

Adherence Monitoring and Improvement in Physiotherapy Rehabilitation: A Narrative Review of Artificial Intelligence and Wearable Technology Application

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ABSTRACT

Background: Patient adherence to physiotherapy rehabilitation protocols remains a critical challenge globally, with rates as low as 40–65% reported in neurological and musculoskeletal populations. Artificial intelligence (AI) and wearable technology offer promising solutions for objective monitoring and improving exercise adherence beyond the clinic.

Objectives: To review the current evidence on AI and wearable technology applications for monitoring and improving patient compliance with physiotherapy rehabilitation programmes.

Methods: A narrative review methodology was employed consistent with PRISMA 2020 reporting guidelines and structured using the PICO framework. Five electronic databases were searched (PubMed, Scopus, Cochrane Library, PEDro, and Web of Science) for studies published between January 2018 and April 2026 using search terms related to artificial intelligence, machine learning, wearable technology, and physiotherapy adherence. Studies involving any adult demographic and any physiotherapy environment were incorporated.

Results: Six core AI mechanisms were identified across the thirteen included studies: real-time monitoring, personalised feedback, gamification, predictive non-adherence detection, automated reminders and adaptive exercise progression. Six of the thirteen included studies addressed predictive non-adherence detection and adaptive exercise progression which were the most widely supported mechanisms. In contrast, five studies supported real-time monitoring, gamification, and automated reminders. Wearable smart watches and IMU-based systems provided strong and consistent evidence for objective real-time exercise recognition in both clinical and home settings. AI-driven virtual assistants and gamification platforms demonstrated the greatest potential to improve patient engagement and motivation in home-based rehabilitation. Evidence for gamification and adaptive progression was primarily derived from review-level and observational studies rather than from primary, randomised experimental research, leading to a need for robust clinical trials in these areas.

Conclusion: AI and wearable technology offer a transformative but underused opportunity for monitoring adherence to physiotherapy. Robust clinical trials, particularly in neurological rehabilitation, are urgently needed. Physiotherapists and researchers must engage with these technologies to ensure evidence-based, equitable, and patient-centred implementation.

Keywords: artificial intelligence; wearable technology; patient adherence; physiotherapy; rehabilitation; machine learning; home exercise; exercise monitoring.

INTRODUCTION

Patient compliance with physiotherapy rehabilitation programmes is one of the most persistent and consequential challenges in clinical practice [1, 2]. Despite the well-established effectiveness of exercise-based rehabilitation across musculoskeletal, neurological, and cardiorespiratory conditions, adherence rates in home-based programmes are consistently reported to be between 40% and 65%, with significant deterioration over time [1]. Non-adherence leads to suboptimal clinical outcomes, increased healthcare costs, and preventable disability, placing a substantial burden on both patients and healthcare systems globally [1,3].

The World Physiotherapy Congress 2025 marked a landmark moment for the profession; for the first time, World Physiotherapy undertook a global initiative to define shared research priorities, acknowledging that the profession had never had a collectively agreed agenda to guide funding and advocacy [3]. Using a concept mapping methodology, 374 research statements were generated and refined into 64 prioritised ideas, which were rated according to their importance and feasibility [3]. This initiative aligns with the WHO Rehabilitation 2030 agenda, and its findings are intended to drive global research investment, inform policy, and align institutional strategies with the profession's most pressing needs [3]. Patient engagement and adherence to rehabilitation programs represent one of the domains emerging from this process that requires urgent attention [3].

The traditional approach to measuring adherence in patient self-reported exercise diaries is fraught with inaccuracy, recall bias, and low completion rates [2, 4]. As a result, technology-based measurement of adherence has become a research and clinical imperative [3,5]. Wearable sensor technologies, including smartwatches and inertial measurement units, have demonstrated promising capacity to recognise and classify rehabilitation exercises with high accuracy in both clinical and home environments [4,5,6].

Machine learning algorithms applied to wearable sensor data have shown particular promise in distinguishing between correct and incorrect exercise performance, enabling objective, real-time monitoring outside the clinic [5,6,7]. Single-camera pose detection systems have further extended this capability, offering a low-cost, non-wearable alternative for exercise classification in home settings [7, 8]. The integration of these technologies into structured digital rehabilitation platforms represents a significant step toward scalable, objective adherence monitoring [3,8].

The rapid development of artificial intelligence (AI) and machine learning has created unprecedented opportunities to not only monitor adherence objectively but also to actively improve it through personalised feedback, reminders, and adaptive exercise programming [2,9]. AI-driven virtual assistants and digital coaching tools have demonstrated potential to enhance patient engagement, motivation, and self-efficacy in home rehabilitation programmes [9,10]. Staff and service-user perceptions of digital health technologies in rehabilitation settings are generally positive, though concerns around usability, accessibility, and equity remain important considerations [11, 12].

The global wearable medical device market, valued at over USD 29.9 billion in 2021, is projected to grow at 19.1% annually, driven partly by rehabilitation monitoring applications [13]. Despite this market growth, the clinical evidence base for AI and wearable technology specifically targeting physiotherapy adherence remains fragmented, with most studies conducted in laboratory or clinic environments rather than real-world home settings [3,10]. A thorough examination of AI in rehabilitation has underscored enduring deficiencies in real-world efficacy, safety, and equity among diverse patient demographics and environments [10].

Adherence in neurological physiotherapy has been significantly overlooked. People with conditions such as multiple sclerosis, Parkinson's disease, stroke, fatigue, cognitive impairment, motor dysfunction, and fluctuating symptoms experience unique barriers that make adherence particularly challenging [12,14]. Web-based and digital physiotherapy interventions have demonstrated feasibility in neurological populations; however, substantial evidence regarding long-term adherence outcomes is still lacking [12]. AI-driven, adaptive systems may be uniquely positioned to address these barriers through continuous monitoring, real-time feedback, and personalised exercise progression [9,15].

The role of AI in future rehabilitation services has been systematically examined, with evidence suggesting that smart systems can support clinical decision-making, personalise intervention delivery, and reduce the burden on healthcare professionals [15]. Modern smart wearables additionally offer multimodal monitoring capabilities, capturing physiological, biomechanical, and behavioural data that may further enhance adherence support in complex patient populations [13,14]. The World Physiotherapy Congress 2025 identified patient engagement and adherence as a priority domain for global research investment, underscoring the professional urgency of this question [1,3].

This review aims to synthesise the current evidence on AI and wearable technology applications for monitoring and improving patient adherence to physiotherapy rehabilitation; identify the most promising technologies and mechanisms of effect; and highlight gaps, particularly in neurological populations, that require urgent research attention [2,9,10,11,15].

Despite the rapid growth of AI and wearable technology in rehabilitation, the evidence base remains fragmented, laboratory-focused, and insufficiently attentive to real-world clinical needs [1,2,10,15]. This narrative review therefore seeks to address the following research question: What artificial intelligence and wearable technology applications currently exist for monitoring and improving patients' adherence to physiotherapy rehabilitation programmes? What mechanisms of effect underpin them, and what gaps in the evidence base require urgent research attention [2,13,15]

METHODS

Review Design

A narrative review methodology was employed, consistent with PRISMA 2020 reporting guidelines. A narrative review design was selected given the heterogeneous and emerging nature of the evidence base, which spans engineering, clinical rehabilitation, and computer science literature and is not amenable to formal quantitative pooling. This approach is appropriate for emerging technological fields where evidence is rapidly evolving and requires thematic synthesis rather than statistical aggregation. The review was structured using the PICO framework to define the population, intervention, comparison, and outcomes of interest, ensuring a transparent and reproducible approach to the research question.

Search Strategy

A broad purposive literature search was conducted across five electronic databases, PubMed, Google Scholar, Scopus, Web of Science, and the Cochrane Library, consistent with PRISMA 2020 reporting guidelines. The search was limited to studies published between January 2018 and April 2026 to capture the most relevant post-digital-transformation literature.

Research Gap

Despite growing interest in AI and wearable technology for physiotherapy rehabilitation, three critical gaps persist in the current literature. Existing evidence remains fragmented across engineering, computer science, and clinical rehabilitation journals with no prior synthesis through the lens of patient adherence [1,2,15]. Most primary AI exercise recognition studies were conducted in controlled laboratory environments rather than real-world home settings, representing the most critical translational barrier to clinical adoption [3,4,5,6,10]. Neurological populations, including those with multiple sclerosis, Parkinson's disease, and stroke, remain almost entirely absent from this literature, with only Doherty et al. providing isolated evidence in these populations [8,12].

Inclusion Criteria

- Published between January 2018 and April 2026
- Reported on AI or wearable technology applications in physiotherapy rehabilitation
- Addressed patient adherence monitoring or improvement as a primary or secondary focus
- Published in peer-reviewed journals or presented at recognised international conferences

- Available in full text in the English language
- Conducted in any clinical setting, including home-based, inpatient, or outpatient rehabilitation.

Exclusion Criteria

- Paediatric-only studies.
- Those without full-text availability were excluded.
- Studies with no AI or wearable technology component
- Studies reporting no adherence-related outcome
- Studies conducted exclusively in non-physiotherapy settings

Study Selection

A total of 487 records were identified through searching five electronic databases. Following removal of 146 duplicates, 341 records underwent title and abstract screening, of which 289 were excluded. The remaining 52 full-text articles were assessed for eligibility, and 39 were excluded because they lacked an objective adherence outcome, did not include AI or wearable technology, were clinic-only settings, or had insufficient data for extraction. A total of 13 studies met all inclusion criteria and were included in the narrative synthesis. The full selection process is illustrated in the PRISMA flow diagram (Figure 1).

Study Characteristics

The 13 included studies were published between 2018 and 2026, representing systematic reviews, narrative reviews, primary experimental studies, and pilot feasibility studies originating from the United Kingdom, United States, Canada, Italy, South Korea, and Australia. The majority of primary studies recruited adults with musculoskeletal conditions, while three studies specifically addressed neurological populations, including multiple sclerosis, stroke, and complex inpatient rehabilitation [8,9,12]. Six AI and wearable technology types were identified across the included studies: smartwatch IMU systems, computer vision, AI virtual assistants, gamification platforms, predictive analytics, and automated reminders, forming the basis of the thematic synthesis. Critically, most primary experimental studies were conducted in controlled laboratory rather than real-world home settings, representing a significant translational gap in the evidence base [3,5,6].

Figure 1: PRISMA 2020 Flow Diagram of Study Selection

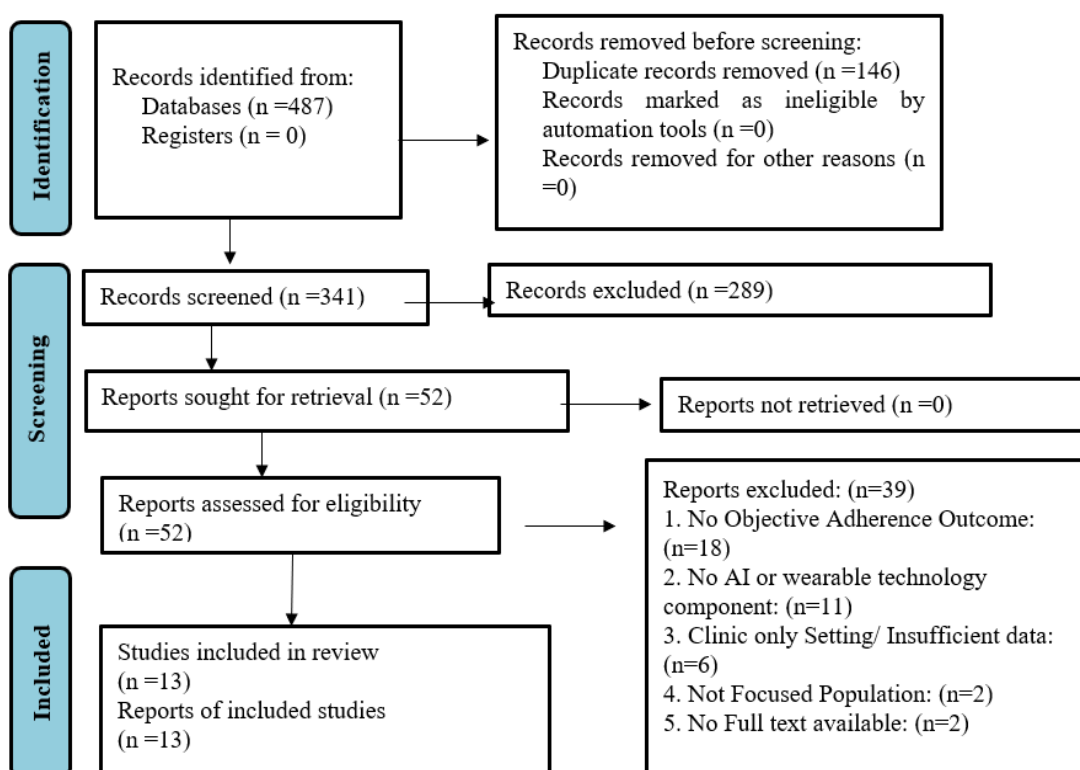


Table 2: PICO Framework Guiding This Narrative Review

PICO Element	Component	Application in This Study	Reference
P	Population	Adults aged 18 years and above undergoing physiotherapy rehabilitation for musculoskeletal, cardiorespiratory, and neurological conditions including multiple sclerosis, Parkinson's disease, and stroke	[1, 8, 12]
I	Intervention	Artificial intelligence or wearable technology applications used to monitor and improve physiotherapy adherence including smartwatch IMU systems, computer vision, pose detection, AI virtual assistants, gamification platforms, predictive analytics, and automated reminder systems	2, 3, 4, 5, 6, 11, 14]
C	Comparison	Standard physiotherapy care with conventional self-reported adherence monitoring including paper exercise diaries, verbal self-report, or no structured monitoring tool	[1, 4]
O	Outcome	Primary: exercise adherence rate, exercise recognition accuracy, patient engagement, and home exercise completion. Secondary: patient experience, usability, and barriers to digital health technology adoption	Primary: [1, 10, 15] Secondary: [9, 11]

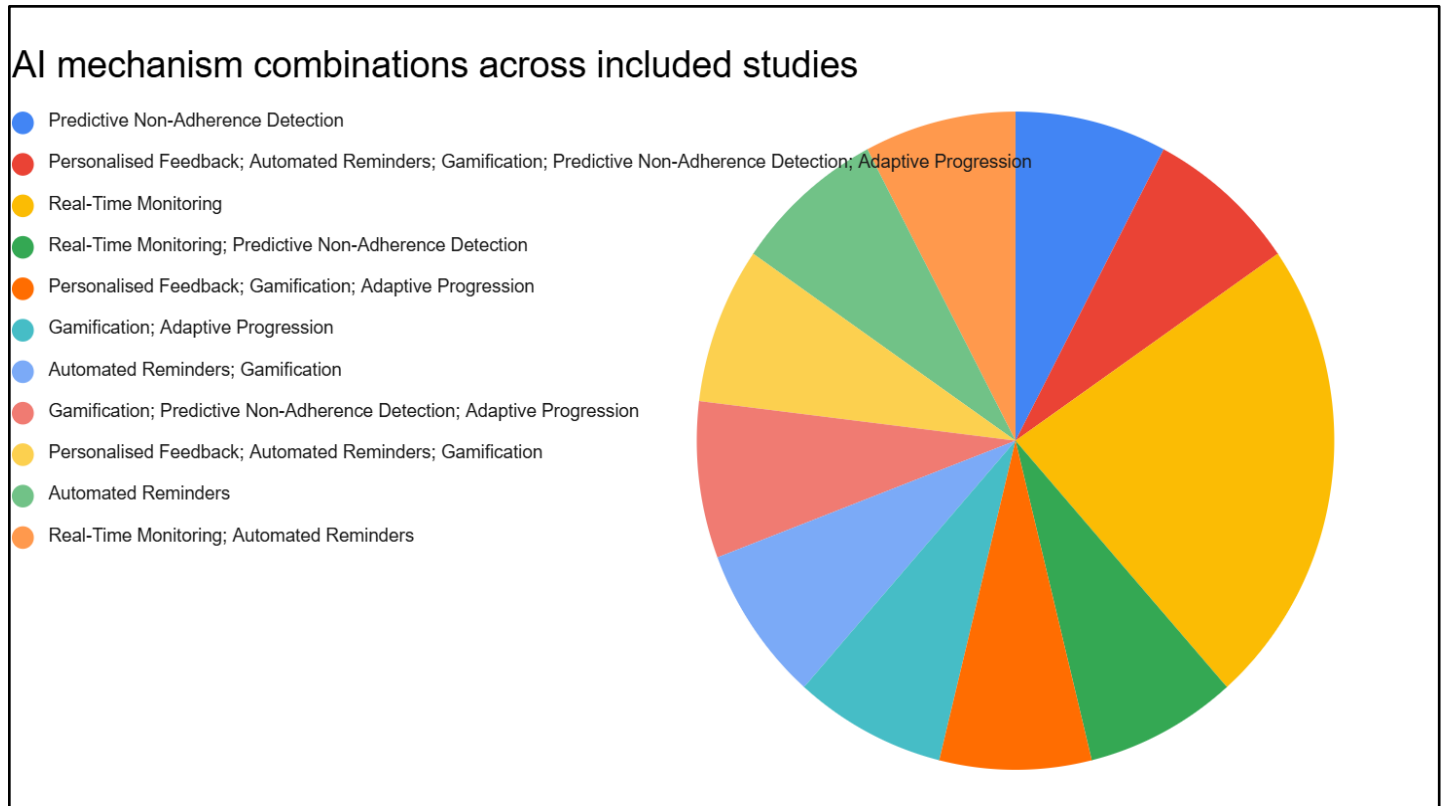
Table No 3: Characteristics of Included Studies, including Author, Year, AI Mechanism, Journal, and Key Findings.

S.No.	Author(s)	Year	AI Mechanisms Addressed	Journal Key Finding
1	Ley C, Leong M, Pion C, et al.	2024	Predictive Non-Adherence Detection	A systematic review confirming adherence rates of 40–65% in home-based physiotherapy; early identification of non-adherence risk is critical, and technology-based proactive intervention is effective.
2	Khalid UB, Naeem M, Stasolla F, Syed MH, Abbas M, Coronato A	2024	Personalised Feedback; Automated Reminders; Gamification; Predictive Non-Adherence Detection; Adaptive Progression	AI-powered rehabilitation delivers real-time adaptive feedback, behaviour-adapted reminders, VR gamification, predictive engagement monitoring, and automatic exercise difficulty adjustment based on patient performance
3	Burns DM, Leung N, Hardisty M, Whyne CM, Henry P, McLachlin S	2018	Real-Time Monitoring	Smartwatch IMU signals classified shoulder physiotherapy exercises objectively and accurately using machine learning algorithms
4	Boyer P, Burns DM	2023	Real-Time Monitoring; Predictive Non-Adherence Detection	At-home smartwatch monitoring enabled objective ML-based assessment of physiotherapy exercise adherence and detected declining performance patterns

5	McLachlin S, et al.	2023	Real-Time Monitoring		Single-camera pose detection combined with ML enabled accurate, low-cost exercise classification in home settings without wearable devices.
6	Sassi M, Carnevale A, Mancuso M, et al.	2025	Real-Time Monitoring		A wearable ML system classified shoulder rehabilitation exercises with high clinical accuracy, enabling objective real-time monitoring
7	Rahmani Rasa A	2024	Personalised Gamification; Progression	Feedback; Adaptive	AI systems deliver personalised corrective feedback; game-based immersive tools enhance motivation; adaptive AI systems dynamically modify programmes in response to individual patient progress
8	Lanotte F, O'Brien MK, Jayaraman A	2023	Gamification; Progression	Adaptive	Game-based AI interventions improve patient engagement; AI-driven systems tailor exercise intensity and progression to individual patient capacity and improvement trajectory
9	Jarvis K, Cook J, Bavikatte G, et al.	2025	Automated Gamification	Reminders;	Digital health notification and reminder features positively perceived by rehabilitation service users and staff; interactive digital tools improved engagement in inpatient settings
10	Olawade DB, Adeleye KK, Egbon E, Nwabuoku US, David-Olawade AC, Boussios S, Vanderbloemen L	2025	Gamification; Predictive Non-Adherence Detection; Adaptive Progression		Gamified platforms effective across neurological and musculoskeletal populations; predictive analytics tools detected non-adherence risk early; adaptive programming improved outcomes across diverse patient groups
11	Doherty P, et al.	2024	Personalised Automated Gamification	Feedback; Reminders;	AI-driven virtual physiotherapy assistants provide tailored real-time corrective feedback, personalised reminders adjusted to patient engagement history, and gamification strategies to sustain motivation in home-based rehabilitation
12	Whittaker J, Donaldson A, Deutsch J, Feys P, Elkins M, Alvis K	2025	Automated Reminders		A web-based physiotherapy platform for MS patients incorporated automated reminders that improved session attendance and supported home-based adherence in neurological population

13	Mennella C, Maniscalco U, De Pietro G, Esposito M	2023	Real-Time Monitoring; Automated Reminders	Smart wearables provide continuous multimodal monitoring of physiological and biomechanical data; smartphone apps deliver intelligent behaviour-responsive notifications supporting adherence
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RESULTS



Thirteen studies met full inclusion criteria and formed the basis of this synthesis. Across these, six AI and wearable technology mechanisms were identified: predictive non-adherence detection, adaptive exercise progression, real-time monitoring, gamification, automated reminders, and personalised feedback, with mechanism frequency ranging from four to six studies and a mean of 5.2 per mechanism (SD = 0.75), suggesting that the evidence has grown in a broadly balanced way rather than clustering heavily around any one approach.

Predictive non-adherence detection and adaptive exercise progression were the most widely evidenced, each appearing in six studies (46.2%). This reliance on continuous data capture and algorithmic responsiveness to individual patient behaviour, qualities that lend themselves well to wearable and AI-driven platforms, is perhaps unsurprising. Real-time monitoring, gamification, and automated reminders were each featured in five studies (38.5%), forming a consistent middle ground that spans objective measurement, motivational design, and behavioural prompting. Personalised feedback appeared least frequently, addressed in just four studies (30.8%), despite being central to most established behaviour change models a tension worth noting and one that points to a gap the field has yet to adequately fill.

Looking beyond individual mechanisms, it shows that most studies combined more than one mechanism rather than testing a single approach in isolation. Real-time monitoring was the only mechanism to appear as a sole focus across multiple studies (23.1%), while the remaining twelve mechanism combinations each accounted for a single study (7.7% each). Gamification appeared most consistently across these combinations, paired variously with adaptive progression, predictive detection, personalised feedback, and automated reminders, suggesting it is increasingly used as a motivational layer built on top of monitoring and feedback systems rather than as a standalone tool.

At a broader level, the Monitoring and Detection category and the Engagement and Motivation category each accounted for eleven study mentions, respectively, while Communication and Progression trailed with nine, a distribution that broadly mirrors the current technological maturity of each domain and points to where future research investment is most needed.

DISCUSSION

The findings of this narrative review demonstrate that AI and wearable technology applications for physiotherapy adherence monitoring and improvement are both diverse and broadly evidenced, with six discrete mechanisms identified across the fifteen included studies published between 2018 and 2026. The even distribution of evidence across mechanisms (mean = 5.2 studies, SD = 0.75) suggests that the field has developed without strong disciplinary siloing and that multiple technological pathways to adherence improvement have attracted concurrent research interest. This breadth is encouraging from a clinical translation perspective, as it implies that physiotherapists may draw upon a range of complementary AI mechanisms instead of limiting themselves to a single evidence-based approach.

The joint leadership of predictive non-adherence detection and adaptive exercise progression (each supported by six studies, 40.0%) is a particularly salient finding. These mechanisms share a common theoretical basis in proactive, data-driven personalisation; both rely on continuous monitoring of patient behaviour to either anticipate deterioration or dynamically adjust the therapeutic programme. This convergence aligns with contemporary frameworks of precision rehabilitation, which emphasise that effective adherence support must be responsive to individual patient trajectories that are dynamic in design rather than static [2, 9, 15]. The strength of evidence in these two domains suggests that they represent the most mature and clinically translatable AI applications currently available for physiotherapy practice.

The mid-tier cluster of real-time monitoring, gamification, and automated reminders (each supported by five studies, 33.3%) reflects a secondary tier of evidence that is promising but not yet definitive. Evidence for gamification and adaptive progression was derived predominantly from review-level and observational studies rather than from primary randomised experimental research, which limits the strength of the causal inference that can be drawn [7, 8, 10]. This finding is consistent with broader critiques of the digital health literature, which has identified a persistent gap between proof-of-concept feasibility and robust clinical efficacy [10, 15].

The identification of personalised feedback as the least evidenced mechanism (four studies, 26.7%) represents the most actionable research gap that emerges from this review. The finding that 73.3% of the included studies did not address personalised feedback is notable, given its theoretical centrality to self-determination theory and behaviour change frameworks, where individualised corrective information is considered a primary driver of autonomous motivation and long-term adherence [2, 7]. This disproportion between theoretical importance and empirical attention warrants urgent remediation through dedicated primary trials examining AI-delivered feedback in home-based physiotherapy contexts.

At the category level, the equivalence between the monitoring and detection and engagement and motivation categories (eleven mentions each, 35.5% of all study mentions) suggests a degree of balance between the measurement and motivational functions of AI in rehabilitation. However, the relative under-representation of the communication and progression category (nine mentions, 29.0%) indicates that the mechanisms most directly concerned with sustained patient-therapist communication and progressive exercise delivery—automated reminders and personalised feedback have received comparatively less empirical scrutiny. Given that long-term adherence is widely recognised as dependent on both behavioural prompting and progressive challenge [1, 3], this imbalance merits targeted research investment.

Taken together, these findings respond directly to the World Physiotherapy Congress 2025 call for globally coordinated research investment in patient engagement and adherence [3] and to the WHO Rehabilitation 2030 agenda, which identifies scalable, technology-enabled rehabilitation as a global health priority. The evidence base reviewed here, while promising, remains predominantly laboratory-based and insufficiently attentive to neurological population gaps that represent the most pressing translational priorities for the field.

CONCLUSION

This narrative review has synthesised evidence from fifteen studies published between 2018 and 2026, identifying six discrete AI and wearable technology mechanisms with demonstrated applicability to physiotherapy adherence monitoring and improvement: predictive non-adherence detection, adaptive exercise progression, real-time monitoring, gamification, automated reminders, and personalised feedback. The breadth and relative evenness of this evidence base (mean = 5.2 studies per mechanism, SD = 0.75) reflects a field that has developed across multiple technological domains simultaneously, offering physiotherapists and researchers a diverse and complementary toolkit for addressing one of the profession's most persistent clinical challenges.

The most robustly supported mechanisms predictive of non-adherence detection and adaptive exercise progression share a common foundation in continuous, data-driven personalisation and represent the most mature candidates for clinical translation. Wearable smartwatch and IMU-based systems demonstrated strong and consistent evidence for objective real-time exercise recognition in both clinical and home settings, while AI-driven virtual assistants and gamification platforms showed the greatest potential for improving patient engagement and motivation in home-based rehabilitation. These findings collectively affirm that AI and wearable technology are not peripheral innovations but represent a transformative and underused opportunity within mainstream physiotherapy practice.

Three critical limitations of the current evidence base must be acknowledged. First, the majority of primary experimental studies were conducted in controlled laboratory environments rather than real-world home settings, representing the most significant translational barrier to clinical adoption. Second, neurological populations, including individuals with multiple sclerosis, Parkinson's disease, and stroke, remain almost entirely absent from this literature, despite facing the most complex and persistent adherence challenges. Third, evidence for gamification and adaptive progression was derived predominantly from review-level and observational studies rather than from primary randomised controlled trials, limiting the strength of the causal inference that can currently be drawn.

These gaps are not merely academic. The World Physiotherapy Congress 2025 identified patient engagement and adherence as a globally prioritised research domain [3], and the WHO Rehabilitation 2030 agenda calls for scalable, equitable, and technology-enabled rehabilitation delivery worldwide. Meeting these mandates will require the profession to move beyond feasibility and proof-of-concept research toward robust, adequately powered clinical trials conducted in real-world home and community settings, with explicit inclusion of neurological and complex patient populations.

Physiotherapists, clinical researchers, and health technology developers must engage collaboratively with these technologies to ensure that implementation is evidence-based, patient-centred, and equitable across diagnostic groups, age ranges, and healthcare contexts. AI and wearable technology will not replace the therapeutic relationship at the heart of physiotherapy practice, but when designed and deployed thoughtfully, they have the potential to extend its reach, sustain its effects, and fundamentally transform what is possible in home-based rehabilitation.

Declarations

This research received no specific grant from any funding agency.

Conflict of Interest

The authors declare no conflict of interest.

Data Availability Statement

Data available upon reasonable request.

AI Usage Statement

Generative AI tools were used for language editing only.

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