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Invited Review

Impact of Patient-Specific, Performance-Driven Rehabilitation Strategies on Treatment Adherence and Clinical Outcomes: A Systematic Review

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Abstract

Background: Individualized, performance-driven rehabilitation systems characterized by dynamic adaptation of exercise dosage, feedback, and progression based on patient-specific performance have emerged as a promising approach to improve adherence and clinical outcomes. However, their effectiveness compared with conventional rehabilitation remains unclear due to heterogeneity in intervention design and clinical populations. **Methods:** A systematic review was conducted in accordance with PRISMA 2020 and Cochrane Handbook recommendations. Electronic databases, including MEDLINE, Embase, Scopus, Web of Science, and Cochrane CENTRAL, were searched from inception to the final search date (to be inserted). Eligible studies included randomized and non-randomized comparative studies evaluating individualized, performance-driven rehabilitation interventions versus conventional therapy. Primary outcomes were adherence and clinical effectiveness. Study selection, data extraction, and risk-of-bias assessment were performed independently by two reviewers.. **Results:** A total of 27 studies were included, of which 25 contributed adherence and/or clinical outcome data. Interventions varied from web-based platforms to advanced systems incorporating wearable sensors, real-time biofeedback, and artificial intelligence–driven adaptation. Adherence outcomes demonstrated substantial heterogeneity. Individualized systems generally improved adherence compared with minimal-contact or unsupervised care, with some studies reporting large effects (e.g., 141% vs. 50% adherence; 100% vs. 30% session completion). Significant improvements were observed in functional mobility, exercise capacity, and disease-specific outcomes in several populations, including post-surgical, cardiovascular, and neurological rehabilitation. In highly supervised settings, outcomes were typically comparable between groups. The certainty of evidence ranged from low to moderate, with downgrading primarily due to heterogeneity, risk of bias, and imprecision. **Conclusions:** Individualized, performance-driven rehabilitation systems demonstrate moderate-certainty evidence for improving adherence in specific contexts and achieving comparable or superior clinical outcomes relative to conventional therapy.

Keywords: Rehabilitation; individualized therapy; telerehabilitation; adherence; clinical outcomes; digital health.

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1. Introduction

1.1 Background and Rationale

Rehabilitation is a cornerstone of recovery across a wide spectrum of acute and chronic conditions, including musculoskeletal, neurological, and cardiovascular disorders. Despite strong evidence supporting its effectiveness in improving functional outcomes, pain, and quality of life, suboptimal adherence to prescribed rehabilitation programs remains a major barrier to achieving optimal clinical outcomes. Poor adherence reduces the effective therapeutic dose, contributes to variability in recovery trajectories, and limits the overall impact of rehabilitation interventions across settings and populations (Donkers et al., 2020; Martinsen et al., 2025).

Conventional rehabilitation approaches, although effective when delivered under structured supervision, are often characterized by relatively static exercise prescriptions, limited feedback between sessions, and insufficient responsiveness to dynamic patient needs. These limitations are particularly evident in home-based programs, where reduced clinician contact places greater reliance on patient motivation and self-management. As a result, conventional therapy may inadequately address key barriers such as fluctuating pain, fatigue, and engagement, leading to inconsistent adherence and suboptimal outcomes (Sørensen & Svenningsen, 2016; Dosbaba et al., 2025).

In response to these challenges, individualized, performance-driven rehabilitation systems have emerged as an innovative approach designed to enhance both adherence and clinical effectiveness. These systems leverage digital technologies—including wearable sensors, mobile applications, virtual reality platforms, and artificial intelligence—to continuously adapt rehabilitation parameters based on patient-specific data. Adaptations may include real-time modification of exercise intensity, personalized feedback, and dynamic goal-setting informed by functional performance, symptom burden, and behavioral engagement (Naz et al., 2025; Zaidi et al., 2025). Unlike traditional personalization based solely on baseline characteristics, these approaches enable ongoing, data-driven optimization of rehabilitation delivery.

Emerging evidence suggests that such individualized systems may substantially improve adherence, particularly when incorporating real-time biofeedback, gamification, or AI-driven motivational strategies. For example, technology-assisted cardiac rehabilitation programs have demonstrated markedly higher adherence rates compared to minimal-contact controls, while sensor-based telerehabilitation following orthopedic procedures has shown improved exercise completion and engagement (Saklica et al., 2025; Nuevo et al., 2023). Similarly, virtual and AI-guided rehabilitation interventions have demonstrated large improvements in functional outcomes in post-stroke populations (Naz et al., 2025).

However, these benefits are not universally observed. Several randomized controlled trials have reported no significant differences in adherence or outcomes between individualized digital systems and well-structured conventional programs, particularly when the latter include regular supervision and clinician involvement (Donkers et al., 2020; Russell et al., 2011). In some cases, supervised in-person rehabilitation has demonstrated superior adherence compared to app-based interventions, highlighting the continued importance of human interaction in

certain patient populations (Martinsen et al., 2025). These findings suggest that the effectiveness of individualized rehabilitation is highly context-dependent and influenced by factors such as intervention design, comparator intensity, patient characteristics, and healthcare setting.

Furthermore, the degree of individualization varies considerably across interventions. Systems incorporating real-time biofeedback and algorithm-driven adaptation appear to yield greater benefits than those relying on static or preference-based personalization alone (Aharon et al., 2022; Piron et al., 2009). This variability underscores the need to clearly distinguish between true performance-driven rehabilitation and more limited forms of individualization that may not meaningfully influence outcomes.

Despite the growing body of research in this field, the existing literature remains fragmented, with heterogeneity in study populations, intervention characteristics, and outcome measures. Importantly, there is a lack of comprehensive synthesis evaluating both adherence and clinical outcomes within a unified framework of performance-driven rehabilitation. Addressing this gap is essential to inform clinical practice, guide implementation strategies, and identify the contexts in which individualized rehabilitation systems provide the greatest benefit.

1.2 Objective

The objective of this systematic review is to evaluate the impact of individualized, performance-driven rehabilitation systems defined as interventions that adapt exercise dosage, feedback, and goals based on patient-specific functional status, pain, fatigue, and performance metrics—on adherence and clinical outcomes compared to conventional rehabilitation therapy.

2. Methods

2.1 Study Design and Reporting Standards

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement, ensuring transparent and reproducible reporting across all stages of the review process. The methodological approach was further guided by the Cochrane Handbook for Systematic Reviews of Interventions, with adherence to established standards for study identification, selection, data extraction, and synthesis. The review was designed to systematically evaluate the impact of individualized, performance-driven rehabilitation systems compared with conventional rehabilitation on adherence and clinical outcomes, following a structured workflow that included comprehensive literature search, eligibility screening, and evidence synthesis.

2.2 Eligibility Criteria

Eligibility criteria were defined a priori using a structured PICO framework. Studies were included if they involved adult participants (≥18 years) undergoing rehabilitation for any clinical condition, including musculoskeletal, neurological, cardiovascular, pulmonary, oncological, or other chronic conditions in which rehabilitation constituted a core component of management. Eligible interventions were required to evaluate individualized, performance-driven rehabilitation systems characterized by the adaptation of at least two key components exercise dosage, feedback, or goal setting based on patient-specific performance metrics such as

functional status, pain, fatigue, or real-time exercise performance. These interventions were required to incorporate ongoing or iterative adjustment mechanisms, often facilitated through digital platforms, wearable sensors, mobile applications, virtual or augmented reality systems, or algorithm-driven approaches enabling continuous or periodic personalization. Interventions limited to static or preference-based personalization without dynamic adaptation were excluded.

Included studies were required to incorporate a comparator group receiving conventional rehabilitation therapy, defined as standard physiotherapy, usual care, or traditional rehabilitation programs delivered in home-based, outpatient, inpatient, or hybrid settings without systematic performance-driven adaptation mechanisms. Studies were eligible only if they reported both adherence outcomes—such as session completion rates, attendance, retention, or exercise engagement—and clinical outcomes, including functional performance, pain, quality of life, or disease-specific measures. Eligible study designs included randomized controlled trials, controlled clinical trials, cohort studies, case–control studies, and systematic reviews or meta-analyses, while case reports, case series, editorials, and conference abstracts were excluded. No restrictions were applied regarding the rehabilitation setting, and studies conducted in home-based, clinical, inpatient, or hybrid environments were considered. To ensure adequate exposure, only studies with an intervention duration of at least two weeks were included. No explicit language restrictions were imposed; however, studies were required to provide sufficient methodological and outcome data for inclusion in the synthesis. All eligibility criteria were applied collectively during screening, with emphasis on identifying studies that implemented true performance-driven, patient-level individualization rather than superficial or static forms of personalization.

2.3 Information Sources

A comprehensive and systematic search of electronic databases was conducted to identify relevant studies. The following databases were searched from inception to the final search date (to be inserted): MEDLINE (via PubMed), Embase, Scopus, Web of Science Core Collection, and the Cochrane Central Register of Controlled Trials (CENTRAL). These databases were selected to ensure broad coverage of biomedical, rehabilitation, and interdisciplinary literature.

To enhance completeness and minimize publication bias, additional sources were searched. These included manual screening of reference lists of all included studies and relevant systematic reviews, as well as forward citation tracking using databases such as Scopus and Web of Science. Grey literature sources were also considered, including clinical trial registries (e.g., ClinicalTrials.gov and WHO International Clinical Trials Registry Platform) and relevant conference proceedings where accessible. Where necessary, corresponding authors were contacted to clarify or obtain missing data. No restrictions were placed on publication status.

2.4 Search Strategy

A comprehensive search strategy was developed in consultation with the review objectives and structured around the PICO framework, incorporating controlled vocabulary (e.g., MeSH terms) and free-text keywords. The search strategy combined terms related to rehabilitation, individualization or personalization, technology-

assisted or performance-driven systems, adherence, and clinical outcomes, using Boolean operators ("AND," "OR") and truncation where appropriate.

The search strategy was adapted for each database according to its indexing system. A full reproducible search strategy for MEDLINE (via PubMed) is provided below: ("Rehabilitation"[MeSH] OR rehabilitation OR physiotherapy OR "physical therapy" OR "exercise therapy") AND ("Individualized" OR "personalized" OR "tailored" OR "adaptive" OR "performance-driven" OR "feedback-based") AND ("Telemedicine"[MeSH] OR telerehabilitation OR "digital health" OR "mobile health" OR mHealth OR "wearable devices" OR "virtual reality" OR "artificial intelligence") AND ("Patient Compliance"[MeSH] OR adherence OR compliance OR engagement) AND ("Treatment Outcome"[MeSH] OR "clinical outcomes" OR function OR mobility OR pain OR "quality of life")

Search filters were not applied for study design to maximize sensitivity. The final search strategy, including all database-specific adaptations, is provided in the Supplementary Materials (to be included).

2.5 Study Selection Process

Study selection was conducted in accordance with PRISMA 2020 guidelines using a structured, two-stage screening process. Following the removal of duplicate records, two independent reviewers screened titles and abstracts of all retrieved studies against the predefined eligibility criteria. Studies deemed potentially relevant were then retrieved for full-text review.

In the second stage, full-text articles were independently assessed by the same reviewers to determine final inclusion. Reasons for exclusion at the full-text stage were recorded systematically. Discrepancies between reviewers at any stage were resolved through discussion and consensus; where disagreement persisted, a third reviewer was consulted to adjudicate the decision.

The study selection process was documented using a PRISMA flow diagram, detailing the number of records identified, screened, excluded, and included at each stage, along with reasons for exclusion at the full-text stage.

2.6 Data Extraction

Data extraction was performed using a standardized and pre-defined data extraction form developed based on the review objectives and eligibility criteria. The extraction framework was designed to capture detailed information on study characteristics, intervention features, comparator details, adherence outcomes, and clinical effectiveness outcomes. Specifically, extracted variables included study design, sample size, population characteristics, clinical condition, setting, intervention duration, technological components of the individualized rehabilitation system, mechanisms of adaptation (e.g., real-time feedback, algorithm-driven personalization), comparator characteristics, adherence measures, and clinical outcome measures with corresponding results. Data extraction was conducted independently by two reviewers, and discrepancies were resolved through discussion to ensure accuracy and completeness of the extracted data.

2.7 Risk of Bias Assessment

The methodological quality of included studies was assessed using validated risk-of-bias tools

appropriate to study design. For randomized controlled trials, the Cochrane Risk of Bias 2 (RoB 2) tool was used to evaluate bias across domains including randomization, deviations from intended interventions, missing outcome data, measurement of outcomes, and selection of reported results. For non-randomized studies, the Risk Of Bias In Non-randomized Studies of Interventions (ROBINS-I) tool was applied, assessing bias due to confounding, selection of participants, intervention classification, deviations from intended interventions, missing data, outcome measurement, and selective reporting. Risk-of-bias assessment was conducted independently by two reviewers, with disagreements resolved through consensus or consultation with a third reviewer. The results of the assessment were used to inform the interpretation of findings.

2.8 Data Synthesis

A narrative synthesis was conducted to summarize and interpret findings across included studies, given the anticipated heterogeneity in populations, intervention characteristics, and outcome measures. The synthesis focused on identifying patterns in adherence and clinical outcomes, as well as contextual factors influencing effectiveness, including intervention design, level of individualization, and comparator characteristics. Studies were grouped and compared based on key variables such as clinical population, rehabilitation setting, and type of performance-driven adaptation.

2.9 Subgroup Analyses

Subgroup analyses were conducted where pre-specified and where sufficient data were available. These analyses aimed to explore potential sources of heterogeneity, including differences across clinical populations (e.g., musculoskeletal vs. neurological conditions), intervention characteristics (e.g., level of technological sophistication, presence of real-time biofeedback), and rehabilitation settings (e.g., home-based vs. supervised care).

2.10 Sensitivity Analyses

Sensitivity analyses were planned to assess the robustness of the findings. These included evaluating the impact of excluding studies at high risk of bias, as well as examining the influence of study design and methodological quality on pooled estimates where meta-analysis was performed.

2.11 Publication Bias Assessment

Where a sufficient number of studies (typically ≥10) were available for a given outcome, publication bias was assessed using visual inspection of funnel plots. Statistical assessment of asymmetry was conducted using Egger's regression test, where appropriate.

2.12 Certainty of Evidence

The certainty of evidence for each outcome was assessed using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach. This involved evaluation of risk of bias, inconsistency, indirectness, imprecision, and publication bias. The overall certainty of evidence was categorized as high, moderate, low, or very low. A Summary of Findings (SoF) table was prepared to present key outcomes, effect estimates, and certainty ratings in a transparent and structured format, facilitating interpretation and application of the findings.

3. Results

3.1 Study Selection

The study selection process is presented in Figure 1. A total of 1,000 records were identified through database searching. Following title and abstract screening, 953 records were excluded for not meeting the predefined eligibility criteria. Full-text assessment of the remaining records resulted in the inclusion of 27 studies in the final synthesis, as summarized in Table 1. The primary reasons for exclusion at the full-text stage included lack of performance-driven individualization, absence of adherence or clinical outcome reporting, and ineligible study designs.

3.2 Study Characteristics

The characteristics of the included studies are presented in Table 1. The included evidence base comprised 27 studies, encompassing a broad range of clinical populations, rehabilitation technologies, and study designs. The majority of studies were randomized controlled trials, supplemented by crossover trials, single-blind trials, feasibility studies, and retrospective analyses.

The included studies spanned multiple clinical domains, including cardiovascular, musculoskeletal, neurological, pulmonary, renal, oncological, and autoimmune conditions. Intervention durations ranged from 3 weeks to 12 months, with several studies including follow-up assessments extending up to one year. The most frequently represented populations included post-stroke rehabilitation, musculoskeletal conditions such as total knee and hip arthroplasty and osteoarthritis, and cardiovascular rehabilitation. Neurological conditions beyond stroke, including Parkinson's disease and multiple sclerosis, were also well represented. Less frequently studied populations included systemic lupus erythematosus, chronic obstructive pulmonary disease, cancer survivorship, hemodialysis, chronic low back pain, post-COVID syndromes, traumatic hand injuries, and transfemoral amputation.

Sample sizes varied substantially across studies, reflecting both exploratory and confirmatory research designs. While most studies included relatively small to moderate sample sizes, larger randomized trials were also present. One systematic review within the dataset synthesized multiple trials, further contributing to the breadth of evidence.

The interventions demonstrated substantial variability in both technological sophistication and degree of individualization. At the lower end of complexity, interventions consisted of web-based or app-based programs with periodic clinician-guided adjustments. More advanced systems incorporated real-time biofeedback, wearable sensors, virtual reality environments, and artificial intelligence–driven adaptive algorithms, enabling dynamic adjustment of exercise dosage, feedback, and progression based on patient-specific performance. Conventional comparators included standard physiotherapy, supervised rehabilitation, and usual care, with varying levels of clinician interaction.

3.3 Risk of Bias Within Studies

The risk-of-bias assessment is summarized in Table 2. Overall, methodological quality varied across studies. Most randomized controlled trials were judged to have some concerns, primarily due to the inherent difficulty of blinding participants and personnel in rehabilitation interventions. Additional concerns included variability in adherence measurement, incomplete reporting of

allocation concealment, and potential performance bias.

Pilot and feasibility studies were more frequently associated with high risk of bias, largely due to small sample sizes and exploratory designs. Retrospective studies were assessed as having serious risk of bias, primarily due to confounding and selection bias. Despite these limitations, the overall direction of findings was generally consistent across studies.

3.4 Results of Individual Studies

Adherence Outcomes

Adherence outcomes were reported in 25 studies, as summarized in Table 3. Adherence was measured heterogeneously across studies, including session completion rates, exercise minutes, percentage of prescribed training achieved, retention rates, and self-reported physical activity levels. Across studies reporting comparative data, individualized, performance-driven rehabilitation systems generally demonstrated improved adherence compared with conventional care. Among the most pronounced findings, adherence in cardiac rehabilitation reached 141% compared with 50% in conventional care, while technology-assisted interventions achieved 100% adherence compared with 30% in control groups receiving minimal guidance. Similarly, telerehabilitation following orthopedic surgery demonstrated adherence rates of approximately 86% compared with 60% in conventional rehabilitation.

Additional studies demonstrated moderate improvements in adherence, including increased physical activity levels and improved self-reported adherence scores. Real-time feedback systems and virtual environments were associated with particularly high engagement, with some studies reporting adherence exceeding prescribed exercise levels.

However, adherence advantages were not consistent across all studies. Several trials reported no significant differences between individualized and conventional rehabilitation, particularly when the comparator involved structured or supervised physiotherapy. In some cases, adherence favored conventional therapy, with supervised rehabilitation demonstrating significantly higher adherence than app-based interventions.

Retention and dropout patterns were generally favorable for technology-based interventions, with several studies reporting high retention rates and minimal attrition. Nevertheless, some studies reported low engagement and high early discontinuation rates, indicating potential barriers related to usability, onboarding, and system complexity.

Clinical Effectiveness Outcomes

Clinical outcomes were reported in 25 studies, as summarized in Table 4. Across studies, individualized rehabilitation systems demonstrated outcomes that were either superior or noninferior to conventional therapy. Significant improvements were observed across multiple domains. In post-surgical rehabilitation, individualized systems demonstrated superior improvements in functional mobility, including clinically meaningful improvements in Timed Up and Go performance. In stroke rehabilitation, AI-driven and sensor-based interventions produced substantial improvements in functional independence and motor recovery.

Cardiovascular rehabilitation studies consistently demonstrated improvements in exercise capacity, including increases in walking distance and peak oxygen uptake. These findings indicate that technology-assisted rehabilitation can achieve clinically meaningful improvements in cardiorespiratory fitness.

In musculoskeletal conditions, individualized rehabilitation resulted in significant improvements in pain and functional scores in several studies. However, some studies reported no significant differences between groups, indicating equivalence rather than superiority.

Several large randomized trials demonstrated noninferiority, indicating that individualized systems can achieve outcomes comparable to conventional therapy while offering alternative delivery models. In inpatient or highly supervised settings, differences between groups were generally minimal, suggesting that the relative benefit of individualized systems depends on the baseline level of care. Sustained effects were reported in several studies, with improvements in physical activity, pain, and quality of life maintained at follow-up assessments ranging from several months to one year.

3.5 Synthesis of Results

3.5.1 Adherence Outcomes

The synthesis of adherence outcomes indicates that individualized, performance-driven rehabilitation systems improve adherence primarily when compared with minimal-contact or unsupervised conventional care. Interventions incorporating real-time feedback, gamification, or adaptive algorithms demonstrated the highest adherence levels. However, when compared with structured or supervised physiotherapy, adherence advantages were reduced or absent, and in some cases reversed. These findings indicate that the effectiveness of individualized systems in improving adherence is strongly influenced by comparator intensity and intervention design.

3.5.2 Clinical Outcomes

Clinical outcomes demonstrated greater consistency across studies, with individualized rehabilitation systems achieving outcomes that were at least equivalent to conventional therapy and often superior in specific contexts.

Superiority was most evident in home-based rehabilitation, post-surgical recovery, and interventions incorporating advanced adaptive technologies, whereas equivalence was observed in inpatient or highly supervised settings. These findings suggest that individualized systems provide the greatest benefit in contexts where baseline rehabilitation support is limited.

3.6 Publication Bias

Formal assessment of publication bias was limited due to heterogeneity in study designs and outcome measures. Where assessment was feasible, visual inspection suggested potential asymmetry; however, these findings should be interpreted cautiously.

3.7 Certainty of Evidence (GRADE)

The certainty of evidence is summarized in Table 5. Overall, the certainty ranged from low to moderate across outcomes. Evidence for adherence and functional outcomes was rated as moderate certainty, while evidence for pain, quality of life, and safety outcomes was rated as low to moderate certainty, primarily due to heterogeneity, risk of bias, and imprecision.

Table 1. Characteristics of included studies

Study	Study design	Population/condition	Intervention	Comparator	Duration
Saarikoski et al. (2024)	RCT	Acute coronary syndrome	Tablet-based virtual physiotherapy agent	Usual care	6 months
Cannell et al. (2017)	RCT	Stroke	Motion-capture rehabilitation software	Usual stroke rehabilitation	8–40 sessions
Pak et al. (2023)	RCT	Chronic shoulder pain	Digital PT with inertial trackers and biofeedback	Conventional clinic-based PT	8 weeks
Nuevo et al. (2023)	RCT	Total knee arthroplasty	IMU sensor-based ReHub telerehabilitation	Conventional rehabilitation	4 weeks
Bettger et al. (2019)	RCT	Total knee arthroplasty	Virtual PT with avatar coach and 3D biometrics	Traditional PT care	12 weeks
van den Berg et al. (2006)	RCT	Rheumatoid arthritis	Internet-based individualized physical activity program	Usual care/control intervention	12 months
Hafner & Askew (2015)	Crossover RCT	Transfemoral amputation	Adaptive/active prosthetic knees	Passive prosthetic knee condition	14 months
Maggio et al. (2024)	Retrospective study	Parkinson's disease	Personalized pathway using VR, robotics, wearables	Conventional rehabilitation	Not specified
Turner et al. (2016)	Single-blind RCT	Multiple sclerosis	Telehealth monitoring with telephone counseling	Usual care/control	6 months
Brouns et al. (2020)	Pre–post controlled trial	Stroke	Comprehensive eRehabilitation alongside conventional rehabilitation	Conventional rehabilitation	6 months
Dolezal et al. (2015)	RCT	Firefighter fitness	Wearable PSMs and digital health network feedback	Unsupervised/traditional training	1 month
Fluet et al. (2024)	RCT	Stroke, upper extremity	Leap Motion and Unity 3D game-based rehabilitation	Alternative protocol/scaffolding condition	12 weeks
Schwartz et al. (2015)	RCT	Cancer survivorship	Online recovery tool with adaptive algorithm	Exercise/usual rehabilitation control	12 weeks
Saklica et al. (2025)	RCT	Coronary artery disease	Technology-based cardiac rehabilitation with app, videoconferencing and AI/NLP feedback	Physical activity recommendations/usual control	12 weeks
Visentin et al. (2022)	Crossover RCT	Chronic clinical conditions	Virtual feedback environment with heart-rate monitoring	Conventional exercise condition	4 weeks
Naz et al. (2025)	RCT	Stroke	AI-guided virtual physiotherapy with motion-tracking sensors	Traditional therapy	12 weeks
Zaidi et al. (2025)	RCT	Knee osteoarthritis	AI-driven mobile app with real-time motion tracking	Clinic-based rehabilitation	12 weeks
Fisher et al. (2023)	RCT	Cardiac rehabilitation	Digital contextualized feedback using PA monitors	Standard cardiac rehabilitation/control	8 weeks

Study	Study design	Population/condition	Intervention	Comparator	Duration
Prahm et al. (2025)	RCT	Traumatic hand injuries	Immersive VR with optical hand tracking	Conventional hand rehabilitation	3 weeks
Dosbaba et al. (2025)	RCT	Chronic low back pain	Hybrid guided home-based rehabilitation with phone monitoring	Outpatient rehabilitation	18 weeks; 24-week follow-up
Lu et al. (2025)	RCT	Stroke	Wearable IMU-based intelligent rehabilitation glove/system	Conventional rehabilitation	8 weeks
Martinsen et al. (2025)	RCT	Hip/knee osteoarthritis	Virtual Training app-based exercise	Supervised in-person physiotherapy	6 weeks
Knippenberg et al. (2021)	Single-blind RCT	CNS deficits: stroke, MS, SCI	Kinect-based i-ACT client-centred training system	Conventional neurological rehabilitation	6 weeks plus follow-up
Nabutovsky et al. (2022)	Prospective RCT	Cardiac rehabilitation	Smart sports watch and mobile-app remote rehabilitation	Conventional/center-based rehabilitation alternative	6 months
Faria et al. (2020)	RCT	Stroke, cognitive rehabilitation	VR-based adaptive ADL simulation, Reh@City v2.0	Personalized paper-and-pencil cognitive rehabilitation	12 sessions plus follow-up
Carvalho et al. (2022)	Retrospective study	Coronary heart disease	Hybrid telerehabilitation using MOVIDA.eros mobile app	Conventional cardiac rehabilitation	12 weeks; 1-year follow-up
Janaudis-Ferreira et al. (2024)	RCT	Long COVID	Symptom-titrated virtual rehabilitation with oximeter monitoring	Usual care/control	8 weeks

Table 2. Risk-of-bias summary across included studies

Study	Study design	Key risk-of-bias concerns	Overall judgment*
Saarikoski et al. (2024)	RCT	Lack of blinding; differential adherence measurement	Some concerns
Cannell et al. (2017)	RCT	Limited blinding; comparator variability	Some concerns
Pak et al. (2023)	RCT	Lack of participant blinding; digital vs clinic comparator	Some concerns
Nuevo et al. (2023)	RCT	Short duration; blinding limitations	Some concerns
Bettger et al. (2019)	RCT	Limited blinding; noninferiority design considerations	Low–some concerns
van den Berg et al. (2006)	RCT	Self-reported outcomes; older methodology	Some concerns
Hafner & Askew (2015)	Crossover RCT	Carryover effects; small sample	Some concerns
Maggio et al. (2024)	Retrospective	Confounding; selection bias	Serious
Turner et al. (2016)	RCT	Behavioral intervention; blinding limitations	Some concerns
Dolezal et al. (2015)	RCT	Very small sample; measurement bias	High
Fluet et al. (2024)	RCT	Small sample; reporting limitations	Some concerns
Schwartz et al. (2015)	RCT	Small sample; adherence self-report	Some concerns
Saklica et al. (2025)	RCT	Blinding limitations; intervention heterogeneity	Some concerns
Visentin et al. (2022)	Crossover RCT	Carryover bias; small sample	Some concerns
Naz et al. (2025)	RCT	Blinding limitations; potential performance bias	Some concerns

Zaidi et al. (2025)	RCT	Blinding limitations; digital literacy bias	Some concerns
Fisher et al. (2023)	RCT	Limited reporting detail	Some concerns
Prahm et al. (2025)	RCT	Short intervention duration; blinding limitations	Some concerns
Dosbaba et al. (2025)	RCT	Comparator heterogeneity; blinding limitations	Some concerns
Lu et al. (2025)	RCT	Performance bias; lack of blinding	Some concerns
Martinsen et al. (2025)	RCT	Secondary analysis; adherence bias	Some concerns
Knippenberg et al. (2021)	RCT	Single-blind; heterogeneous population	Some concerns
Nabutovsky et al. (2022)	RCT	Selection bias (self-selection into groups)	Some concerns
Faria et al. (2020)	RCT	Blinding limitations; cognitive outcome variability	Some concerns
Carvalho et al. (2022)	Retrospective	Confounding; selection bias	Serious
Janaudis-Ferreira et al. (2024)	RCT	Blinding limitations; emerging population	Some concerns

Across included studies, the overall risk of bias ranged from low to serious, with the majority of randomized controlled trials judged as having "some concerns", primarily due to the inherent inability to blind participants and personnel in rehabilitation interventions. Pilot and feasibility studies were frequently judged as high risk of bias due to small sample sizes and exploratory designs, while non-randomized and retrospective studies were assessed as having serious risk of bias due to confounding and selection bias.

Table 3. Adherence outcomes across studies reporting adherence data (n = 25)

Study	Adherence measure	Individualized rehabilitation	Conventional therapy	Between-group comparison
Correia et al. (2019)	Retention; session compliance	86% retention; 83% compliance	94% retention	Comparable adherence; lower therapist time ($p < .001$)
Donkers et al. (2020)	Exercise sessions (26 weeks)	38.9 ± 28.1 sessions	34.6 ± 40.8 sessions	No significant difference ($p = .208$)
Aharon et al. (2022)	Retention (3 months)	76% active	24% active	Significant improvement ($p < .001$)
Baumann et al. (2017)	Physical activity (MET-min/week)	Increased (2733 → 4169)	Minimal change (2858 → 2876)	Improvement in intervention group
Barksdale et al. (2020)	Exercise frequency	3–5 sessions/week; no missed sessions	Six missed visits	Improved adherence in intervention
Bennell et al. (2019)	Self-rated adherence (NRS)	Higher adherence (MD −1.0)	Lower adherence	Significant difference (95% CI −1.6 to −0.3)
Russell et al. (2011)	Sessions/day	2.2 ± 0.5	1.7 ± 0.8	No significant difference ($p = .12$)
Brusco et al. (2019)	≥70% adherence threshold	72% achieved target	Not reported	Increased participation ($p = .00$)
Piron et al. (2009)	Study completion	100% completion	100% completion	No difference
Tesio et al. (2019)	Training diary; activity levels	High compliance reported	Not reported	Not reported
Nuevo et al. (2023)	Exercise completion (%)	85.99%	59.78%	Significant improvement ($p = .002$)
Saklica et al. (2025)	Session completion	100%	30%	Significant improvement ($p < .001$)
Saarikoski et al. (2024)	Exercise adherence (%)	141%	50%	Significant improvement ($p < .0001$)
Visentin et al. (2022)	Compliance (%)	101%	50%	Significant improvement ($p = .001$)
Martinsen et al. (2025)	Exercise adherence	Lower adherence	Higher adherence	Control favored (OR = 4.2, $p = .008$)
Dosbaba et al. (2025)	Attendance/compliance	Improved adherence	Comparable	No significant difference

Study	Adherence measure	Individualized rehabilitation	Conventional therapy	Between-group comparison
Sørensen & Svenningsen (2016)	Training adherence	High adherence	Comparable	No significant difference
Nabutovsky et al. (2022)	Participation/retention	High adherence	Comparable	No significant difference
Faria et al. (2020)	Program completion	High completion	Comparable	No significant difference
Naz et al. (2025)	Session adherence	Improved adherence	Lower adherence	Significant improvement
Zaidi et al. (2025)	Exercise adherence	Higher adherence	Lower adherence	Significant improvement
Prahm et al. (2025)	Participation rate	High adherence	Comparable	No significant difference
Lu et al. (2025)	Compliance rate	Improved adherence	Lower adherence	Significant improvement
Knippenberg et al. (2021)	Training adherence	Higher adherence	Lower adherence	Moderate improvement
Turner et al. (2016)	Exercise adherence	Improved adherence	Comparable	No significant difference

Table 4. Clinical outcomes across studies reporting clinical effectiveness data

Study	**Population**	**Primary/major clinical outcome**	**Individualized rehabilitation result**	**Conventional therapy result**	**Between-group finding**
Brusco et al. (2019)	Inpatient musculoskeletal/frail older adults	FIM MCID	22% achieved MCID	10% achieved MCID	Favored intervention; p = .02
Bennell et al. (2019)	Musculoskeletal conditions	Confidence/exercise ability	Higher confidence	Lower confidence	Clinical relevance not established
Aharon et al. (2022)	Cardiac rehabilitation	Adherence-focused outcome	76% retained at 3 months	24% retained	Clinical outcome not separately reported
Bettger et al. (2019)	Total knee arthroplasty	KOOS; healthcare costs	Noninferior outcomes; lower costs	Reference	KOOS noninferior; costs lower, p < .001
Brouns et al. (2020)	Stroke	SIS communication and strength	Small improvements	Reference	Statistically significant but below MCID
Cannell et al. (2017)	Stroke	Functional reach	+4.1 cm	+3.3 cm	No significant difference; p = .69
Carvalho et al. (2022)	Coronary heart disease	IPAQ; EQ-5D	Improvements sustained to 1 year	Improvements not sustained	IPAQ p = .018; EQ-5D p = .034
Donkers et al. (2020)	Multiple sclerosis	Secondary clinical outcomes	Medium effects for HADS anxiety and TUG in ambulatory participants	Reference	Primary outcome not significantly different
Dosbaba et al. (2025)	Chronic low back pain	Pain; trunk endurance	Greater improvement	Lower improvement	Pain g = 0.910, p = .001; endurance g = 0.688, p = .009
Faria et al. (2020)	Stroke cognitive rehabilitation	MoCA; visuospatial/executive function	Greater improvement	Minimal change	Favored VR-based rehabilitation
Fisher et al. (2023)	Cardiac rehabilitation	ISWT	+89 m	+44 m	Trend favoring intervention; not significant

Fluet et al. (2024)	Stroke upper extremity	UEFMA	21/33 improved ≥4.25 points	Protocol variants	No group × time interaction
Hafner & Askew (2015)	Transfemoral amputation	TUG	−0.91 s with adaptive knee	Passive knee	Favored adaptive knee; p = .001
Janaudis-Ferreira et al. (2024)	Long COVID	AM-PAC mobility; EQ-5D-5L VAS	EQ-5D-5L improved	Reference	Mobility NS; EQ-5D-5L VAS significant
Knippenberg et al. (2021)	CNS deficits	WMFT; MAM-36; COPM	Improved	Improved	No significant between-group difference
Lu et al. (2025)	Stroke	FMA; MBI	Superior improvement	Reference	Favored wearable system; both p < .01
Maggio et al. (2024)	Parkinson's disease	MMSE; FAB; GAS	Improved across outcomes	Limited improvement	Favored technology; all p < .001
Martinsen et al. (2025)	Hip/knee osteoarthritis	H/KOOS	No significant association	Reference	No significant difference
Nabutovsky et al. (2022)	Cardiac rehabilitation	Peak VO_2	+2.46 mL/kg/min	−0.72 mL/kg/min	Favored remote rehabilitation; p < .001
Naz et al. (2025)	Stroke	FIM; FMMS	Greater improvement	Lower improvement	FIM d = 1.18, p = .01; FMMS d = 0.99, p = .02
Nuevo et al. (2023)	Total knee arthroplasty	ROM; quadriceps strength	No difference in ROM; better strength	Reference	Strength favored telerehabilitation; p = .028
Pak et al. (2023)	Chronic shoulder pain	QuickDASH	Improved	Improved	No significant difference; p = .75
Prahm et al. (2025)	Traumatic hand injury	Wrist ROM; thumb opposition	ROM +27.8°	ROM +17.3°	ROM p < .001; thumb opposition p = .04
Saarikoski et al. (2024)	Acute coronary syndrome	Vagal modulation; exercise capacity	lnHF 5.5→5.8 ms^2	lnHF 5.3→5.2 ms^2	Interaction p = .014; exercise capacity NS
Saklica et al. (2025)	Coronary artery disease	ISWT	+87.2 m / +89.4 m	+10.9 m	Favored technology; p = .001
Schwartz et al. (2015)	Cancer survivorship	6MWT	18.5% greater improvement	Reference	Trend favoring intervention; NS
Turner et al. (2016)	Multiple sclerosis	Fatigue; depression	Reduced fatigue and depression	Reference	Fatigue d = −0.70; depression d = −0.72
van den Berg et al. (2006)	Rheumatoid arthritis	Physical activity recommendations	Greater achievement at 6, 9, 12 months	Reference	Favored internet-based program; p < .005
Zaidi et al. (2025)	Knee osteoarthritis	WOMAC; VAS pain; TUG	Greater improvement	Lower improvement	WOMAC p < .01; pain p < .05; TUG p < .01

Table 5. GRADE Summary of Findings

Outcome	Studies contributing evidence	Main findings	Certainty of evidence	Reasons for certainty rating
Adherence / engagement	25 studies	Individualized systems generally improved adherence compared with minimal-contact or unsupervised conventional care; effects were attenuated or reversed when compared with structured supervised therapy.	Moderate	Downgraded for inconsistency due to heterogeneous adherence definitions, intervention types, and comparator intensity.
Functional mobility / physical performance	25 studies	Most studies showed superior or noninferior functional outcomes, particularly in post-surgical, stroke, cardiac, and home-based rehabilitation settings.	Moderate	Downgraded for risk of bias related to blinding limitations, small samples in several trials, and clinical heterogeneity.
Pain-related outcomes	6 studies	AI-guided or hybrid individualized rehabilitation showed greater pain reduction in knee osteoarthritis and chronic low back pain; evidence was less consistent across other musculoskeletal conditions.	Low	Downgraded for inconsistency, limited number of contributing studies, and imprecision.
Quality of life / patient-reported health status	10 studies	Several studies reported improved or sustained quality-of-life outcomes, but effects varied by condition and intervention model.	Low	Downgraded for indirectness, heterogeneous measures, and imprecision.
Exercise capacity / cardiorespiratory outcomes	7 studies	Technology-supported cardiac rehabilitation improved walking capacity or VO_2-related outcomes in several studies.	Moderate	Downgraded for heterogeneity in cardiac populations, intervention models, and outcome measures.
Safety / adverse events	Reported in limited studies	Safety was generally favorable where reported, with no consistent signal of intervention-related harm.	Low	Downgraded for incomplete adverse-event reporting and limited systematic safety assessment.
Patient satisfaction / usability	Limited studies	Usability and satisfaction were generally high for digital and sensor-based systems, although technology barriers were reported in some studies.	Low	Downgraded for selective reporting, feasibility-study designs, and lack of standardized satisfaction measures.

4. Discussion

4.1 Principal Findings

This systematic review synthesized evidence from 47 studies evaluating individualized, performance-driven rehabilitation systems compared with conventional therapy. The findings demonstrate that the effectiveness of these systems is highly context-dependent, with clearer and more consistent benefits observed for clinical outcomes than for adherence. Across studies, individualized rehabilitation systems improved adherence primarily when compared with minimal-contact or unsupervised care, whereas differences were attenuated or reversed when compared with structured, supervised rehabilitation. In contrast, clinical outcomes were more consistently superior or noninferior across a range of populations, particularly in post-surgical, cardiovascular, and neurological rehabilitation contexts.

The findings of this review are consistent with previous research demonstrating that technology-supported rehabilitation can improve accessibility and clinical effectiveness, particularly in home-based settings. However, this review extends existing literature by distinguishing between generic personalization and true performance-driven individualization, characterized by continuous adaptation based on patient performance metrics. Studies incorporating real-time feedback and algorithm-driven adjustments demonstrated greater effectiveness compared with those relying on static or preference-based personalization, supporting emerging evidence that dynamic adaptation is essential for meaningful clinical impact (Naz et al., 2025; Zaidi et al., 2025).

At the same time, the review highlights inconsistencies not fully addressed in prior literature, particularly regarding adherence. While previous studies have often reported improved adherence with digital interventions, the present synthesis demonstrates that such benefits are conditional on comparator intensity and intervention design. This aligns with findings from Donkers et al. (2020) and Martinsen et al. (2025), where structured conventional therapy reduced or eliminated the relative advantage of technology-based approaches.

4.2 Mechanisms and Clinical Interpretation

Reconciling Adherence Findings

The contrast between studies showing large adherence advantages, such as Saarikoski et al. (2024) and Saklica et al. (2025), and those showing no difference (Donkers et al., 2020) or even reversed effects (Martinsen et al., 2025), can be explained by differences in comparator intensity and the degree of intervention individualization. Studies demonstrating the largest adherence gains typically compared technology-based systems against minimal-contact controls, including generic advice or unsupervised exercise programs. In contrast, studies using structured comparators with physiotherapist involvement showed diminished or absent differences, indicating that the marginal benefit of technology decreases as the quality of conventional care increases.

The findings from Martinsen et al. (2025) are particularly informative, demonstrating that supervised physiotherapy outperformed app-based rehabilitation (OR = 4.2, p = .008), with adherence strongly influenced by self-efficacy, education level, and fatigue. These results suggest that patients with lower self-efficacy or

health literacy may benefit more from direct human interaction than from autonomous digital systems. Conversely, Donkers et al. (2020) observed higher adherence among wheelchair users in a web-based intervention, suggesting that individuals with limited access to in-person care derive greater benefit from technology-enabled programs.

Real-time biofeedback and gamification emerged as key drivers of adherence. Studies such as Prahm et al. (2025), Popović et al. (2014), and Visentin et al. (2022) demonstrated substantial increases in exercise engagement and compliance, consistent with principles of self-determination theory. These systems enhance intrinsic motivation by providing immediate feedback, promoting autonomy, and creating engaging task environments. However, barriers such as low uptake, early attrition, and technical challenges—highlighted in studies such as Brouns et al. (2020) and Alhusayni et al. (2023)—underscore the importance of user-centered design, onboarding processes, and technological accessibility.

Reconciling Clinical Effectiveness Findings

Clinical superiority of individualized systems was most evident in post-surgical rehabilitation and studies with longer follow-up durations. For example, Correia et al. (2019) and Correia et al. (2018) demonstrated consistent improvements in mobility outcomes at 6 months, whereas Bettger et al. (2019) reported noninferiority rather than superiority, potentially reflecting differences in intervention sophistication and comparator intensity. Systems incorporating real-time biofeedback and clinician monitoring appeared to produce greater improvements than those relying solely on remote coaching without continuous adaptation.

AI-driven interventions showed the largest effect sizes, as observed in studies by Naz et al. (2025) and Zaidi et al. (2025), although these findings should be interpreted cautiously due to potential selection bias and limited generalizability. Nonetheless, the consistent direction of effects suggests that algorithmic adaptation may offer advantages beyond conventional or static digital interventions.

In stroke rehabilitation, the pattern was more nuanced. Studies conducted in inpatient settings with short intervention durations generally demonstrated equivalence, whereas longer-duration, home-based interventions incorporating adaptive features showed superiority. This suggests a dose-response relationship, whereby technology-based systems provide greater benefit in contexts where baseline rehabilitation intensity is limited.

Cardiac rehabilitation findings were more consistent, with converging evidence from multiple studies demonstrating improvements in exercise capacity and functional outcomes. Notably, technology-assisted programs were particularly effective in reaching patients who would otherwise not participate in conventional rehabilitation, highlighting their role in expanding access to care.

Moderating Factors

Several patient- and system-level factors influenced outcomes across studies. Greater benefits were observed among patients with higher baseline disability, limited access to care, or mobility constraints. Conversely, factors such as low self-efficacy, limited digital literacy, and high fatigue levels reduced adherence and effectiveness in some populations. Psychological outcomes showed mixed results, suggesting that

while technology can support behavioral interventions, the therapeutic relationship inherent in face-to-face care remains important for certain patient groups. However, studies incorporating behavioral coaching alongside technology demonstrated significant improvements in psychological outcomes, indicating that hybrid approaches may be optimal.

4.3 Strengths of the Review

This review provides a comprehensive synthesis of a rapidly evolving field, incorporating a wide range of clinical populations and intervention types. A key strength is the clear distinction between performance-driven individualization and generic personalization, allowing for a more precise evaluation of intervention effectiveness. The inclusion of both adherence and clinical outcomes offers a holistic perspective, and adherence to PRISMA 2020 and Cochrane methodological standards enhances transparency and reproducibility.

4.4 Limitations

Study-Level Limitations

The included studies were characterized by substantial heterogeneity in populations, interventions, and outcome measures. Many studies were small, pilot, or feasibility trials, limiting statistical power and generalizability. Blinding was rarely feasible, increasing the risk of performance and detection bias. Additionally, adherence was measured inconsistently across studies, limiting comparability.

Review-Level Limitations

At the review level, heterogeneity precluded comprehensive meta-analysis across all outcomes. Inclusion of non-randomized and feasibility studies may have introduced bias, although this reflects the current evidence base. Publication bias could not be fully assessed, and incomplete reporting of long-term outcomes and adverse events further limited the synthesis.

4.5 Implications for

Clinical Practice

Individualized, performance-driven rehabilitation systems represent a viable alternative or adjunct to conventional therapy, particularly in home-based and resource-limited settings. Systems incorporating real-time feedback, adaptive algorithms, and behavioral support appear most effective. However, patient selection remains critical, and individuals with low self-efficacy or complex needs may benefit from hybrid or supervised approaches.

Policy

These findings support the integration of digital rehabilitation systems into healthcare delivery models, particularly to improve access and scalability. Evidence of noninferiority and cost-effectiveness in some studies suggests that such systems may reduce healthcare burden while maintaining clinical effectiveness. Implementation should be supported by appropriate infrastructure and training.

Future Research

Future research should focus on high-quality randomized trials with standardized outcome measures and longer follow-up periods. Greater emphasis is needed on identifying optimal intervention components, evaluating cost-effectiveness, and addressing implementation barriers. Standardization of adherence measurement is also essential.

5. Conclusions

Individualized, performance-driven rehabilitation systems demonstrate moderate-certainty evidence for improving adherence in specific contexts and moderate-certainty evidence for achieving superior or noninferior clinical outcomes compared with conventional therapy. The effectiveness of these systems depends on intervention design, comparator intensity, and patient characteristics. Systems incorporating real-time feedback, adaptive algorithms, and behavioral support provide the greatest benefit, particularly in home-based settings.

While these findings support the integration of individualized rehabilitation into clinical practice, the heterogeneity of the evidence and methodological limitations warrant cautious interpretation. Further high-quality research is required to strengthen the evidence base and guide optimal implementation.

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Reference

Saarikoski, E. O., Roiha, E. T. M., Kiviniemi, A., et al. (2024). Adherence to exercise after an acute coronary syndrome: A 6-month randomized controlled trial. Frontiers in Physiology. https://doi.org/10.3389/fphys.2024.1319907

Nuevo, M., Rodríguez-Rodríguez, D., Jauregui, R., et al. (2023). Telerehabilitation following fast-track total knee arthroplasty is effective and safe: A randomized controlled trial with the ReHub® platform. Disability and Rehabilitation. https://doi.org/10.1080/09638288.2023.2228689

Saklica, D., Vardar-Yagli, N., Sağlam, M., et al. (2025). The impact of technology-based cardiac rehabilitation on exercise capacity and adherence. Arquivos Brasileiros de Cardiologia. https://doi.org/10.36660/abc.20240765

Martinsen, L., Østerås, N., Moseng, T., & Tveter, A. (2025). Adherence to in-person and app-based exercise for patients with hip or knee osteoarthritis. Rheumatology International. https://doi.org/10.1007/s00296-025-05967-4

Donkers, S. J., Nickel, D., Paul, L., et al. (2020). Adherence to physiotherapy-guided web-based exercise in multiple sclerosis. International Journal of MS Care. https://doi.org/10.7224/1537-2073.2019-048

Naz, Z., Rasool, A., Urooj, N., et al. (2025). AI-guided virtual physiotherapy versus traditional therapy for post-stroke rehabilitation. Link Medical Journal. https://doi.org/10.61919/94tgwn21

Zaidi, S., Subhani, M. I., Khan, M. A., et al. (2025). AI-tailored home physiotherapy versus clinic-based rehabilitation in knee osteoarthritis. Insights Journal of Health and Rehabilitation. https://doi.org/10.71000/52a9k939

Correia, F. D., Nogueira, A., Magalhães, I., et al. (2019). Digital versus conventional rehabilitation after total hip arthroplasty. JMIR Rehabilitation and Assistive Technologies. https://doi.org/10.2196/14523

Correia, F. D., Nogueira, A., Magalhães, I., et al. (2018). Digital versus conventional home-based rehabilitation after total knee arthroplasty. JMIR Rehabilitation and Assistive Technologies. https://doi.org/10.2196/13111

Bettger, J. P., Green, C. L., Holmes, D. N., et al. (2019). Virtual exercise rehabilitation vs traditional care after total knee arthroplasty. Journal of Bone and Joint Surgery. https://doi.org/10.2106/JBJS.19.00695

Cannell, J., Jovic, E., Rathjen, A., et al. (2017). Motion capture-based rehabilitation in stroke. Clinical Rehabilitation. https://doi.org/10.1177/0269215517720790

Knippenberg, E., Timmermans, A., Coolen, J., et al. (2021). Technology-based client-centred training system in neurological rehabilitation. Journal of NeuroEngineering and Rehabilitation. https://doi.org/10.1186/s12984-021-00977-2

Nabutovsky, I., Levin, C., Yeshayahu, S., et al. (2022). Remote cardiac rehabilitation among unmotivated patients. European Journal of Preventive Cardiology. https://doi.org/10.1093/eurjpc/zwac056.307

Popović, D. B., Kostić, M., Rodić, S. Z., & Konstantinović, L. (2014). Feedback-mediated upper extremity exercise in stroke rehabilitation. BioMed Research International. https://doi.org/10.1155/2014/520374

Pak, S. S., Janela, D., Freitas, N., et al. (2023). Digital versus conventional physical therapy for chronic shoulder pain. Journal of Medical Internet Research. https://doi.org/10.2196/49236

van den Berg, M. H., Ronday, H. K., Peeters, A., et al. (2006). Internet-based physical activity intervention for rheumatoid arthritis. Arthritis & Rheumatism. https://doi.org/10.1002/art.22339

Hafner, B. J., & Askew, R. L. (2015). Prosthetic knee performance outcomes. Journal of Rehabilitation Research and Development. https://doi.org/10.1682/JRRD.2014.09.0210

Fluet, G., Qiu, Q., Patel, J., et al. (2019). Home virtual rehabilitation system feasibility study. Games for Health Journal. https://doi.org/10.1089/g4h.2019.0012

Maggio, M. G., Bonanno, M., Manuli, A., et al. (2024). Neuro-rehabilitation in Parkinson's disease. Biomedicines. https://doi.org/10.3390/biomedicines12112426

Turner, A. P., Hartoonian, N., Sloan, A., et al. (2016). Telephone-based physical activity counseling in multiple sclerosis. Journal of Consulting and Clinical Psychology. https://doi.org/10.1037/ccp0000086

Brouns, B., van Bodegom-Vos, L., de Kloet, A. D., et al. (2020). eRehabilitation in stroke recovery. Journal of Rehabilitation Medicine. https://doi.org/10.2340/16501977-2785

Schwartz, A. L., Biddle-Newberry, M., & de Heer, H. D. (2015). Exercise and online recovery tool in cancer survivors. Physician and Sportsmedicine. https://doi.org/10.1080/00913847.2015.1005547

Lützow, L., Teckenburg, I., Koch, V., et al. (2023). Smartphone-based rehabilitation in Parkinson's disease. Journal of Patient-Reported Outcomes. https://doi.org/10.1186/s41687-023-00631-6

Karisa, P., Sylviana, N., Syamsunarno, M. R., et al. (2026). Home-based cardiac rehabilitation systematic review. Patient Preference and Adherence. https://doi.org/10.2147/PPA.S581645

Plavoukou, T., Kasnesis, P., Syropoulou, A. C., et al. (2025). Wearable telerehabilitation in knee osteoarthritis. Applied Sciences. https://doi.org/10.3390/app152412988

Dosbaba, F., Senkyr, V., Vlažná, D., et al. (2025). Hybrid rehabilitation for chronic low back pain. Journal of Bodywork and Movement Therapies. https://doi.org/10.1016/j.jbmt.2025.08.009

Sørensen, D., & Svenningsen, H. (2016). Web-based inspiratory muscle training in COPD. European Respiratory Journal. https://doi.org/10.1183/13993003.CONGRESS-2016.PA1618