

Review

Digital Health Technologies to Support At-Home Recovery of People with Stroke: A Scoping Review

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Abstract: (1) Background: Digital health technologies (DHTs) are increasingly being utilized to facilitate receiving rehabilitation services remotely, offering innovative solutions to enhance recovery outcomes. This scoping review examines the role of DHT in home-based stroke rehabilitation, focusing on its applications, effectiveness, and limitations. It identifies key advancements and future directions for improving stroke recovery through technological innovations. (2) Methods: Using Arksey and O'Malley's framework, a systematic search was conducted across multiple databases to identify studies involving DHT for home-based stroke rehabilitation. Eligible studies incorporated technologies for monitoring and evaluation. Data extraction followed PRISMA-ScR guidelines, synthesizing findings across various research designs. (3) Results: Ten studies were reviewed, categorizing technologies into wearable devices, smartphones, and sensor-based solutions. These tools primarily assessed mobility, upper extremity function, cognitive function, daily living activities, and continuous physiological monitoring. High feasibility and usability were reported, though challenges included small sample sizes and user-centered design limitations. (4) Conclusions: Most DHTs used for evaluating and monitoring home-based stroke rehabilitation are wearable and sensor-based, mainly focusing on mobility and upper extremity function. Their application is effective, but limitations remain. Future research should address these gaps to enhance usability and coverage.

Keywords: digital health technology; stroke rehabilitation; home monitoring; evaluation



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1. Introduction

Stroke remains one of the leading causes of death and disability worldwide, imposing a significant burden on individuals, families, and healthcare systems [1,2]. The economic impact of stroke rehabilitation is also substantial, as long-term care costs are often required, placing a strain on healthcare systems worldwide [3]. According to recent estimates, approximately 6.5 to 6.6 million stroke-related deaths occur annually, a number that reflects the growing impact of this condition globally [4]. Stroke incidence continues to rise, largely due to the increasing aging population and the rising prevalence of risk factors such as hypertension, diabetes, and a sedentary lifestyle [5,6]. Following a stroke, disability is highly prevalent, and patients often face a range of physical and cognitive challenges, including upper extremity (UE) dysfunction, balance disorders, aphasia, dysphagia, and

cognitive impairments [7]. The aftermath of a stroke can significantly impact a person's ability to return to work and perform daily activities, ultimately affecting their quality of life [8]. Approximately 25–74% of stroke survivors require assistance with daily activities, placing a substantial burden on caregivers and healthcare facilities [9]. Early and effective rehabilitation is crucial in the first two months following a stroke, as this period is essential for minimizing the risk of permanent disability and improving recovery outcomes [10].

Also, stroke rehabilitation is no longer confined to hospital settings; a significant component of recovery can take place in the home environment. Home-based rehabilitation allows for continuous monitoring, evaluation, and intervention, which is particularly important for stroke patients who live alone or suffer from cognitive disorders [11]. Home-based digital health tools can support self-management, track progress, and provide ongoing feedback to both patients and healthcare providers [12,13]. This approach offers the potential to reduce the burden on hospitals and outpatient services while ensuring that patients receive the necessary care in the comfort of their homes [14].

As technological advancements continue to reshape healthcare, DHTs are emerging as powerful tools in stroke rehabilitation [15]. DHTs not only improve the efficiency and outcomes of rehabilitation, but they also provide more accessible options for patients [16]. For example, DHT can facilitate remote rehabilitation services, making it possible to reach individuals in rural or underserved areas who may not have access to specialized rehabilitation facilities [17,18]. Moreover, the use of DHT has proven beneficial in uncommon circumstances, such as during the COVID-19 pandemic, when in-person rehabilitation sessions were disrupted by lockdowns and social distancing measures [19]. The field of DHT requires further clarification, not only in terms of the technology itself but also in evaluating its efficacy, effectiveness, and implementation ability. Recent literature reviews have shown that home-based technologies are widely used in stroke rehabilitation, with each technology offering specific benefits and limitations. Additionally, designing for motivation and considering the home environment are crucial factors in developing effective home-based stroke rehabilitation technologies [11]. The most influential research on this topic occurred between 1994 and 2012, with a strong emphasis on randomized clinical trials. Virtual reality technology, in particular, has become a prominent area of research within DHT for stroke rehabilitation [20]. Furthermore, self-monitoring interventions using DHT, which provide feedback and enable self-observation, have proven to be particularly effective in supporting behavior change among stroke patients [21].

However, there is a gap in the literature regarding the specific types of technologies used for home-based rehabilitation monitoring and evaluating patient performance. This is critical for promoting greater independence and safety for patients in their home environments. Therefore, in this scoping review, we aim to explore the digital health technologies currently used to monitor and evaluate home-based stroke rehabilitation. By reviewing the available evidence, we seek to synthesize how these technologies are applied in practice and to provide guidance for future technological development and research initiatives.

2. Materials and Methods

2.1. Design

The research question guiding this review was:

“What digital health technologies are currently used to monitor and evaluate home-based stroke rehabilitation? What is the clinical focus, technological characteristics, reliability, clinical utility, and related recommendations of these technologies for technologists and researchers?”

This scoping review adhered to the methodology proposed by Arksey and O'Malley, which involves defining research questions, selecting appropriate studies, organizing data, and synthesizing and presenting the findings [22].

The protocol for this review was prospectively registered on the Open Science Framework (OSF) and is available at <https://doi.org/10.17605/OSF.IO/QWJXV>.

In accordance with the JBI methodology for scoping reviews, a critical appraisal of individual sources of evidence was not undertaken, as the objective was to map the existing literature rather than assess study quality [23]. The review process was also aligned with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews checklist (PRISMA-ScR) to ensure comprehensive reporting [24]. All stages of this review were carried out with careful attention to detail, ensuring both rigor and reproducibility in the process. To facilitate the study selection and data extraction, we utilized Covidence software (Veritas Health Innovation, Melbourne, Vic, Australia, available at www.covidence.org), which streamlined the review process and ensured consistency in the handling of included studies [25].

2.2. Search Strategy

The search strategy was developed by the lead author [M.-A.C.] and a health sciences librarian [C.M.] and peer-reviewed by an academic librarian. To locate records, we created searches on the concepts of digital technology, stroke, rehabilitation, and home self-management using a combination of controlled vocabulary (i.e., MeSH) and keywords. The digital technology search included MeSH terms that cover a wide selection of health technologies such as physiologic monitoring, artificial intelligence, smartphones, virtual reality, wearable devices, and more. Other MeSH terms included were stroke, self-management, and physical therapy modalities. The search was limited to English articles. The original search was created in Medline (Ovid) [Appendix A] and translated to PsycINFO (Ovid), Scopus, and CINAHL with Full Text (EBSCOhost). To locate grey literature, we searched for conference proceedings in IEEE Xplore: IEEE Electronic Library (IEL); EMBASE (Ovid); and Google. All records were exported to Endnote (Clarivate, PA, USA) and deduplicated. Following deduplication, records were exported to Covidence (Veritas Health Innovation, Melbourne, Vic, Australia). All other search strategies are available in Appendix A.

2.3. Inclusion and Exclusion Criteria

Inclusion criteria for this scoping review are as follows: studies that involve patients who have experienced a stroke, are undergoing rehabilitation in a home environment, and use technology as assistive technology or for evaluative and monitoring purposes. Exclusion criteria include conceptual and theoretical studies, such as those focused on frameworks and policies.

2.4. Study Selection Process

The study selection process (Figure 1) was carried out using Covidence by three researchers based on predefined eligibility criteria. Initially, 1409 studies were identified from databases and registers. After removing six duplicate records (one manually and five via Covidence), 1403 studies proceeded to the screening stage. Following title and abstract screening, 1243 studies were excluded, leaving 57 studies for full-text assessment. All 57 studies were successfully retrieved, but 47 were excluded due to various reasons, including inappropriate setting ($n = 4$), intervention ($n = 2$), study design ($n = 8$), theoretical focus ($n = 3$), interventional study design ($n = 2$), wrong patient population ($n = 4$), incorrect technological specifications ($n = 19$), and absence of specific technology mention ($n = 5$). Consequently, 10 studies met the inclusion criteria and were included in this scoping review, with no ongoing or unclassified studies.

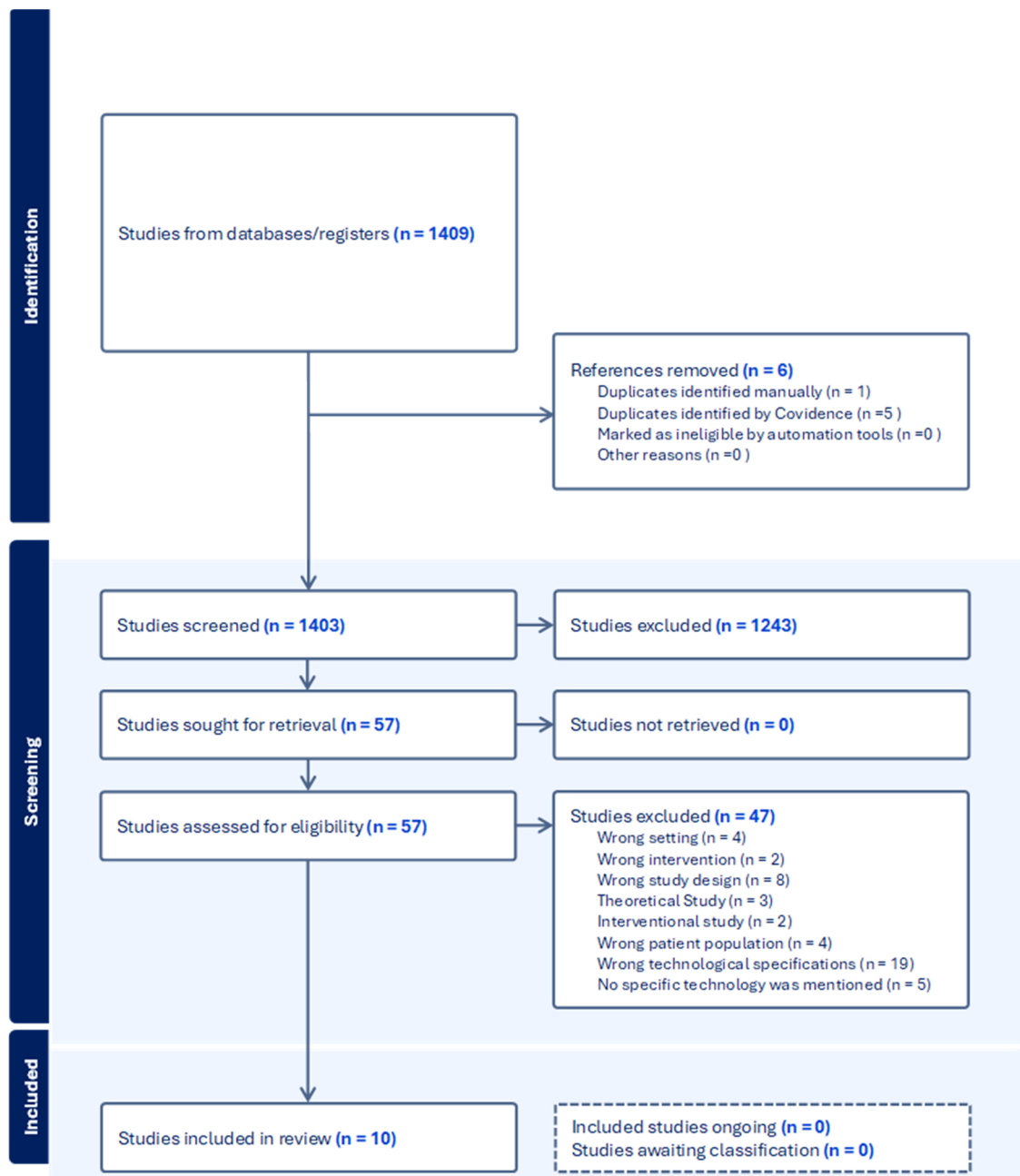


Figure 1. Study selection process.

2.5. Data Extraction and Analysis

Data extraction from the selected studies was performed using customized charting forms created by the research team. Two of the authors, S.A. and J.B.H., conducted the data extraction, while P.S. reviewed and made any necessary revisions to the charted information, ensuring completeness and accuracy. M.K. performed data synthesis, analyses, and material preparation.

3. Results

Below are the summarized results from the included studies:

3.1. Characteristics of the Included Studies

The included studies were published between 2002 and 2021 and were conducted in the United States (n = 2) [26,27], Scotland (n = 1) [28], Italy (n = 1) [29], Canada (n = 1) [30], Swe-

den ($n = 1$) [31], Switzerland ($n = 1$) [32], Thailand ($n = 1$) [33], France ($n = 1$) [34], and Korea ($n = 1$) [35]. Included studies comprised longitudinal observational studies ($n = 3$) [26,30,32], feasibility studies ($n = 3$) [29,33,35], a construct validation study ($n = 1$) [28], a qualitative observational study ($n = 1$) [31], a prospective experimental pre/post-design study ($n = 1$) [27], and a design and development study ($n = 1$) [34].

Three articles involved small sample sizes, with 1–5 participants [29,33,35], while six articles included medium sample sizes, ranging from 6 to 16 participants [26–28,31,32,34]. One article reported a large sample size of 25 participants [30]. Feasibility testing was addressed in all the included studies as part of the research stage. Seven studies focused on patients in the chronic phase of stroke [26–31,34], one included both subacute and chronic phases [32], and one involved healthy participants [35]. Additionally, one study focused on frozen shoulder, which applies to stroke, but did not specify the stroke phase [33].

3.2. DHT Characteristics and Goals

The findings from the included studies emphasize the effectiveness of various technologies in supporting home-based rehabilitation and remote monitoring and evaluation. The included studies' characteristics, objectives, and outcomes are detailed in Table 2.

3.2.1. Clinical Focus Addressed in the Included Studies

Seven articles investigated mobility measurement, with four addressing the UE [28,32–34], two focusing on the lower extremities (LE) [26,29], and one examining the sit-to-stand transition [30]. One article focused on the actual and perceived use of the paretic UE [27], one explored cognitive support for activities of daily living (ADL) [31], and another addressed physiological monitoring [35].

3.2.2. Types of Technologies Used

Five articles explored wearable devices, including SECOSP [29], IMUs [32], SULAM [28], accelerometers [27], and wireless physiological monitoring devices (ECG and EMG) [35], while three articles examined sensor-based monitoring systems such as SAM [26], Pressure-Sensitive Bed Mats [30], and the SyMPATHy cup [34]. One article discusses the Tentaculus System (TS) as a cognitive assistive technology [31], and one article focuses on the iJoint web application and 3D simulation [33].

3.2.3. Accuracy and Reliability of Wearable Devices for Stroke Rehabilitation

Four studies examined the accuracy and reliability of wearable devices for stroke rehabilitation. One study revealed that SECOSP demonstrated superior accuracy compared to an IMU, with a mean error lower than 0.6%. It outperformed a widely used step-monitoring system, indicating its potential for precise step counting in mobility assessment [29].

Another study showed that the SULAM system effectively monitored UE activity throughout daily routines with minimal interference. The study provided preliminary evidence of its capability to objectively evaluate rehabilitation interventions aimed at improving UE function [28].

Another study found that participants who received high-dose accelerometer-based feedback reported significant perceived gains in both the amount and quality of paretic UE use. The feedback increased awareness of paretic limb utilization [27].

One study demonstrated that a wireless physiological signal monitoring system effectively filtered interference and captured continuous ECG and EMG data during daily activities. The system's wireless connectivity enabled post-stroke and motor rehabilitation in home environments where standard monitoring devices were not accessible [35].

Table 1. Summary of included articles.

	Author	Country	Study Type	Objective	Research Stage	Sample Size	Stroke Phase	Technology	Goal of the Technology	Protocol	Results
1	Richard F. Macko (2002) [26]	United States	Longitudinal Observational Study	This study investigates the accuracy and reliability of a mechanical pedometer versus microprocessor-based step activity monitoring (SAM) in gait-impaired hemiparetic stroke patients.	Feasibility Testing	$n = 16$	Chronic	Microprocessor-based Step Activity Monitor (SAM)	LE Mobility Measurement	The SAM attached by elastic straps with Velcro closure above the lateral malleolus. Patients performed replicate 1 min floor walks at self-selected and fastest comfortable paces, and two 6 min walks on separate days.	SAM, but not the conventional pedometer, provides accurate and reliable measures of cadence and total stride counts in hemiparetic stroke patients. Portable microprocessor-based gait monitoring offers potential to quantitatively measure home-community-based ambulatory activity levels in this population. By using the SULAM, it is possible to monitor upper-limb activity over the course of a person's normal day, with minimal interference. This study provides preliminary evidence of the SULAM as a useful tool for objectively evaluating interventions aimed at improving upper-limb activity and function.
2	Arturo Vega-González (2005) [28]	Scotland	Construct Validation Study	To develop and evaluate a system for the objective measurement of upper-limb activity during a person's activities of daily living.	Feasibility Testing	$n = 10$	Chronic	The Strathclyde Upper-Limb Activity Monitor (SULAM)	UE Mobility Measurement	Participants wore the SULAM for 8 h, which covered the participants' normal day. The SULAM was placed on both arms. The sampling frequency was 10 Hz. For analysis, the data were downloaded onto a personal computer and software, written in C++, was used to calculate the summary variables.	The accuracy of the system was very high; the mean error was lower than 0.6%. SECOSP performed better than an IMU, which is one of the best current systems used to monitor step count.
3	Daniele Giansanti (2008) [29]	Italy	Feasibility Study	Comparison of the new device (SECOSP) to one of the most-used systems (IMU) in assessing step count. Investigating the accuracy of the performance of SECOSP as a step counter.	Feasibility Testing	$n = 6$	Chronic	Sensorized Codivilla Spring AFO (SECOSP)	LE mobility measurement	Three subjects undergoing stroke rehabilitation with mono-lateral damage who had the SECOSP and were at Level 2 of the Tinetti test of unbalance participated in the study. These participants were asked to perform repetitions of 100 supervised steps on rectilinear ground with linoleum with fast and a slow gait.	

Table 1. Cont.

Author	Country	Study Type	Objective	Research Stage	Sample Size	Stroke Phase	Technology	Goal of the Technology	Protocol	Results
4 Amaya Arcelus (2009) [30]	Canada	Longitudinal Observational Study	Measuring the duration of a sit-to-stand transfer to monitor a person's status of physical mobility.	Feasibility Testing	$n = 25$	Chronic	Pressure-Sensitive Bed Mats, High-Density Floor Plate Sensor	Mobility Measurement	Each subject was requested to perform consecutive transfers of lying supine on the bed, sitting upright, and then standing with both feet on the floor plate. After 10 s, participants were asked to return from standing to a supine lying position. Five SiSt transfers were then extracted from each sequence for subsequent timing analysis. Pressure sequences were extracted from frames of sensor data measuring bed and floor pressure over time by an algorithm. The assistive technology used in the main study was judged to be able to initiate the performance of a specific task and to inform about upcoming events. With the use of sensors placed in the home, the support provided related to the completion of an already-initiated task or to reminders required in a specific location or after specific actions. Data for this explorative and descriptive study were collected through interviews based on two assessment instruments in the context of an intervention project. Interviews were conducted in the participants' homes on two occasions in order to identify difficulties in their everyday activities. The data were analyzed using content analysis.	As expected, young and old healthy adults generated shorter sit durations of around 2.31 and 2.88 s, respectively, whereas post-hip fracture and post-stroke adults produced longer sit durations of around 3.32 and 5.00 s. The paper provides valuable information that can be used for the ongoing monitoring of patients within extended-care facilities or within the smart home environment.
5 Eva Lindqvist (2010) [31]	Sweden	Qualitative Observational Study	To identify in which everyday activities a specific type of computer-based and modifiable assistive technology could provide adequate support to persons who experienced difficulties related to cognition after a stroke.	Feasibility Testing	$n = 6$	Chronic	The Tentaculus System (TS)	Cognitive Support for ADL	Interviews were conducted in the participants' homes on two occasions in order to identify difficulties in their everyday activities. The data were analyzed using content analysis.	This type of support might have the potential to support people with cognitive impairments in the performance of their everyday activities. These AT solutions soon could be used more frequently than they are today. Hopefully, the development of the AT support process in this study can provide a first step towards a guide for these implementations.

Table 1. Cont.

Table 2. Cont.

Author	Country	Study Type	Objective	Research Stage	Sample Size	Stroke Phase	Technology	Goal of the Technology	Protocol	Results
6 Kaspar Leuenberger (2017) [32]	Switzerland	Longitudinal Observational Study	To assess functional arm use, as in the case of reaching to and manipulating an object, with a single wrist-worn IMU (inertial measurement unit).	Feasibility Testing	$n = 10$	Subacute and Chronic	Single Wrist-Worn Inertial Measurement Unit	UE Mobility Measurement	Monitored 10 stroke survivors wearing inertial sensors at 5 anatomical locations for 48 h. Measurements are compared to conventional activity counts and to a test for gross manual dexterity. Investigated ability to reject influence of ambulatory activities on arm use.	Gross arm movement measured with one 6-dof IMU worn at the paretic wrist qualifies as assessment of functional arm use in real life. The proposed method is sensitive to absolute changes in arm activity and is robust against overestimation of passive arm movements, e.g., by ambulation, and has the advantage of relying on a single-sensor unit as opposed to accelerometers on both arms to calculate ratios, or on additional sensors on the shank to exclude walking episodes.
7 Nuntiya Chiensriwimola (2017) [33]	Thailand	Feasibility Study	To improve the monitoring features of an existing web application to support the medical practitioner in determining suitable activity exercises in the frozen shoulder treatment process.	Feasibility Study	$n = 5$	Applicable To People With Stroke	The iJoint Application: By Using a 3D Simulation Model to Display an Animation of The Angle Exercise Data	UE Mobility Measurement	In the experiment, the subjects needed to exercise in the period set by the medical practitioners to track the shoulder rehabilitation progress. The exercises were based on assigned tasks with target angles of 60, 90, 120, and 150 degrees, respectively, and 10 rounds per each set. During the test, the participants were asked to move their arms freely and not to reach the target angle on the 3rd round and 7th round; then, the correctness of the 3D simulation results of each set for each patient were recorded and compared against data on a graph.	This technique can help the medical practitioner see how the patients exercise and analyze any error when something goes wrong while the patients are performing the exercises. The preliminary results found that our application can possibly help medical practitioners in the treatment process and tele-rehabilitation tracking.

Table 2. Cont.

Author	Country	Study Type	Objective	Research Stage	Sample Size	Stroke Phase	Technology	Goal of the Technology	Protocol	Results
8 Maureen Whitford (2020) [27]	United States	Prospective Experimental Pre/Post Design	To explore the effects of home-based high-dose accelerometer-based feedback on (1) perception of paretic upper extremity use; (2) actual amount of use; (3) capability. The secondary purpose was to characterize paretic UE use in the home setting.	Feasibility Study	$n = 8$	Chronic	Bilateral Triaxial Wrist Accelerometers	Improve UE Function	Participants wore bilateral wrist accelerometers for 3 weeks, during which seven sessions of accelerometer-based feedback were administered in the home.	Participants had significant perceived gains in how much ($p = 0.017$) and how well ($p = 0.050$) they used the paretic UE. However, there were no significant group changes in actual paretic UE amount of use or capability. At home, high-dose accelerometer-based feedback increased perceived paretic UE use and overall awareness of paretic UE use. Perception of use may serve as a first step to promote the behavioral change necessary to encourage actual paretic UE use, potentially decreasing the maladaptive effects of learned non-use on participation.
9 Maxence Bobin (2018) [34]	France	Design and Development Study	This study focused on design and assessing the usability and acceptability of a cup for monitoring the arm and hand activity of stroke patients.	R&D, Feasibility Testing	Participants: Health-care professionals: $n = 10$; Patients: $n = 9$	Chronic	Smart Cup Called SyMPATHy	UE Mobility Measurement	The design process of sympathy included five main steps: (1) identification of the task to be performed, determination of the information to monitor and sensory feedback to provide to the patient; (2) implementation of the prototype; (3) a preliminary study of the functionalities of sympathy; (4) improvements to the prototype and an insight into the visualization application; (5) a preliminary study involving patients on the usability and acceptability of the cup.	The results showed that the cup was very well accepted by eight of the nine patients in monitoring their activity within a rehabilitation center or at home. Moreover, these eight patients had almost no concerns about the design of the cup and its usability.

Table 2. Cont.

Author	Country	Study Type	Objective	Research Stage	Sample Size	Stroke Phase	Technology	Goal of the Technology	Protocol	Results
10 Jin-Woo Jeong (2021) [35]	Korea	Feasibility Study	To demonstrate the feasibility of the device for daily use.	Feasibility Testing	A healthy male subject	Applicable to People with Stroke (Participant was healthy)	Consists of Three Major Sub-Systems: (1) A Wearable Wireless Physiological (ECG and EMG) Signal Monitoring Device, (2) A Host Device (Android Smartphone) With Real-Time Monitoring and a custom-designed Data Processing Software, and (3) In-Depth Bio-Signal Analysis Through A Cloud Network Server	Physiological Monitoring	The accuracy of ECG and EMG signal coverage is assessed using Bland–Altman analysis by comparing with a reference physiological signal acquisition instrument (RHS2116 Stim/Recording System, Intan); a 24 h continuous recording session of ECG and EMG is conducted.	The feasibility study results show that the device can effectively filter the interference signals and capture continuous ECG/EMG data during everyday activity. By preserving wireless connectivity to BLE-enabled devices, we anticipate our wearable physiological signal monitoring system as a healthcare tool for post-stroke and motor rehabilitation in home environments where standard monitoring devices are not reachable.

3.2.4. Accuracy and Reliability of Smartphone- and Sensor-Based Solutions for Stroke Patient Rehabilitation

One study found that SAM, unlike conventional pedometers, provides accurate and reliable measurements of cadence and total stride counts in hemiparetic stroke patients. This suggests that portable microprocessor-based gait monitoring can effectively quantify home- and community-based ambulatory activity levels in this population [26].

One study found that using Pressure-Sensitive Bed Mats, sit-to-stand (SiSt) durations were measured and showed variations among different populations, with post-stroke adults exhibiting longer durations compared to young and elderly healthy adults. These findings provide valuable data for monitoring patients in extended-care facilities or smart home environments [30].

A separate study showed that the SyMPATHy cup was well accepted by eight out of nine patients in rehabilitation settings or at home. These patients had minimal concerns about the design and usability of the cup, indicating its potential as an effective tool for monitoring arm and hand activity. This suggests that the cup could be a valuable tool for monitoring UE activity in rehabilitation settings [34].

One study found that The Tentaculus System (TS), an assistive technology solution, has the potential to support individuals with cognitive impairments in their everyday activities. These technologies could become more frequently used in the near future, and the study's development process may serve as a foundation for guiding future AT implementations [31].

One study indicated that the iJoint web application could assist medical practitioners by enabling them to monitor patient exercises, detect errors, and support the rehabilitation process through telerehabilitation tracking. Preliminary findings suggest its usefulness in treatment planning [33].

4. Discussion

This scoping review explored the role of DHTs in monitoring and evaluating home-based stroke rehabilitation. Our findings suggest that DHTs are increasingly feasible and effective for evaluating and monitoring diverse aspects of stroke recovery in home settings. The review categorized technologies based on their clinical focus and technological features, identifying both strengths and limitations in current applications.

4.1. Clinical Focus of Digital Monitoring

Among the studies reviewed, mobility was the most frequently targeted domain. This is consistent with the critical importance of mobility for independence after stroke [36,37]. Technologies such as the SAM and the SECOSP demonstrated high accuracy and reliability in mobility assessment. SAM effectively tracked stride counts in chronic hemiparetic stroke patients [26], while SECOSP outperformed conventional IMU-based systems [29]. Similarly, pressure-sensitive mats and accelerometers reliably measured transitional movements such as SiSt, offering valuable feedback for tracking recovery progress [30].

Upper extremity function, another vital area of stroke rehabilitation, was addressed in several studies using technologies like SULAM, vibrotactile wristbands, and the SyMPATHy smart cup [28,32–34]. These tools supported both monitoring and sensory–motor enhancement, with preliminary evidence supporting their effectiveness in promoting UE recovery [28,33]. Accelerometer-based feedback increased patients' awareness of paretic limb use, although it did not always translate to objective functional improvement [27]. A recent scoping review confirmed that most wearable technology applications in stroke rehabilitation have focused on UE recovery, particularly hemiparetic arms, while LE moni-

toring remains understudied. Our findings align with this observation but expand on it by highlighting the monitoring and evaluation angle, not just intervention [38].

Conversely, only a few studies targeted cognition and activities of daily living (ADLs) [31]. This is a notable gap, considering the high prevalence of post-stroke cognitive impairments and their impact on independence and quality of life [39]. TS, a sensor-based cognitive assistive technology, showed potential to enhance ADL performance by guiding users through daily tasks [31]. Given the relevance of cognition in functional recovery, more research is warranted in this domain [40].

Additionally, physiological status monitoring received limited attention, though it holds promise for comprehensive at-home stroke care [41]. One study demonstrated the feasibility of using a wireless wearable device for continuous ECG and EMG signal tracking, even in environments where traditional monitoring tools are inaccessible [35]. This technology enables clinicians to remotely assess cardiac and muscular health, potentially reducing the need for frequent hospital visits [42].

4.2. Types and Characteristics of Technologies

The majority of DHTs fell into two categories: wearable devices and smartphone and sensor-based solutions. Wearable technologies, such as SECOSP, SULAM, and GM-IMU, effectively measured physical activity, particularly UE and LE movement [28,29,32]. Accelerometer-based devices and wireless physiological monitoring systems further enabled remote feedback and data collection [27,35].

Smartphone and sensor-based tools, including SAM [26], SyMPATHy [34], pressure-sensitive mats [30], and the TS [31], also demonstrated strong performance in tracking specific rehabilitation metrics. These technologies were generally found to be reliable and usable, although some limitations such as discomfort, rigid design, and small sample sizes may hinder broader adoption [28,32,35].

Importantly, while wearables dominate the monitoring domain, the field of DHT interventions is increasingly trending toward virtual reality [43] and AI-based approaches in today's healthcare landscape [44]. This divergence highlights the need for convergence between monitoring and intervention tools. More interdisciplinary collaboration between healthcare professionals, engineers, and data scientists is essential to develop holistic, human-centered solutions for patient adherence and daily use [45].

4.3. Reliability and Clinical Utility

Most included studies demonstrated that wearable and sensor-based technologies provide high levels of accuracy and reliability, particularly in monitoring mobility and motor function. For instance, SECOSP showed superior performance compared to IMUs [29], SAM reliably tracked stride counts in stroke patients [26], and SULAM enabled low-interference monitoring of daily arm activity [28]. Similarly, pressure mats effectively measured SiSt transitions across different populations [30], while the SyMPATHy cup and Tentaculus System received positive user feedback regarding usability and acceptability [31,34].

However, several challenges persist. In some cases, accelerometer feedback enhanced patients' perceived limb function without corresponding objective improvements in motor outcomes, indicating a disconnect between subjective experiences and clinical progress [27]. Moreover, the design of physiological monitoring devices still requires refinement to improve user comfort and facilitate engagement during long-term use [35].

A recent meta-analysis further supports the potential of home-based digital rehabilitation, demonstrating that it can achieve outcomes comparable to traditional in-clinic services in domains such as upper extremity motor ability, static balance, stroke-related quality of life, and self-reported function [46]. While previous reviews have broadly explored

home-based stroke care, our review focuses specifically on the monitoring and evaluation functions of digital health technologies, offering a more detailed analysis of these aspects.

In addition to performance considerations, several studies also highlighted technical and usability challenges that could impact real-world adoption. Issues such as device discomfort, difficulties in handling feedback mechanisms [34], and risks associated with sensor misplacement [32] were frequently reported. Addressing these user-centered concerns is crucial in rehabilitation settings, where comfort, usability, and patient adherence are critical to success.

4.4. Recommendations for Technologists and Researchers

Technology-wise, improvements can be made at the hardware and software levels to enhance stroke rehabilitation. For example, the design and usability of devices can be improved by developing flexible, skin-friendly sensors or smart garments, which would not only increase patient comfort but also provide richer data on body movements [34,35]. Also, the development of comprehensive monitoring tools that incorporate features like pressure mapping, limb configuration, and detailed activity data would make systems more robust and clinically relevant, ultimately improving rehabilitation outcomes [30,34]. From a software perspective, integrating advanced analytics through machine learning algorithms could significantly improve system functionality, enabling the classification of movements, detection of abnormalities, and real-time alerts for healthcare providers [35].

Research-wise, expanding the technologies to monitor other body parts and testing them on larger, more diverse patient populations would improve system versatility and validity, enhancing their broader applications [28,33]. For instance, combining accelerometer-based feedback with behavioral interventions, including exercise programs, could help address learned non-use and better motivate patients toward recovery [27]. Moreover, integrating multiple modalities, such as pairing systems like SECOSP with IMU sensors, would offer a more comprehensive view of patient activity by capturing specific motion percentages and movement intensity throughout the day [29]. Yet, significant gaps remain. Technologies that address cognitive function, ADLs, or whole-body rehabilitation are under-represented [47]. Future studies should emphasize more comprehensive approaches that integrate cognitive and motor rehabilitation, interdisciplinary development, AI integration, and larger, more diverse samples to ensure generalizability and impact [48–50].

4.5. Methodological Considerations

The methodological robustness across the included studies reveals several recurring challenges that influence the strength and generalizability of their findings.

Firstly, small sample sizes were a pervasive limitation across almost all studies [26–35]. Many investigations involved fewer than ten participants [26,28,29,31–34], which restricts statistical power and undermines the generalizability of results to broader clinical populations. For instance, some studies evaluated devices only in individuals without impairments [28] or solely at a specific functional level (e.g., Tinetti Level 2 stroke patients [29]), thus narrowing applicability.

Secondly, restricted participant diversity further affected external validity. Several studies included only participants with mild impairments [31] or excluded those with particular sensory challenges (e.g., pain or touch sensitivity) [28]. This selective sampling limits the ability to apply findings across the full spectrum of stroke or rehabilitation populations [26,28,32].

Third, short-term and highly controlled study designs were common [27,29,33]. Many systems were tested only under supervised, short-duration sessions in laboratory or rehabilitation center settings, rather than through prolonged independent home use. This lack

of real-world evaluation introduces uncertainty about device performance in naturalistic environments where user behavior and environmental factors vary greatly [30,34].

Additionally, the assessment focus was often narrow. Several studies validated only single technical aspects of devices (e.g., concurrent validity or step counting accuracy) [28,29], while omitting broader evaluations like discriminant validity, sensitivity to change, or usability over time. Moreover, few studies examined how these technologies influence clinical outcomes or rehabilitation progress, leaving important translational questions unanswered [30,32].

Overall, while the included studies provided valuable insights into emerging technologies for stroke rehabilitation and home-based monitoring, the evidence base remains preliminary. Larger, longer-term, and more ecologically valid studies are needed to strengthen confidence in the clinical applicability and real-world effectiveness of these digital health interventions.

4.6. Strengths and Limitations of This Review

A key strength of this review is its clarification of the current state of the art in the use of DHTs for monitoring and evaluating stroke rehabilitation. This provides a foundation for researchers to address gaps in existing evidence or expand on the current literature. Moreover, the specific focus on evaluation and monitoring—rather than intervention—offers novel insights that may contribute to best practices for at-home support and independent living of stroke patients.

However, this research area is still emerging, and this scoping review included only 10 papers, which limits our ability to formulate strong recommendations. Additionally, the variety of applications and the diversity of study protocols prevent us from making highly specific recommendations or suggesting a follow-up systematic review focused on a particular topic. Furthermore, aspects related to medical device certification, data privacy regulations, and equity of access to digital health technologies were not explicitly addressed in the included studies, representing important areas for future research and consideration.

5. Conclusions

DHTs for monitoring and evaluating home-based stroke rehabilitation. The findings indicate that wearable, sensor-based, and smartphone-linked technologies are increasingly feasible for assessing mobility and upper extremity function in real-world settings. However, critical aspects such as cognitive monitoring, ADLs, and whole-body rehabilitation remain insufficiently addressed in the existing literature. While the reviewed technologies show promising accuracy and usability, important challenges around patient comfort, system adaptability, and integration of advanced analytics were identified.

Given the small number of studies and notable methodological heterogeneity, these findings should be interpreted with caution. Future research should prioritize the development of comprehensive, patient-centered monitoring solutions validated across larger and more diverse populations. Moreover, greater attention to regulatory certification, data privacy protections, and equitable access will be essential to ensure that emerging digital health technologies can be safely, effectively, and ethically integrated into home-based stroke rehabilitation programs.

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Abbreviations

The following abbreviations are used in this manuscript:

DHT	digital health technology
UE	upper extremity
LE	lower extremity
SiSt	sit-to-stand
ECG	electrocardiogram
EMG	electromyogram
SAM	Step Activity Monitor
SECOSP	Sensorized Codivilla Spring
SULAM	Strathclyde Upper-Limb Activity Monitor
IMU	inertial measurement unit
VR	virtual reality
TS	Tentaculus System

Appendix A

Medline (Ovid) Search; 1946–26 January 2023

1 *exp stroke/*

2 *exp Cerebral Hemorrhage/ s*

3 *(stroke or strokes or cva* or poststroke* or apoplexy).tw,kw.*

4 *((cerebro* or brain or brainstem or cerebral*) adj3 (infarct* or accident*)).tw,kf.*

5 *brain attack*.tw,kw.*

6 *exp artificial intelligence/*

7 *exp Monitoring, Physiologic/*

8 *exp Monitoring, Ambulatory/*

9 *Biofeedback, psychology/*

10 *Self-Help Devices/*

11 *exp Man-Machine Systems/*

12 *automation/*

13 *exp Computer Simulation/*

14 *exp Video Games/*

15 *exp wearable electronic devices/*

16 *exp Cell Phone/ or Mobile Applications/ or Computers, Handheld/*

17 *Electronic Mail/*

18 *exp Touch Perception/*

19 *wireless technology/*

20 *(artificial intelligen* or AI or neural network* or (automat* adj2 recogni*) or machine learn-*

ing).tw,kf.
 21 robot*.tw,kw.
 22 (video gam* or videogam* or exergam* or exer gam*).tw,kw.
 23 ambient assisted living.tw,kw.
 24 ambient intelligen*.tw,kw.
 25 (assistive adj3 (device* or technolog* or self-help)).tw,kf.
 26 ((ambient or smart or intelligent) adj2 (environment* or home* or house*)).tw,kf.
 27 (intelligent adj2 system*).tw,kf.
 28 ((technolog* or comput*) adj5 (ambient or non-wearable* or nonwearable* or unobtrusiv* or non-intrusive or nonintrusive or pervasive or ubiquitous or non-contact or noncontact or smart or intelligen* or passive)).tw,kf.
 29 (home adj2 (automation or device or module)).tw,kw.
 30 (digital technolog* or smart technolog*).tw,kw.
 31 ((monitor* or track*) adj2 (biomedical or medical or personal or home* or patient* or health or activit* or ambulat* or physiolog*)).tw,kf.
 32 (robot* or automat* or computer aided or computer assisted or power assist*).tw,kw.
 33 (virtual realit* or VR or simulat*).tw,kw.
 34 ((interactiv* or virtual) adj2 (environment or technolog*)).tw,kf.
 35 augmented realit*.tw,kw.
 36 (smartphone or smart-phone*).tw,kw.
 37 ((mobile or cell or smart or handheld) adj2 (device or phone*)).tw,kf.
 38 (iphone* or android* or ipad*).tw,kw.
 39 (personal digital assistant* or handheld computer* or handheld device*).tw,kw.
 40 mobile app*.tw,kw.
 41 haptic*.tw,kw.
 42 biofeedback.tw,kw.
 43 ((force or tactile or touch or tactual or electr*) adj2 (feedback or perception)).tw,kf.
 44 sensory substitution.tw,kw.
 45 piezoelectric*.tw,kw.
 46 (vibrotactile or vibration).tw,kw.
 47 wearable*.tw,kw.
 48 sensory aids/
 49 ((intelligent or smart) adj1 (home* or technolog* or sensor? or environment)).tw,kw.
 50 (at-home or home* or house* or residence or abode or residential or apartment or condo or domicile or dwelling or take-home).tw,kw.
 51 exp Self Care/
 52 Self-Management/
 53 (self-care or self-manage*).tw,kw.
 54 (rehabilitat* or rehab or "occupational therap*" or physiotherap* or "physical therap*").tw,kw.
 55 rehabilitation/ or "activities of daily living"/ or neurological rehabilitation/ or stroke rehabilita-
 tion/ or telerehabilitation/
 56 exp Physical Therapy Modalities/
 57 Occupational Therapy/
 58 or/1-5 [Stroke Search]
 59 or/6-49 [Digital Technology Search]
 60 or/50-53 [At-Home Search]
 61 or/54-57 [Rehab Search]
 62 58 and 59 and 60 and 61 (829)
 63 limit 62 to english (815)

References

- Feigin, V.L.; Krishnamurthi, R.V.; Parmar, P.; Norrving, B.; Mensah, G.A.; Bennett, D.A.; Barker-Collo, S.L.; Moran, A.E.; Sacco, R.L.; Truelsen, T.C.; et al. Update on the Global Burden of Ischemic and Hemorrhagic Stroke in 1990–2013: The GBD 2013 Study. *Neuroepidemiology* **2015**, *45*, 161–176. [\[CrossRef\]](#) [\[PubMed\]](#)
- Gund, B.M.; Jagtap, P.N.; Ingale, V.B.; Patil, R.Y. Stroke: A Brain Attack. *IOSR J. Pharm.* **2013**, *3*, 1–23.
- Majersik, J.J.; Woo, D. The enormous financial impact of stroke disability. *Neurology* **2020**, *94*, 377–378. [\[CrossRef\]](#) [\[PubMed\]](#)
- eClinicalMedicine. The rising global burden of stroke. *eClinicalMedicine* **2023**, *59*, 102028. [\[CrossRef\]](#)
- Katan, M.; Luft, A.R. Global Burden of Stroke. *Semin. Neurol.* **2018**, *38*, 208–211. [\[CrossRef\]](#)
- Otite, F.O.; Liaw, N.; Khandelwal, P.; Malik, A.M.; Romano, J.G.; Rundek, T.; Sacco, R.L.; Chaturvedi, S. Increasing prevalence of vascular risk factors in patients with stroke. *Neurology* **2017**, *89*, 1985–1994. [\[CrossRef\]](#)
- Noé-Sebastián, E.; Balasch-Bernat, M.; Colomer-Font, C.; Moliner-Muñoz, B.; Sanchez-Leiva, C.R.; Ugart, P.; Llorens, R.; Ferri-Campos, J. Disability after stroke: A longitudinal study in moderate and severe stroke patients included in a multidisciplinary rehabilitation program. *Rev. Neurol.* **2017**, *64*, 385–392.
- Treger, I.; Shames, J.; Giaquinto, S.; Ring, H. Return to work in stroke patients. *Disabil. Rehabil.* **2007**, *29*, 1397–1403. [\[CrossRef\]](#)
- Miller, E.L.; Murray, L.L.; Richards, L.G.; Zorowitz, R.D.; Bakas, T.; Clark, P.C.; Billinger, S.A. Comprehensive Overview of Nursing and Interdisciplinary Rehabilitation Care of the Stroke Patient: A Scientific Statement From the American Heart Association. *Stroke* **2010**, *41*, 2402–2448. [\[CrossRef\]](#)
- Miller, E. Assessment of the effectiveness of early post-stroke rehabilitation. *Wiad. Lek.* **2008**, *61*, 252–257.
- Chen, Y.; Abel, K.T.; Janecek, J.T.; Chen, Y.; Zheng, K.; Cramer, S.C. Home-based technologies for stroke rehabilitation: A systematic review. *Int. J. Med. Inform.* **2019**, *123*, 11–22. [\[CrossRef\]](#) [\[PubMed\]](#)
- Shafeeq, D.M.; Khan, D.Z. Digital health interventions for diabetes self-management: Harnessing technology for improved outcomes. *Int. J. Diabetes Res.* **2023**, *5*, 5–11. [\[CrossRef\]](#)
- Morton, K.; Dennison, L.; May, C.R.; Murray, E.; Little, P.; McManus, R.J.; Yardley, L. Using digital interventions for self-management of chronic physical health conditions: A meta-ethnography review of published studies. *Patient Educ. Couns.* **2017**, *100*, 616–635. [\[CrossRef\]](#) [\[PubMed\]](#)
- Denecke, K.; May, R.; Borycki, E.; Kushniruk, A. Digital health as an enabler for hospital@home: A rising trend or just a vision? *Front. Public Health* **2023**, *11*, 1137798. [\[CrossRef\]](#)
- Malik, A.N.; Tariq, H.; Afridi, A.; Rathore, F.A. Technological advancements in stroke rehabilitation. *JPMA J. Pak. Med. Assoc.* **2022**, *72*, 1672–1674.
- Laut, J.; Porfiri, M.; Raghavan, P. The Present and Future of Robotic Technology in Rehabilitation. *Curr. Phys. Med. Rehabil. Rep.* **2016**, *4*, 312–319. [\[CrossRef\]](#)
- Schmeler, M.R.; Schein, R.M.; McCue, M.; Betz, K.L. Telerehabilitation Clinical and Vocational Applications for Assistive Technology: Research, Opportunities, and Challenges. *Int. J. Telerehabilitat.* **2009**, *1*, 59–72. [\[CrossRef\]](#)
- Cary, M.P.; Spencer, M.; Carroll, A.; Hand, D.H.; Amis, K.; Karan, E.; Cannon, R.F.; Morgan, M.S.; Hoenig, H.M. Benefits and Challenges of Delivering Tele-rehabilitation Services to Rural Veterans. *Home Healthc. Now* **2016**, *34*, 440–446. [\[CrossRef\]](#)
- Zou, C.; Harvard, A.; Qian, J.; Fox, B.I. A systematic review of digital health technologies for the care of older adults during COVID-19 pandemic. *Digit. Health* **2023**, *9*, 20552076231191050. [\[CrossRef\]](#)
- Fatehi, V.; Salahzadeh, Z.; Mohammadzadeh, Z. Mapping and analyzing the application of digital health for stroke rehabilitation: Scientometric analysis. *Disabil. Rehabil. Assist. Technol.* **2024**, *20*, 321–330. [\[CrossRef\]](#)
- Wang, S.; Kassavou, A. Digital Health Behavioural Interventions to Support Physical Activity and Sedentary Behaviour in Adults after Stroke: A Systematic Literature Review with Meta-Analysis of Controlled Trials. *Behav. Sci.* **2023**, *13*, 62. [\[CrossRef\]](#) [\[PubMed\]](#)
- Arksey, H.; O'Malley, L. Scoping studies: Towards a methodological framework. *Int. J. Soc. Res. Methodol.* **2005**, *8*, 19–32. [\[CrossRef\]](#)
- Peters, M.D.; Godfrey, C.; McInerney, P.; Munn, Z.; Tricco, A.C.; Khalil, H. Scoping reviews. *JBIMan. Evid. Synth.* **2020**, *10*, 10.46658.
- Tricco, A.C.; Lillie, E.; Zarin, W.; O'Brien, K.K.; Colquhoun, H.; Levac, D.; Moher, D.; Peters, M.D.J.; Horsley, T.; Weeks, L.; et al. PRISMA extension for scoping reviews (PRISMA-ScR): Checklist and explanation. *Ann. Intern. Med.* **2018**, *169*, 467–473. [\[CrossRef\]](#)
- Babineau, J. Product review: Covidence (systematic review software). *J. Can. Health Libr. Assoc. J. L'association Bibliothèques Santé Can.* **2014**, *35*, 68–71. [\[CrossRef\]](#)
- Macko, R.F.; Haeuber, E.; Shaughnessy, M.; Coleman, K.L.; Boone, D.A.; Smith, G.V.; Silver, K.H. Microprocessor-based ambulatory activity monitoring in stroke patients. *Med. Sci. Sports Exerc.* **2002**, *34*, 394–399. [\[CrossRef\]](#)
- Whitford, M.; Scheerer, E.; Rowlett, M. Effects of in home high dose accelerometer-based feedback on perceived and actual use in participants chronic post-stroke. *Physiother. Theory Pract.* **2020**, *36*, 799–809. [\[CrossRef\]](#)

28. Vega-González, A.; Granat, M.H. Continuous monitoring of upper-limb activity in a free-living environment. *Arch. Phys. Med. Rehabil.* **2005**, *86*, 541–548. [\[CrossRef\]](#)
29. Giansanti, D.; Tiberi, Y.; Silvestri, G.; Maccioni, G. New wearable system for step-counting telemonitoring and telerehabilitation based on the Codivilla spring. *Telemed. J. E Health* **2008**, *14*, 1096–1100. [\[CrossRef\]](#) [\[PubMed\]](#)
30. Arcelus, A.; Herry, C.L.; Goubran, R.A.; Knoefel, F.; Sveistrup, H.; Bilodeau, M. Determination of sit-to-stand transfer duration using bed and floor pressure sequences. *IEEE Trans. Biomed. Eng.* **2009**, *56*, 2485–2492. [\[CrossRef\]](#)
31. Lindqvist, E.; Borell, L. The match between experienced difficulties in everyday activities after stroke and assistive technology for cognitive support. *Technol. Disabil.* **2010**, *22*, 89–98. [\[CrossRef\]](#)
32. Leuenberger, K.; Gonzenbach, R.; Wachter, S.; Luft, A.; Gassert, R. A method to qualitatively assess arm use in stroke survivors in the home environment. *Med. Biol. Eng. Comput.* **2017**, *55*, 141–150. [\[CrossRef\]](#) [\[PubMed\]](#)
33. Chiensriwimol, N.; Chan, J.H.; Mongkolnam, P.; Mekhora, K. Monitoring frozen shoulder exercises to support clinical decision on treatment process using smartphone. *Procedia Comput. Sci.* **2017**, *111*, 129–136. [\[CrossRef\]](#)
34. Bobin, M.; Anastassova, M.; Boukallel, M.; Ammi, M. Design and study of a smart cup for monitoring the arm and hand activity of stroke patients. *IEEE J. Transl. Eng. Health Med.* **2018**, *6*, 2100812. [\[CrossRef\]](#)
35. Jeong, J.-W.; Lee, W.; Kim, Y.-J. A real-time wearable physiological monitoring system for home-based healthcare applications. *Sensors* **2021**, *22*, 104. [\[CrossRef\]](#)
36. Parmar, M.J.; Gandhi, N.V. The Relationship between Balance and Mobility in Poststroke Survivors: A Narrative Review. *J. Soc. Indian Physiother.* **2025**. [\[CrossRef\]](#)
37. Tse, T.; Douglas, J.; Lentin, P.; Carey, L. Measuring participation after stroke: A review of frequently used tools. *Arch. Phys. Med. Rehabil.* **2013**, *94*, 177–192. [\[CrossRef\]](#)
38. Toh, S.F.M.; Fong, K.N.K.; Gonzalez, P.C.; Tang, Y.-M. Application of Home-Based Wearable Technologies in Physical Rehabilitation for Stroke: A Scoping Review. *IEEE Trans. Neural Syst. Rehabil. Eng.* **2023**, *31*, 1614–1623. [\[CrossRef\]](#)
39. Rohde, D.; Gaynor, E.; Large, M.; Mellon, L.; Hall, P.; Brewer, L.; Bennett, K.; Williams, D.; Dolan, E.; Callaly, E. The impact of cognitive impairment on poststroke outcomes: A 5-year follow-up. *J. Geriatr. Psychiatry Neurol.* **2019**, *32*, 275–281. [\[CrossRef\]](#)
40. McDonald, M.W.; E Black, S.; A Copland, D.; Corbett, D.; Dijkhuizen, R.M.; Farr, T.D.; Jeffers, M.S.; Kalaria, R.N.; Karayanidis, F.; Leff, A.P.; et al. Cognition in stroke rehabilitation and recovery research: Consensus-based core recommendations from the second Stroke Recovery and Rehabilitation Roundtable. *Int. J. Stroke* **2019**, *14*, 774–782. [\[CrossRef\]](#)
41. Clarke, M. The need for an integrated approach to remote monitoring of physiological data and activity data. *J. Telemed. Telecare* **2014**, *20*, 159–160. [\[CrossRef\]](#) [\[PubMed\]](#)
42. Banchs, J.E.; Scher, D.L. Emerging role of digital technology and remote monitoring in the care of cardiac patients. *Med. Clin. North Am.* **2015**, *99*, 877–896. [\[CrossRef\]](#) [\[PubMed\]](#)
43. Rajashekar, D.; Boyer, A.T.; Larkin-Kaiser, K.A.; Dukelow, S.P. Technological Advances in Stroke Rehabilitation: Robotics and Virtual Reality. *Phys. Med. Rehabil. Clin. N. Am.* **2023**, *35*, 383–398. [\[CrossRef\]](#) [\[PubMed\]](#)
44. Baysal, Z. AI-Driven Rehabilitation Robots: Enhancing Physical Therapy for Stroke and Injury Recovery. *Next Front. Life Sci. AI* **2024**, *8*, 155. [\[CrossRef\]](#)
45. Gregorio, S.I.F.; Montané-Jiménez, L.G. Towards the improvement of computer-assisted medical activities for stroke rehabilitation. In Proceedings of the 2022 10th International Conference in Software Engineering Research and Innovation (CONISOFT), San José Chiapa, Mexico, 24–28 October 2022; pp. 102–111.
46. Hestetun-Mandrup, A.M.; Toh, Z.A.; Oh, H.X.; He, H.-G.; Martinsen, A.C.T.; Pikkarainen, M. Effectiveness of digital home rehabilitation and supervision for stroke survivors: A systematic review and meta-analysis. *Digit. Health* **2024**, *10*, 20552076241256861. [\[CrossRef\]](#)
47. Cisek, K.; Kelleher, J.D. Current Topics in Technology-Enabled Stroke Rehabilitation and Reintegration: A Scoping Review and Content Analysis. *IEEE Trans. Neural Syst. Rehabil. Eng.* **2023**, *31*, 3341–3352. [\[CrossRef\]](#)
48. Stockbridge, M.D.; Bunker, L.D.; Hillis, A.E. Reversing the Ruin: Rehabilitation, Recovery, and Restoration After Stroke. *Curr. Neurol. Neurosci. Rep.* **2022**, *22*, 745–755. [\[CrossRef\]](#)
49. Senadheera, I.; Hettiarachchi, P.; Haslam, B.S.; Nawaratne, R.; Sheehan, J.; Lockwood, K.J.; Alahakoon, D.; Carey, L.M. AI Applications in Adult Stroke Recovery and Rehabilitation: A Scoping Review Using AI. *Sensors* **2024**, *24*, 6585. [\[CrossRef\]](#)
50. Sun, X.; Xu, K.; Shi, Y.; Li, H.; Li, R.; Yang, S.; Jin, H.; Feng, C.; Li, B.; Xing, C. Discussion on the rehabilitation of stroke hemiplegia based on interdisciplinary combination of medicine and engineering. *Evid. Based Complement. Altern. Med.* **2021**, *2021*, 6631835. [\[CrossRef\]](#)

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