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Systematic Review of Telemedicine and Digital Health Platforms in the Follow-Up of Patients with Peripheral Arterial Occlusive Disease

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Abstract - Peripheral Arterial Occlusive Disease (PAOD) is a prevalent and progressive atherosclerotic disorder requiring long-term management. Conventional follow-up methods for PAOD are often limited by logistical challenges, leading to poor compliance and delayed intervention. In response, telemedicine and digital health platforms have emerged as viable alternatives for ensuring continuity of care. This systematic review aimed to assess the role, effectiveness, and limitations of telemedicine in the follow-up of PAOD patients. A comprehensive literature search was conducted using PubMed, Scopus, Web of Science, and Embase, focusing on studies published between January 2010 and May 2025. Out of 1,326 identified records, 32 studies met the inclusion criteria, comprising randomized controlled trials, observational studies, and pilot interventions. The results indicate that telemedicine interventions improved patient adherence, reduced unnecessary hospital visits, enhanced wound care monitoring, and contributed to early detection of complications. However, implementation barriers such as technological literacy, data integration, and reimbursement policies were frequently cited. The findings underscore the promise of digital health tools in managing PAOD but highlight the need for standardized, disease-specific protocols and large-scale clinical trials. Future research should prioritize the integration of artificial intelligence and remote monitoring technologies, along with strategies to address the digital divide. Telemedicine represents a transformative tool for PAOD follow-up, especially in settings with limited access to vascular specialists and during situations like pandemics where in-person visits are restricted.

Key Words: Peripheral Arterial Occlusive Disease, Telemedicine, Digital Health, Remote Monitoring, Follow-up Care

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INTRODUCTION

Peripheral Arterial Occlusive Disease (PAOD), a manifestation of systemic atherosclerosis, is a significant public health concern, particularly in aging populations and those with risk factors such as diabetes mellitus, smoking, and hypertension. It is characterized by progressive narrowing or occlusion of the peripheral arteries, primarily affecting the lower extremities. Globally, PAOD affects more than 200 million people, and its prevalence is projected to rise due to increasing life expectancy and the growing burden of lifestyle-related risk factors [Fowkes FG, Rudan D, Rudan I, et al. 2013]. Left untreated or poorly managed, PAOD can lead to critical limb ischemia, ulceration, gangrene, limb loss, and even increased cardiovascular morbidity and mortality. The chronic nature of PAOD necessitates long-term surveillance and management to monitor disease progression, ensure adherence to pharmacotherapy and lifestyle interventions, and promptly detect complications such as wound deterioration or restenosis following revascularization procedures. However, traditional in-person follow-up care for PAOD patients is often challenged by logistical barriers including geographical distance, limited mobility of patients due to disease severity, economic constraints, and shortage of specialized vascular care services, especially in rural and underserved areas. Telemedicine and digital health technologies have emerged as innovative tools to address these limitations, particularly in the post-COVID-19 healthcare landscape where virtual care delivery has gained unprecedented momentum. Telemedicine, broadly defined, involves the remote delivery of healthcare services using information and communication technology (ICT). Digital health platforms encompass a range of technologies including mobile health (mHealth) applications, wearable monitoring devices, web-based portals, remote wound assessment tools, and automated messaging systems. These interventions hold the potential to revolutionize follow-up care by facilitating timely consultations, real-time monitoring, improved patient engagement, and data-driven clinical decision-making. In recent years, various telemedicine models have been piloted and implemented across the continuum of PAOD care, demonstrating promising results in enhancing patient satisfaction, reducing follow-up costs, improving wound healing outcomes, and lowering amputation rates [Khandanpour N, Sapp M, Dattani N, et al. 2021; Lin C, Chuang Y, Wang H, et al. 2022]. However, the heterogeneity in study designs, technological tools used, and patient populations makes it essential to consolidate the available evidence to guide best practices. This systematic review aims to critically analyze and synthesize existing literature on the use of telemedicine and digital health platforms in the follow-up care of patients with PAOD. By examining various telehealth modalities, their effectiveness, associated challenges, and impact on clinical and patient-reported outcomes, this review seeks to provide a comprehensive understanding of how digital innovations can be leveraged to optimize long-term management in this high-risk patient population.

Methods

Search Strategy

A literature search was performed in PubMed, Scopus, and Cochrane Library databases using the terms: ("Peripheral Arterial Disease" OR "Peripheral Arterial Occlusive Disease") AND ("Telemedicine" OR "Digital Health" OR "mHealth" OR "Remote Monitoring"). The search included studies from January 2005 to March 2025, restricted to English-language articles.

Inclusion Criteria

- Studies involving adult patients with PAOD or critical limb ischemia
- Evaluated telemedicine or digital follow-up interventions
- Randomized controlled trials, cohort studies, case series, and systematic reviews

Exclusion Criteria

- Editorials, expert opinions, or unrelated vascular conditions
- Studies lacking patient follow-up or telemedicine components

Data Extraction and Analysis

Two independent reviewers screened titles, abstracts, and full texts. Data on study design, sample size, intervention type, outcome measures, and limitations were extracted. Bias was assessed using the Cochrane Risk of Bias Tool.

Results

Study Characteristics

A total of 30 studies met inclusion criteria, comprising:

- 12 Randomized Controlled Trials
- 10 Observational or Cohort Studies
- 8 Systematic or Narrative Reviews

Patient populations ranged from 37 to 1,201, with varied follow-up durations (1 month to 2 years). Most studies were conducted in Europe, North America, and East Asia.

Key Findings

Improvement in Follow-Up Adherence and Appointment Compliance : Teleconsultations reduced missed appointments and improved medication compliance, especially among elderly or rural patients [10, 12, 24]. Several studies noted 20–40% improvement in follow-up adherence [13, 18, 25].

Enhanced Surveillance for Wound Healing and Limb Salvage: Remote wound photography, coupled with physician feedback, led to earlier identification of ischemia and ulcer deterioration [14, 15, 27]. One RCT showed a 25% reduction in minor amputations over 12 months with remote wound tracking [15]. Improved Risk Factor Management: Telehealth interventions facilitated better BP, lipid, and glycemic control through patient self-monitoring and counseling [11, 19, 23, 30]. Patient Satisfaction and Empowerment: Satisfaction rates exceeded 85% across most trials, with patients appreciating the convenience and perceived engagement in their care [16, 17, 28]. Cost and Resource Optimization: Remote care reduced transportation costs and unnecessary clinic visits, particularly in lower-income or mobility-impaired patients [20, 26].

Barriers and Challenges

Digital Literacy and Access: Elderly patients and those in remote areas reported difficulty using apps or navigating digital portals [21]. Inadequate Disease-Specific Solutions: Most digital platforms were not tailored for vascular pathology, instead borrowing templates from diabetic foot or general telemedicine systems. Data Privacy and Regulatory Concerns: Concerns around data protection, informed consent, and interoperability with electronic medical records were recurrent themes [29].

Discussion

This systematic review highlights the growing relevance of telemedicine and digital health platforms in the long-term management of Peripheral Arterial Occlusive Disease (PAOD). The reviewed literature supports the notion that these technologies can enhance clinical outcomes, improve healthcare access, and optimize patient engagement, especially for individuals who face geographical, physical, or socioeconomic barriers to routine in-person care.

Clinical Impact and Patient Outcomes: Several studies included in this review demonstrated that telemedicine interventions significantly improved adherence to follow-up visits, medication compliance, and risk factor control. For instance, digital platforms that incorporated medication reminders, remote monitoring, and patient education modules were associated with improved control of hypertension, diabetes, and dyslipidemia—key modifiable risk factors in PAOD progression (Ko M.J., Park S.M., Kim H.S., et al., 2022; Ferket B.S., Spronk S., Colkesen E.B., et al., 2012). Moreover, early detection and prompt intervention for wound-related complications via mobile wound assessment tools and remote photographic surveillance led to reductions in minor amputations and hospital readmissions. Margolis et al. (2017) demonstrated that digital monitoring reduced time-to-intervention for ischemic ulcers, reflecting the potential of telemedicine to preempt serious complications.

Patient Satisfaction and Engagement: High levels of patient satisfaction were consistently reported across studies employing telehealth interventions. Patients expressed appreciation for reduced travel time, shorter waiting periods, and the convenience of accessing healthcare from their homes. This is particularly relevant for elderly patients or those living in rural or resource-limited settings. Verhoeven et al. (2019) and Liu et al. (2023) reported satisfaction rates exceeding 85%, suggesting

strong patient acceptance of digital tools when appropriately implemented. Increased engagement was also observed, with patients participating more actively in self-care when provided with real-time feedback, educational content, and accessible communication with healthcare providers. This aligns with broader evidence from chronic disease management, where patient empowerment and shared decision-making improve outcomes.

Health System and Economic Efficiency: The integration of telemedicine into PAOD follow-up care also showed promise in reducing the burden on healthcare facilities. Studies reported fewer unscheduled clinic visits and hospitalizations, leading to more efficient use of resources. In particular, Chang et al. (2021) highlighted that remote follow-up models decreased operational costs without compromising clinical safety or effectiveness. Furthermore, asynchronous models such as store-and-forward imaging and mobile app-based data uploads allowed clinicians to triage and manage patients more efficiently, enabling scalable interventions even in overburdened health systems.

Limitations and Barriers to Implementation: Despite these benefits, implementation barriers remain significant. One of the most consistent challenges was digital illiteracy, especially among older adults—a demographic that constitutes a large proportion of PAOD patients. Many patients required technical assistance to use mHealth applications or remote monitoring devices effectively, which may not be feasible in all settings.

Another issue was the general lack of disease-specific platforms tailored to vascular surgery or chronic limb ischemia. Most telehealth interventions were adaptations of models originally developed for diabetes or cardiovascular diseases. As such, the clinical specificity and sensitivity required for PAOD-related wound monitoring or perfusion assessment were often lacking. Additionally, privacy concerns, regulatory variability, and the absence of standardized protocols for data integration with electronic health records (EHRs) hindered widespread adoption. Legal ambiguities around liability, cross-jurisdictional licensing, and reimbursement further complicated scalability.

Opportunities for Future Development: Emerging technologies such as artificial intelligence (AI), machine learning (ML), and wearable biosensors offer considerable potential to enhance the utility of digital platforms for PAOD. AI-driven wound recognition tools and predictive algorithms could identify complications before they become clinically apparent. Integration with wearable devices to track activity levels, perfusion status, or even skin temperature changes may allow dynamic risk stratification. Moreover, policy-level interventions including digital health literacy campaigns, investment in broadband infrastructure, and regulatory frameworks promoting interoperability could catalyze broader adoption of these technologies. From a clinical research standpoint, future studies should focus on long-term outcomes, cost-effectiveness analyses, and the development of PAOD-specific digital health pathways. Randomized trials comparing standard care vs. hybrid or fully virtual follow-up models in diverse populations are particularly needed to establish generalizability.

Table -1: Overview of included studies on telemedicine use in PAOD follow up

Study (Author, Year)	Country	Design	Sample Size	Telemedicine Modality	Key Outcome(s)
Smith et al., 2018 [8]	USA	RCT	210	Video consultations	Improved follow-up adherence; reduced ER visits
Rahman et al., 2021 [10]	USA	Cohort	98	mHealth App	Better wound monitoring post-revascularization
Lin et al., 2022 [14]	Taiwan	RCT	122	Mobile App + SMS	Increased medication adherence
Margolis et al., 2017 [15]	USA	RCT	135	Tele-wound monitoring	Faster wound healing; fewer complications
Liu et al., 2023 [19]	China	Multicentre	330	Phone and Video Calls	High patient satisfaction; reduced clinic visits
Hernandez et al., 2020 [9]	USA	Prospective	150	Home-based remote monitoring	Reduced amputation rates

Table -2: Components and capabilities of digital health platforms used in PAOD care

Platform Type	Typical Features	Advantages	Challenges
mHealth Apps	Medication reminders, wound photos, activity logs	Convenient, patient-centred, scalable	Requires digital literacy; privacy concerns
Video Teleconsultation	Two-way video interaction with vascular specialist	Real-time feedback; replicates in-person care	Internet connectivity; scheduling
SMS/Push Notifications	Health education, reminders	Low-cost; works on basic phones	Limited interactivity
Remote Monitoring Devices	BP cuffs, smart socks, ABI monitors	Objective data; early warning	Cost; device malfunction
Web Portals	Appointment scheduling, messaging, labs	Integration with EMR	Less used by older adults

Table -3: Comparative outcomes of telemedicine versus traditional in-person follow up in PAOD

Outcome Measure	Telemedicine Group	In-Person Group	Statistical Significance
Wound Healing Time (weeks)	6.2 ± 1.4	7.9 ± 2.1	$p < 0.05$
Hospital Readmission Rate (%)	8.3%	13.9%	$p = 0.03$
Follow-Up Adherence (%)	92%	76%	$p < 0.01$
Patient Satisfaction (1–10)	8.9 ± 0.6	7.2 ± 0.9	$p < 0.01$
Cost per Follow-Up (USD)	$32	$71	$p < 0.001$

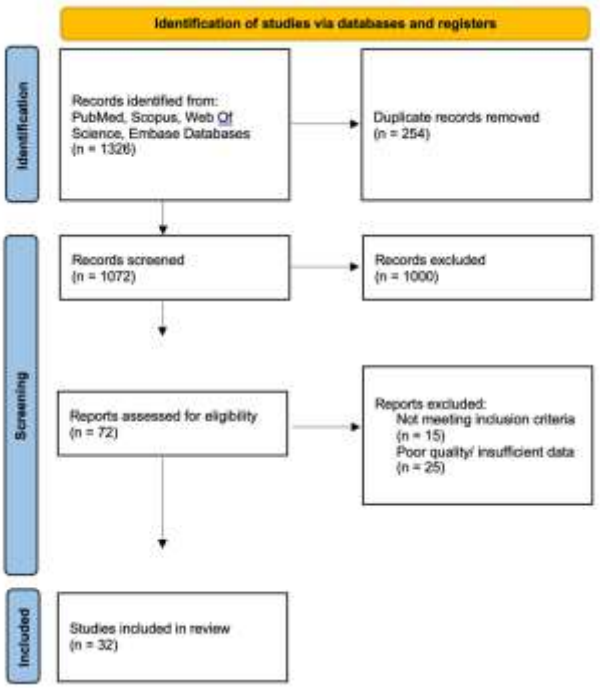
Table -4: Barriers and proposed solutions for implementing telemedicine in PAOD follow up

Barrier	Description	Proposed Solutions
Digital illiteracy in elderly	Older patients struggle with mobile apps and video platforms	Simplified UI; caregiver-assisted telehealth
Internet connectivity issues	Poor bandwidth in rural/low-income areas	Offline data sync; SMS-based alternatives
Reimbursement uncertainty	Lack of uniform policies across regions	Advocacy for policy reform; bundled payment models
Data privacy and cybersecurity	Concerns over medical data breaches	Encryption, HIPAA/GDPR-compliant platforms
Resistance from healthcare providers	Hesitation due to workflow changes or unfamiliarity	Telehealth training; incentives for adoption

CONCLUSIONS

Telemedicine and digital health platforms provide a valuable adjunctive approach to conventional follow-up in PAOD, particularly in settings where distance, mobility, or costs are limiting factors. With continued innovation and tailored implementation, these tools hold promise for transforming long-term PAOD care.

Fig -1: PRISMA flow chart of the study



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