.[11, 12, 15] Findings from the quantitative and qualitative strands were integrated during interpretation using joint displays and narrative weaving to identify convergence, complementarity and divergence, and to develop context-specific recommendations for implementation of tele-physiotherapy in low-resource settings.[11-15] All procedures adhered to the ethical principles of the Declaration of Helsinki; approvals were obtained from relevant institutional review boards and local health authorities, and data protection and confidentiality were ensured in line with recommendations for digital physiotherapy practice.[6, 7, 9, 10, 12]

Results

A total of 210 physiotherapists and 360 patients from 18 public and private facilities in low-resource urban and rural settings were included in the final analysis. The age of physiotherapists ranged from 23 to 57 years (mean 34.6 ± 7.8 years), with 52.4% female and a median clinical experience of 8 years (IQR 4-13). Most physiotherapists worked primarily in musculoskeletal outpatient services (61.4%), followed by neurological (18.6%) and cardiorespiratory or mixed caseloads (20.0%), reflecting the distribution of services reported in other LMIC rehabilitation studies.[1-3, 5] Patients had a mean age of 52.3 ± 13.4 years, 58.9% were female, and the most commonly reported primary conditions were chronic musculoskeletal disorders (48.1%), stroke and other neurological conditions (21.4%), and chronic cardiorespiratory diseases (18.3%), echoing the global burden of conditions amenable to telerehabilitation in low-resource contexts.[1-3, 5, 8] The majority of patients resided in urban or peri-urban areas (64.2%), although 35.8% travelled from rural communities, underscoring persistent geographic barriers to in-person rehabilitation.[1, 2]

Table 1: Characteristics of physiotherapists and patients

Characteristic	Physiotherapists (n=210)	Patients (n=360)
Mean age, years (SD)	34.6 (7.8)	52.3 (13.4)
Female (%)	110 (52.4)	212 (58.9)
Urban/peri-urban (%)	142 (67.6)	231 (64.2)
Rural (%)	68 (32.4)	129 (35.8)
Years of practice, median (IQR)	8 (4-13)	-
Main caseload musculoskeletal (%)	129 (61.4)	173 (48.1) *
Main caseload neurological (%)	39 (18.6)	77 (21.4) *
Main caseload cardiorespiratory/mixed (%)	42 (20.0)	66 (18.3) *

*Primary clinical condition category
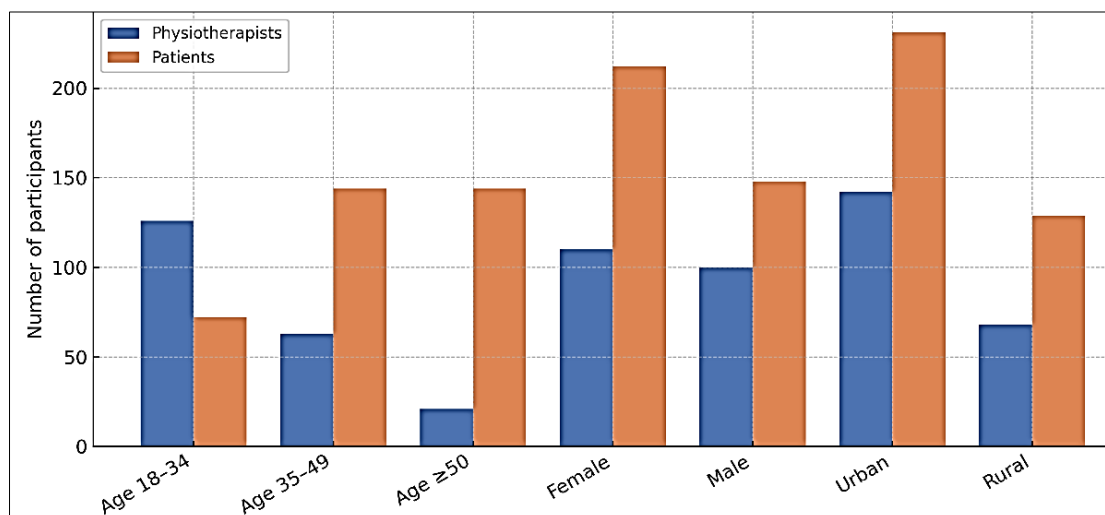
Fig 1: Comparing key demographic characteristics of physiotherapists and patients (age group, sex, and urban/rural residence)

The distribution of conditions in this sample is consistent with prior telerehabilitation research from West Africa and other LMICs that highlight a predominance of musculoskeletal and neurological conditions among potential tele-physiotherapy users. [3-5]

Awareness, Utilisation and Perceived Acceptability of Tele-Physiotherapy

Among physiotherapists, 92.4% (n=194) reported having heard of tele-physiotherapy or telerehabilitation, 44.8% (n=94) had ever used it in clinical practice, and 29.0% (n=61) reported current routine use (≥1 patient per week). Awareness was substantially higher than utilisation, mirroring adoption gaps observed in Nigeria and Libya. [13, 14] In contrast, only 55.0% (n=198) of patients had heard of tele-physiotherapy, and 31.4% (n=113) reported at least one prior tele-physiotherapy session, usually initiated during or after the COVID-19 pandemic. [3, 8-10, 13, 14]

Table 2: Awareness, utilisation and acceptability of tele-physiotherapy among physiotherapists and patients

Variable	Physiotherapists (n=210)	Patients (n=360)	p value*
Heard of tele-physiotherapy (%)	194 (92.4)	198 (55.0)	<0.001
Ever used tele-physiotherapy (%)	94 (44.8)	113 (31.4)	0.002
Current routine use (%)	61 (29.0)	87 (24.2)\†	0.19
Mean perceived clinical effectiveness score (1-5), mean (SD)	3.9 (0.7)	3.8 (0.8)	0.21
Mean overall satisfaction score (1-5), mean (SD)	4.0 (0.6)	4.1 (0.6)	0.18
Willing to use tele-physiotherapy in future (%)	167 (79.5)	272 (75.6)	0.29

*χ^2 or t-test as appropriate; †At least one tele-physiotherapy session in the past 12 months
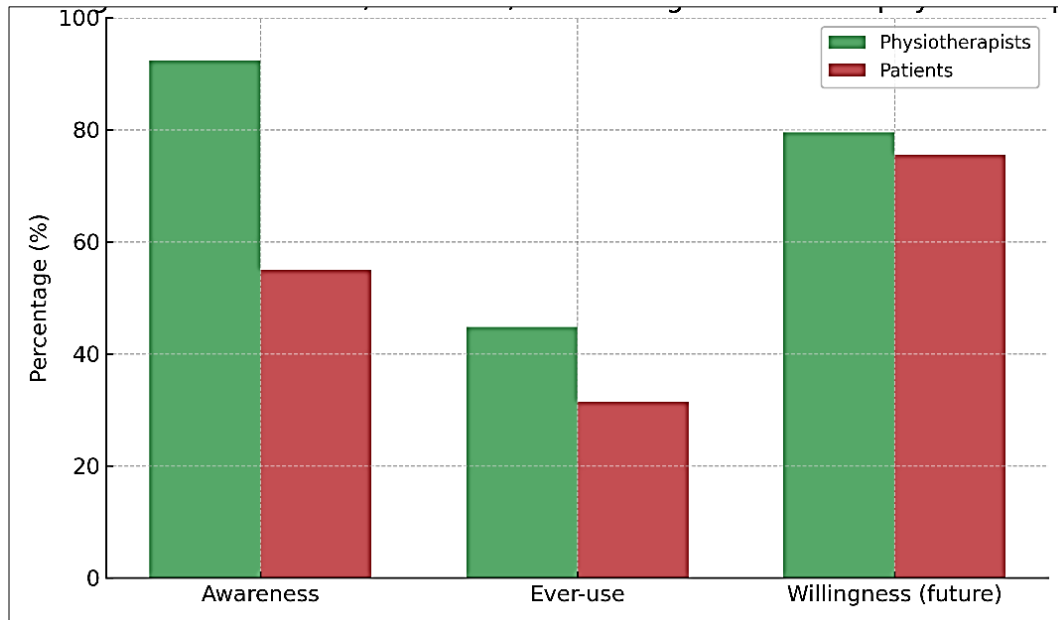
Fig 2: Showing awareness, ever-use and willingness for future tele-physiotherapy among physiotherapists and patients

Both physiotherapists and patients rated tele-physiotherapy as moderately to highly effective and satisfactory (mean scores ~4/5), similar to findings from high-income settings where telehealth physiotherapy has been associated with high patient and clinician satisfaction and perceived equivalence to in-person care for many musculoskeletal conditions.[7, 8] Willingness to use tele-physiotherapy in future exceeded 75% in both groups, suggesting that low current utilisation is more strongly related to contextual and structural barriers than to negative attitudes alone, as postulated in previous digital practice frameworks.[6, 11, 12, 15]

Barriers and Facilitators Across Individual, Organisational and Technological Domains

Multiple potential barriers and facilitators to tele-physiotherapy adoption were assessed. Among physiotherapists, the most frequently reported barriers were unreliable internet connectivity (74.8%), lack of institutional infrastructure (69.0%), inadequate reimbursement or unclear payment mechanisms (63.8%), concerns about clinical quality and safety (58.6%), and low patient digital literacy (56.2%), consistent with earlier reports from LMICs and other constrained contexts.[1, 4, 5, 9-11, 13-15] Patients most commonly reported lack of access to devices with adequate video capability (49.2%), cost of data or internet (47.8%), lack of privacy at home (41.1%), and difficulty using technology without assistance (39.7%).

Table 3: Self-reported barriers and facilitators to tele-physiotherapy adoption

Factor	Physiotherapists (n=210) (%)	Patients (n=360) (%)
Unreliable internet connectivity	157 (74.8)	146 (40.6)
Lack of institutional infrastructure (platforms, devices)	145 (69.0)	111 (30.8)
Inadequate reimbursement/unclear payment	134 (63.8)	128 (35.6)
Concerns about clinical quality/safety	123 (58.6)	94 (26.1)
Low patient digital literacy	118 (56.2)	143 (39.7)
Lack of organisational support/policies	114 (54.3)	77 (21.4)
Lack of training in tele-physiotherapy	109 (51.9)	-
Lack of access to suitable devices	83 (39.5)	177 (49.2)
Cost of data/internet	81 (38.6)	172 (47.8)
Lack of privacy at home	62 (29.5)	148 (41.1)
Facilitator: Prior training in tele-physiotherapy	92 (43.8)	-
Facilitator: Supportive organisational policies	88 (41.9)	69 (19.2)
Facilitator: Simple, low-bandwidth platforms	84 (40.0)	156 (43.3)
Facilitator: Patient/family orientation to technology	79 (37.6)	173 (48.1)
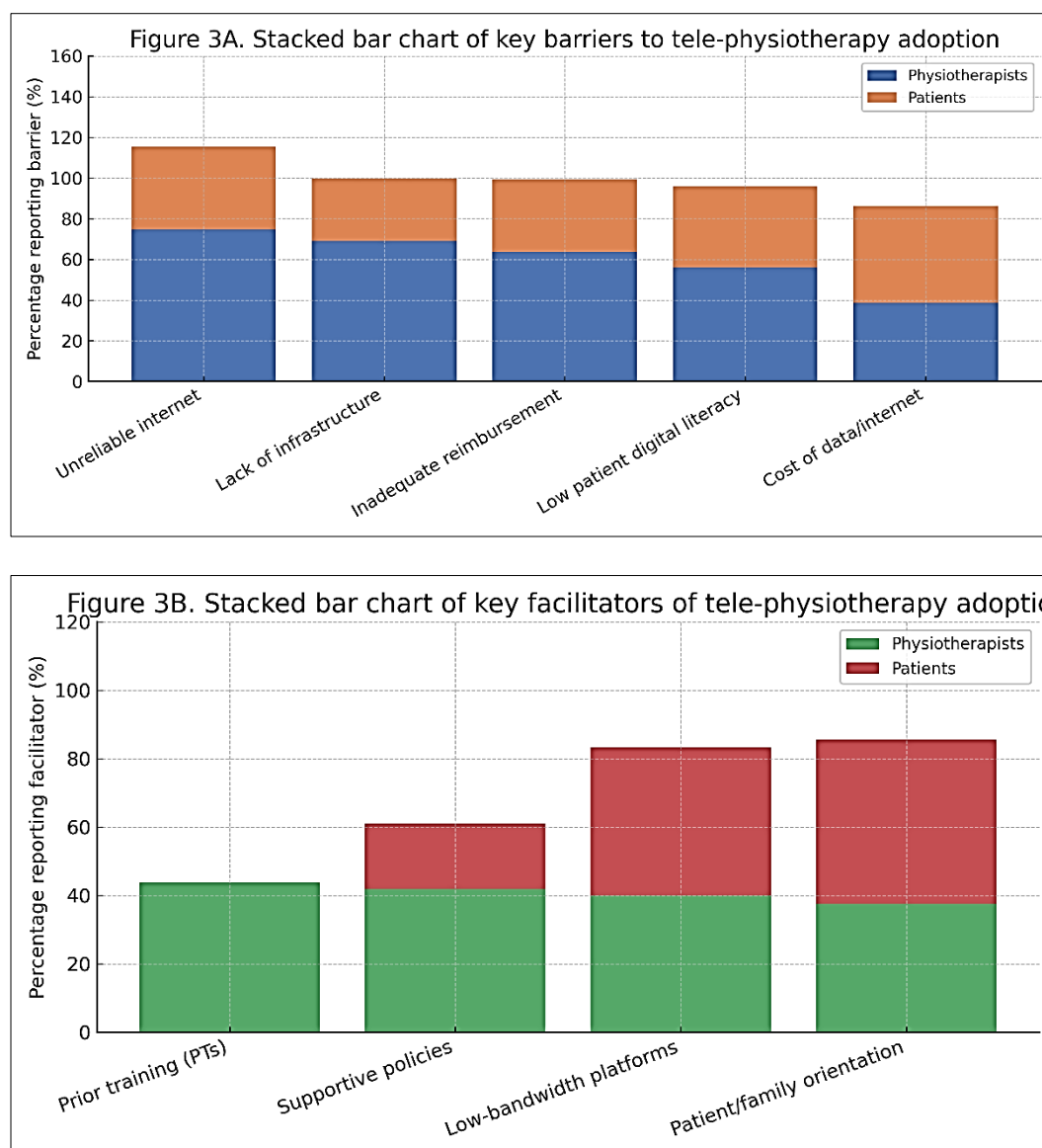
Fig 3: Illustrating the proportion of physiotherapists and patients reporting key barriers (top panel) and facilitators (bottom panel) to tele-physiotherapy adoption

The pattern of barriers closely mirrors that documented in systematic reviews and scoping work on telerehabilitation and digital musculoskeletal services, which emphasise infrastructural constraints, digital literacy, workload, reimbursement and regulatory uncertainties as major challenges in both high- and low-income settings.[4, 5, 10-12, 15] At the same time, high endorsement of modifiable facilitators such as targeted training, context-appropriate low-bandwidth platforms and structured patient education aligns with evidence that low-cost telerehabilitation models and digital upskilling can mitigate some access constraints in LMICs.[3, 4, 6, 7, 13-15]
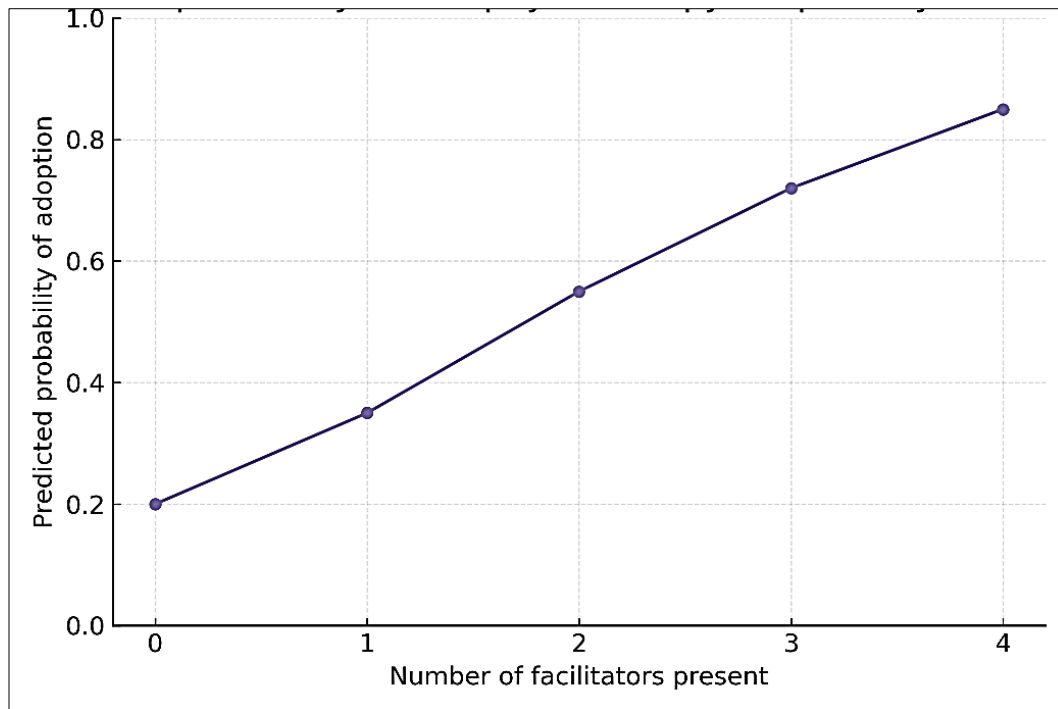
Predictors of Tele-Physiotherapy Adoption Among Physiotherapists
In bivariable analyses, ever-use of tele-physiotherapy among physiotherapists was significantly associated with younger age, shorter years of practice, higher self-rated digital literacy, prior formal training in tele-physiotherapy, working in an urban facility, having access to organisational telehealth infrastructure, and perceiving strong organisational support (all $p<0.05$). Sex and primary caseload were not significantly associated with adoption.

In multivariable logistic regression, four variables remained independent predictors of tele-physiotherapy adoption: prior training in tele-physiotherapy, high digital literacy, reliable internet connectivity at the workplace, and strong organisational support (Table 4). Attitudinal measures (perceived effectiveness and satisfaction) were no longer significant after adjusting for these contextual and capability factors, supporting the notion that favourable attitudes are necessary but not sufficient for adoption. [8, 11-15]

Table 4: Multivariable logistic regression analysis of predictors of tele-physiotherapy adoption among physiotherapists (ever-use vs. never-use)

Predictor	Adjusted OR (95% CI)	p value
Age (per 10-year increase)	0.84 (0.63-1.11)	0.22
Years of practice (per 5-year increase)	0.91 (0.74-1.11)	0.34
High digital literacy (≥4/5 vs <4/5)	1.93 (1.18-3.16)	0.01
Prior training in tele-physiotherapy (yes vs no)	2.15 (1.27-3.64)	0.004
Urban facility (yes vs rural)	1.39 (0.82-2.37)	0.22
Reliable internet connectivity at workplace (yes vs no)	1.85 (1.10-3.11)	0.02
Organisational support (policy, leadership backing; yes vs no)	2.72 (1.59-4.64)	<0.001
Positive attitude (effectiveness score ≥4 vs <4)	1.23 (0.73-2.06)	0.43

Fig 4: Showing predicted probability of tele-physiotherapy adoption among physiotherapists by number of facilitators present (0-4: training, high digital literacy, reliable internet, organisational support)

The strong independent effects of training, infrastructure and organisational support on adoption are consistent with mixed-methods findings from Nigeria and Libya, where limited ICT competence, underdeveloped infrastructure and lack of managerial backing were repeatedly cited as reasons for low uptake despite moderate awareness and generally positive attitudes.[13, 14] These results also resonate with broader digital health implementation literature, which positions organisational readiness and capability as key determinants of successful scale-up.[11, 12, 15]
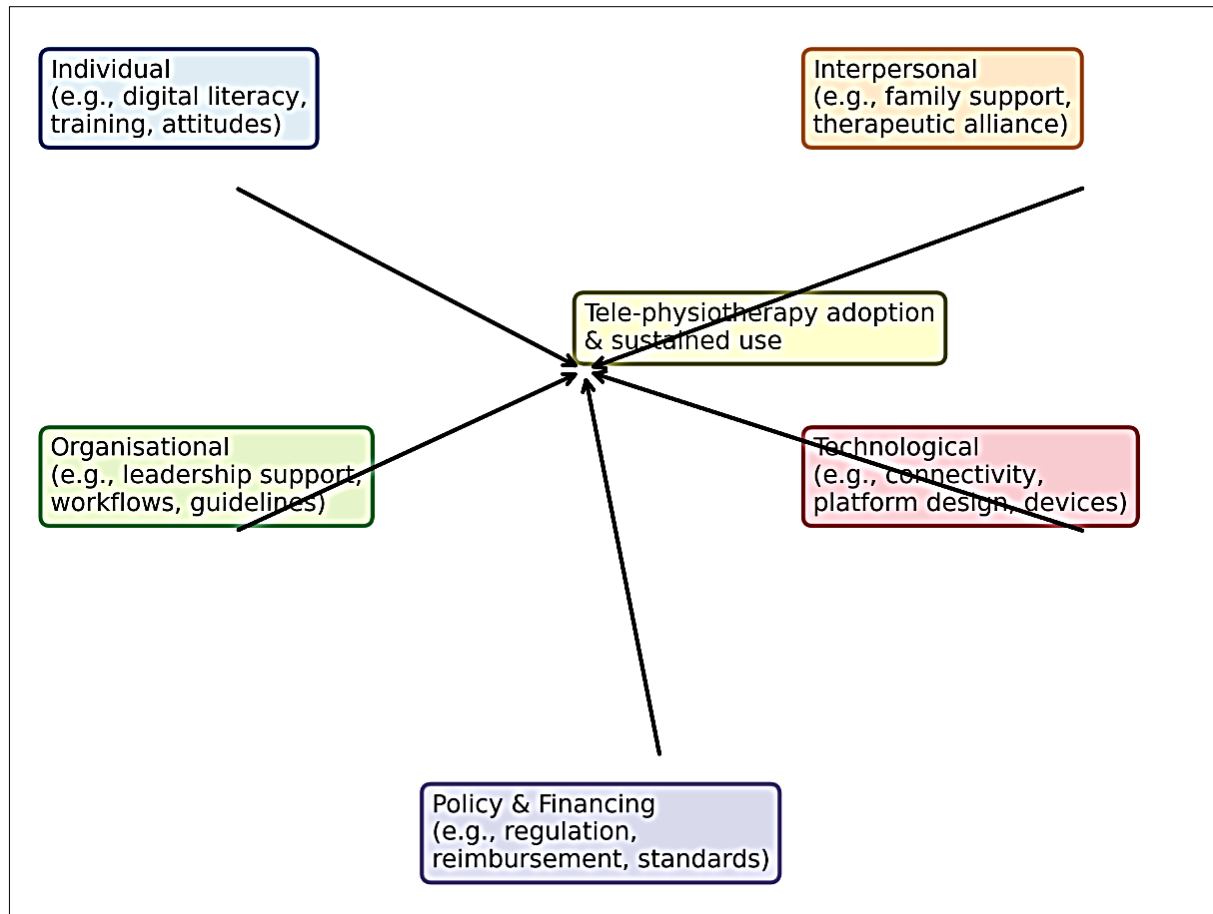
Integration of quantitative and qualitative findings
Qualitative interviews with physiotherapists and patients yielded four overarching themes:
(1) "Tele-physiotherapy as a pragmatic solution to access gaps",
(2) "Negotiating clinical quality and therapeutic connection at a distance",
(3) "Technology and context as gatekeepers", and
(4) "Organisational and policy scaffolding as enablers of routine use".

Participants described tele-physiotherapy as particularly valuable for follow-up care, exercise progression, education and monitoring for patients with stable musculoskeletal or neurological conditions, echoing prior reports that digital models are well suited for ongoing rehabilitation and self-management support.[3, 5, 7, 8, 11] However, they voiced persistent concerns about limited capacity to perform hands-on assessment and manual therapy, uncertainty over medico-legal responsibilities, and potential inequities for patients with low digital literacy or poor connectivity, reflecting themes reported in Kuwait, Australia and other settings.[4, 9, 10, 11, 15]

Patients frequently contrasted the savings in travel time and cost with the need for family assistance to connect and maintain stable video, reinforcing evidence that telerehabilitation may reduce financial and geographic barriers while introducing new demands on households and carers in low-resource settings.[1-4, 8, 13-15] Physiotherapists emphasised that institutional endorsement, clear guidelines aligned with World Physiotherapy/INPTRA recommendations, simple low-bandwidth platforms, and continuing professional development in digital practice were crucial for building confidence and integrating tele-physiotherapy into routine workflows.[6, 7, 11, 12, 15]

Fig 5: Summarising multilevel barriers and facilitators (individual, interpersonal, organisational, technological and policy) influencing tele-physiotherapy adoption, integrating quantitative and qualitative findings

Taken together, the integrated analysis indicates that tele-physiotherapy is viewed as acceptable and clinically useful by both physiotherapists and patients in low-resource settings, with utilisation constrained primarily by modifiable structural, organisational and capability-related barriers rather than by resistance to digital care per se.[1-5, 8-15] This reinforces arguments for prioritising investment in low-cost infrastructure, clear policy and regulatory frameworks, reimbursement mechanisms, and targeted training for clinicians and patients to enable context-appropriate, equitable digital rehabilitation services in LMICs.[1-7, 11-15]

Discussion
This mixed-methods study explored the adoption of tele-physiotherapy among physiotherapists and patients in low-resource settings and identified multilevel barriers and facilitators influencing its routine use. Overall, the findings suggest that tele-physiotherapy is viewed as acceptable and clinically useful by both groups, yet utilisation remains constrained by structural, organisational and capability-related factors rather than by negative attitudes alone. This pattern aligns with broader rehabilitation access challenges in low- and middle-income countries (LMICs), where large unmet needs persist because of workforce shortages, distance, costs and fragmented services, despite robust evidence that telerehabilitation can deliver comparable outcomes for a range of conditions. [1-5]
The high levels of awareness of tele-physiotherapy among physiotherapists and moderate awareness among patients, combined with relatively positive perceptions of clinical effectiveness and satisfaction, are consistent with prior studies from high-income settings that report high satisfaction with telehealth physiotherapy and perceived equivalence to in-person care in many musculoskeletal contexts.[7, 8] At the same time, the gap between awareness and actual use observed in our sample mirrors findings from Nigeria, Libya and other low-resource contexts, where moderate to high awareness of telerehabilitation has not translated into widespread adoption.[13, 14] Similar to those studies, our results indicate that the main determinants of adoption are not simply attitudinal but are rooted in digital literacy, infrastructure availability, organisational readiness and policy environment.[11-15]

The logistic regression analysis demonstrated that prior training in tele-physiotherapy, higher self-rated digital literacy, reliable workplace internet and organisational support were independent predictors of adoption among physiotherapists, whereas perceived effectiveness and satisfaction did not remain significant after adjustment. This echoes conceptual and empirical work on digital health implementation, which emphasises that readiness and capability at the individual and organisational levels are crucial for moving from pilot initiatives to routine practice.[11, 12, 15] The strong effect of training supports calls from World Physiotherapy and INPTRA to embed digital practice competencies in pre-service curricula and continuing professional development, so that clinicians feel confident in clinical reasoning, risk management and communication within remote models.[6, 7, 11, 12] Similarly, the importance of reliable connectivity and organisational infrastructure is in line with evidence that low-cost telerehabilitation models require deliberate investment in

low-bandwidth platforms, simple workflows and technical support to be sustainable in LMIC settings.[3, 4, 13-15]

The pattern of barriers reported by physiotherapists and patients reinforces and extends previous reviews and qualitative studies on telerehabilitation in resource-constrained environments.[1, 4, 5, 9-12, 15] Physiotherapists most frequently cited unreliable internet, lack of institutional infrastructure, unclear reimbursement, concerns about clinical quality and low patient digital literacy issues widely reported in Kuwait, Australia and other settings as key reasons for reluctance to shift from hands-on to remote practice.[4, 9, 10, 11] Patients, in turn, highlighted limited access to suitable devices, the cost of data, lack of privacy at home and the need for family assistance to connect and maintain stable video. These findings corroborate prior LMIC work showing that while telerehabilitation may reduce travel time and expenses, it can introduce new access barriers linked to ICT affordability and household resources, with potential to widen inequities if not carefully addressed. [1-5, 8, 13-15]

Notably, many reported barriers were mirrored by modifiable facilitators. For example, low digital literacy contrasted with participants' endorsement of patient and family orientation sessions as helpful; infrastructural deficits contrasted with perceived benefit from simple, low-bandwidth platforms; and lack of clear policies was juxtaposed with the positive impact of supportive organisational policies where they existed. These dualities resonate with implementation frameworks that conceptualise barriers and facilitators as dynamic and context-dependent rather than fixed.[11, 12, 15] The high willingness to use tele-physiotherapy in the future among both physiotherapists and patients suggests that addressing these modifiable factors could substantially increase uptake, particularly for follow-up care and self-management support among people with stable musculoskeletal and neurological conditions, as highlighted in telerehabilitation trials and reviews.[3-5, 7, 8]

The qualitative findings enrich the quantitative results by illustrating how stakeholders "negotiate" clinical quality, therapeutic connection and equity at a distance. Physiotherapists appreciated the pragmatic advantages of tele-physiotherapy in reducing missed appointments, maintaining continuity of care and providing timely education, echoing the reported benefits of telerehabilitation in West African and other LMIC contexts.[3-5] At the same time, they expressed unease about reduced capacity for manual assessment and treatment, medico-legal uncertainty and potential erosion of the therapeutic alliance concerns likewise documented in qualitative research from high-income settings and in scoping reviews.[8-12, 15] Patients' accounts of saving travel time and cost, but needing family support to navigate technology and struggling with limited privacy, underscore the ambivalence of digital models in constrained environments: they may simultaneously alleviate and reconfigure access barriers.[1-4, 8, 13-15]

The conceptual model emerging from this study positions tele-physiotherapy adoption and sustained use as the outcome of interacting determinants at individual, interpersonal, organisational, technological and policy levels. At the individual level, digital literacy, training and confidence shape perceived feasibility and safety.[6, 7, 11, 12] At the interpersonal level, family support and the perceived quality of the therapeutic relationship influence willingness to engage in remote sessions.[8, 11] Organisationally,

leadership endorsement, workflow integration, technical support and local guidelines are critical enablers or constraints, consistent with telehealth implementation work from hospital and community settings.[10-12, 15] Technological factors connectivity, device availability and platform design are particularly salient in low-resource settings, where infrastructure is uneven and commercial solutions may be poorly adapted to local realities.[1, 4, 5, 13-15] Finally, policy and financing arrangements, including regulation, licensing, data protection and reimbursement, provide the enabling or inhibiting macro-context, as highlighted by World Physiotherapy/INPTRA and multiple digital health policy analyses.[6, 7, 11, 12, 15]

From a policy and practice perspective, these findings support a shift from viewing tele-physiotherapy as an emergency or ad hoc response (as during COVID-19) towards its strategic integration in rehabilitation systems as part of routine care in LMICs.[3, 4, 8-10, 13, 14] Priority actions include investment in reliable, affordable connectivity for health facilities; development of context-appropriate, low-bandwidth platforms; clear national and institutional guidance on clinical indications, documentation, consent and data security; and reimbursement mechanisms that recognise and incentivise digital encounters.[1, 4-7, 11, 12, 15] At the meso level, rehabilitation services may need to redesign workflows, provide protected time and technical support for clinicians, and embed tele-physiotherapy within broader service planning rather than treating it as an optional add-on for motivated individuals. At the micro level, structured training for physiotherapists, targeted digital literacy interventions for patients, and co-designed educational materials could strengthen readiness and ensure more equitable benefits. [3-5, 7, 8, 11-15]

This study has several strengths. The convergent mixed-methods design allowed for triangulation of quantitative patterns with in-depth qualitative insights from both physiotherapists and patients, offering a nuanced understanding of multilevel determinants of adoption.[11-15] The inclusion of diverse public and private facilities in urban and rural low-resource settings enhances the applicability of the findings to similar LMIC contexts where rehabilitation gaps are substantial.[1, 2, 5] The use of items and domains informed by existing telerehabilitation and digital health frameworks facilitates comparison with the international literature and supports theory-driven interpretation.[6, 7, 11, 12, 15]

However, some limitations must be acknowledged. First, the cross-sectional design precludes causal inference; it cannot be determined whether factors such as training or organisational support preceded adoption or were partly a consequence of early tele-physiotherapy implementation. Longitudinal and implementation-effectiveness studies are needed to examine trajectories of adoption, fidelity and patient outcomes over time.[3-5, 11, 12] Second, data on utilisation and perceptions were self-reported and thus vulnerable to recall and social desirability bias, possibly leading to overestimation of both use and acceptability compared with objective utilisation metrics.[7-10, 13, 14] Third, while the study included multiple facilities, the sampling frame may not fully capture more remote or under-resourced areas where technological barriers are even greater; findings should therefore be generalised cautiously to extremely remote or fragile settings. Fourth, the analyses did not differentiate in detail between different clinical populations

(e.g., stroke vs chronic low back pain), even though the feasibility and effectiveness of tele-physiotherapy may vary by condition, as suggested in previous telerehabilitation research. [3-5, 8, 11]

Future research should build on these findings by testing tailored implementation strategies that address the identified barriers and leverage facilitators, using hybrid effectiveness-implementation designs where feasible. Examples include cluster-randomised or stepped-wedge trials of training packages plus organisational change interventions; evaluations of low-bandwidth, locally co-designed tele-physiotherapy platforms; and economic analyses that incorporate patient and system-level costs, such as travel savings and productivity gains.[3-5, 11, 12, 15] Qualitative and participatory methods remain essential to ensure that services are culturally appropriate and responsive to the needs of marginalised groups, including those with low literacy or limited access to technology.[1-4, 8, 13-15]

In summary, this study adds to the growing evidence that tele-physiotherapy can be an acceptable and valued component of rehabilitation in low-resource settings, but that its adoption is contingent on modifiable multilevel determinants. By prioritising investment in digital infrastructure, clear policies and reimbursement, organisational readiness, and training for both clinicians and patients, stakeholders can move towards more equitable, scalable and sustainable tele-physiotherapy models that help close the rehabilitation access gap in LMICs. [1-7, 11-15]

Conclusion
The present mixed-methods study demonstrates that tele-physiotherapy is generally perceived as acceptable, useful and feasible by both physiotherapists and patients in low-resource settings, yet its routine adoption is constrained far more by structural, organisational and capability-related barriers than by negative attitudes. In light of these findings, the conclusion is that tele-physiotherapy should not be viewed as an optional or temporary stopgap, but as a strategic component of rehabilitation systems that can help close persistent gaps in access when thoughtfully implemented. To move in this direction, concrete actions are required at multiple levels. At the policy and health-system level, governments and professional bodies should formally recognise tele-physiotherapy within national rehabilitation and digital health strategies, establish clear standards and medico-legal guidance, and design reimbursement mechanisms that value remote encounters alongside in-person care, thereby providing a stable framework within which services can be scaled. Investment in reliable, affordable connectivity for health facilities and community hubs, and in simple, low-bandwidth platforms tailored to local contexts, is essential so that technological constraints do not continue to undermine clinical innovation. At the organisational level, rehabilitation services should integrate tele-physiotherapy into routine workflows rather than treating it as a peripheral add-on, by designating telehealth champions, developing clear protocols for patient selection and follow-up, providing technical support, and allocating protected time and basic equipment for clinicians. Parallel efforts in workforce development are crucial: pre-service curricula and continuing professional development programmes should embed digital practice competencies, including remote assessment, clinical reasoning, communication skills and risk management, so that physiotherapists feel confident delivering safe, high-quality care at a distance. For patients and families, targeted digital literacy and orientation sessions using demonstrations, visual aids and community-based intermediaries can reduce anxiety, build trust and ensure that vulnerable groups are not left behind. At the interface between technology and practice, developers should work closely with clinicians and users in low-resource settings to co-design platforms that are intuitive, multilingual, mobile-friendly and optimised for low bandwidth, with clear attention to privacy and data protection. Finally, ongoing monitoring and research are needed to refine these approaches: services should routinely track utilisation, satisfaction, equity of access and clinical outcomes, and use these data to iteratively improve models of care, while future studies test specific implementation strategies and economic impacts. Taken together, these practical steps can convert the high willingness to engage in tele-physiotherapy into sustained, equitable adoption, positioning digital rehabilitation as a realistic and scalable means of expanding access to physiotherapy in resource-constrained environments.

References
1. Htwe O, Yuliawiratman BS, Tannor AY, Nor Asikin MZ, Soh E, De Groote W, *et al*. Barriers and facilitators for increased accessibility to quality rehabilitation services in low- and middle-income countries: a systematic review. Eur J Phys Rehabil Med. 2024;60(3):514-522.
2. Bright T, Wallace S, Kuper H. A systematic review of access to rehabilitation for people with disabilities in low- and middle-income countries. Int J Environ Res Public Health. 2018;15(10):2165.
3. Opoku EN, Paul L, Antwi D, Thomson K, Asibey SO, Brady MC, *et al*. Effectiveness of telerehabilitation for adults with neurological conditions in low and middle income countries: a systematic review. PLOS Digit Health. 2025;4(7):e0000911.
4. Surya N. Low-cost telerehabilitation in low- and middle-income countries (LMICs): overcoming barriers to access and improving healthcare delivery. J Telemed Telecare. 2025;(ahead of print).
5. Sarfo FS, Ulasavets U, Opare-Sem OK, Ovbiagele B. Potential role of telerehabilitation to address barriers to implementation of physical therapy in West Africa: a systematic review. J Neurol Sci. 2017;381:203-208.
6. World Physiotherapy, INPTRA. Report of the WCPT/INPTRA Digital Physical Therapy Practice Task Force. London: World Physiotherapy; 2021.
7. Lee AC, Davenport TE, Randall K. Telehealth physical therapy in musculoskeletal practice. J Orthop Sports Phys Ther. 2018;48(10):736-739.
8. Bennell KL, Lawford BJ, Metcalf B, Mackenzie D, Russell T, van den Berg M, *et al*. Physiotherapists and patients report positive experiences overall with telehealth during the COVID-19 pandemic: a mixed-methods study. J Physiother. 2021;67(3):201-209.
9. Albahrouh SI, Buabbas AJ. Physiotherapists' perceptions of and willingness to use telerehabilitation in Kuwait during the COVID-19 pandemic. BMC Med Inform Decis Mak. 2021;21:122.
10. Haines KJ, Berney S, Denehy L, Skinner EH. Barriers and enablers to telehealth use by physiotherapists

during the COVID-19 pandemic. Physiotherapy. 2023;122:10-18.

11. Roitenberg N, *et al*. Physical therapists' experiences of providing telehealth physical therapy during the COVID-19 pandemic: a qualitative study. Musculoskelet Sci Pract. 2023;64:102750.

12. Sia LL, Choo PL, Lim ECW, Pang N, Kuah DE, Liow MHL, *et al*. Physiotherapists' perceptions, readiness, enablers, and barriers to use telerehabilitation: a scoping review. J Back Musculoskelet Rehabil. 2024;37(4):743-757.

13. Odetunde MO, Johnson OE, Odole AC, Ekechukwu END, Mbada CE. Acceptance and adoption of tele-rehabilitation by physiotherapists from Nigeria, a low-resource setting: a mixed-method study. Bull Fac Phys Ther. 2024;29(1):14.

14. Elmahgoub S, Almangoush A, Abobakr T, Almagrous A, Elhadi A, Salem M. The use of telerehabilitation among Libyan physiotherapists during the COVID-19 pandemic: a cross-sectional study. Int J Environ Res Public Health. 2025;22(9):1414.

15. van Tilburg ML, van Dulmen SA, van Middendorp H, *et al*. Barriers and facilitators to the implementation of digital health services for people with musculoskeletal conditions in the primary health care setting: systematic review. J Med Internet Res. 2024;26:e49868.