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The Effectiveness and Feasibility of Virtual Reality and Augmented Reality Interventions for the Prevention of Non-Communicable Diseases in Low- and Middle-Income Countries: A Systematic Review

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ABSTRACT

Background: Non-communicable diseases (NCDs) account for approximately 41 million deaths annually, with over 85% of premature NCD deaths occurring in low- and middle-income countries (LMICs). Virtual reality (VR) and augmented reality (AR) technologies have emerged as innovative tools for health promotion and disease prevention, yet their application in LMIC settings remains poorly characterized.

Objective: This systematic review synthesizes current evidence on the effectiveness and feasibility of VR and AR interventions for NCD prevention in LMICs.

Methods: Following PRISMA guidelines, we searched PubMed, Scopus, and Web of Science databases for peer-reviewed studies published between January 2010 and May 2026. Studies were included if they evaluated VR or AR interventions targeting NCD prevention (primary, secondary, or tertiary) in LMIC settings or with clear LMIC applicability. Outcomes assessed included effectiveness measures (clinical, behavioral, educational) and feasibility metrics (acceptability, cost, implementation challenges).

Results: From 412 initial records, 24 studies met inclusion criteria. Evidence demonstrated that VR/AR interventions are effective for cardiovascular rehabilitation (improved exercise capacity: MD 53.26, 95% CI 45.14–61.37; reduced anxiety: SMD −0.39, 95% CI −0.69 to −0.08), stroke rehabilitation (upper limb function improvement), medical education (superior to traditional methods for anatomy knowledge: SMD 0.40, 95% CI 0.15–0.65), and health professional training for NCD management. Feasibility assessments identified key barriers including infrastructure limitations (reported in 6 studies), high initial costs, and lack of culturally adapted content. However, emerging low-cost, mobile-based solutions and participatory co-creation approaches show promise for overcoming these challenges.

Conclusions: VR and AR interventions demonstrate significant potential for NCD prevention in LMICs, particularly for rehabilitation and health professional training. However, evidence remains limited in quantity and quality. Successful implementation requires context-specific adaptation, investment in infrastructure, and integration with existing health systems.

Introduction

Background

Non-communicable diseases (NCDs) which includes cardiovascular diseases, diabetes, chronic diseases of the respiration, cancer, and mental health disorders represent the foremost cause of death and disability around the world . According to the World Health Organization, NCDs kill almost 41 million people in a year which is equivalent to 71% of all deaths around the world. Critically, over 85% of premature NCD deaths (occurring between ages 30 and 69 years) happen in low- and middle-income countries (LMICs), where healthcare systems are often least equipped to respond to this epidemiological transition .

The rising NCD burden in LMICs stems from multiple interconnected factors: rapid urbanization, changing dietary patterns, increasing tobacco and alcohol use, physical inactivity, and aging populations. Unlike high-income countries (HICs), where NCD prevention and management infrastructures are well-established, LMICs face severe resource constraints including shortages of trained healthcare professionals (as few as 0.5 rehabilitation therapists per 10,000 population in some regions), limited diagnostic capabilities, weak primary care systems, and inadequate funding for preventive services . These disparities are particularly stark for rehabilitation services: disability-adjusted life years (DALYs) from stroke are seven times higher in LMICs compared to HICs .

Virtual and Augmented Reality in Healthcare

Virtual reality (VR) and augmented reality (AR) technologies have emerged as transformative tools in healthcare over the past decade . VR creates fully immersive digital environments that can simulate experiences of the real world, while AR overlaps digital information onto the user's physical surroundings. Both technologies rely on motion sensors, depth cameras, head-mounted displays (HMDs), and increasingly, smartphone-based platforms to deliver interactive, engaging health interventions.

In HICs, VR and AR have demonstrated effectiveness across numerous healthcare domains: surgical training and planning, pain management, rehabilitation (particularly for stroke and cardiac conditions), mental health treatment (exposure therapy, mindfulness), health education, and behavior change interventions. Meta-analyses have shown that VR-based cardiac rehabilitation improves exercise capacity and reduces negative emotions including anxiety, depression, and stress . Similarly, immersive VR has been shown to enhance upper limb motor recovery in stroke survivors, with particular efficacy in subacute and chronic phases.

Rationale and Applicability to LMICs

Despite the growing evidence base in HICs, the translation of VR/AR interventions to LMIC settings has been limited. This gap is particularly consequential because LMICs could potentially benefit disproportionately from these technologies. VR/AR interventions offer several theoretical advantages for resource-constrained settings: they can reduce dependence on scarce rehabilitation personnel, enable task-shifting to community health workers, deliver standardized interventions across diverse geographical settings, and potentially lower long-term healthcare costs.

Recent technological developments have made VR/AR more accessible than ever before. Standalone HMDs (e.g., Oculus Quest series) eliminate the need for powerful external computers, while smartphone-based VR and AR applications leverage devices already ubiquitous in LMICs . Mobile health (mHealth) platforms have already demonstrated successful deployment in LMICs for NCD management, suggesting that VR/AR could follow similar adoption pathways.

However, significant challenges remain. Most existing VR/AR interventions were designed in HIC contexts and may not be culturally appropriate for LMIC populations. Language barriers, literacy considerations, differing disease priorities, and limited technical infrastructure all pose implementation obstacles . Furthermore, the evidence base specifically examining VR/AR for NCD prevention in LMICs has not been systematically synthesized.

Objectives

This systematic review aims to:

1. Synthesize available evidence on the effectiveness of VR and AR interventions for NCD prevention (primary, secondary, and tertiary) in LMIC settings
2. Evaluate the feasibility of implementing these interventions in resource-constrained environments
3. Identify barriers and facilitators to successful implementation
4. Provide recommendations for future research and practice

Methods

Protocol and Registration

This systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines. The protocol was registered with the International Prospective Register of Systematic Reviews (PROSPERO; registration number CRD420261429207).

Search Strategy

We searched systematically three electronic databases: PubMed/MEDLINE, Scopus, and Web of Science, for peer-reviewed articles published between January 1, 2010, and May 31, 2026. The search strategy combined terms related to technology (virtual reality, augmented reality, extended reality, immersive technology, head-mounted display), intervention focus (non-communicable disease, chronic disease, prevention, rehabilitation, health promotion, cardiovascular, diabetes, cancer, mental health, respiratory), and setting (low- and middle-income countries, LMIC, developing countries, resource-limited settings, specific country names as classified by World Bank). Boolean operators (AND, OR) were applied, and reference lists of included studies and relevant reviews were hand-searched for additional eligible studies.

Inclusion and Exclusion Criteria

Studies were included if they met the following criteria: (1) evaluated an intervention using VR, AR, or extended reality (XR) technologies; (2) targeted prevention (primary, secondary, or tertiary) of NCDs including cardiovascular disease, diabetes, chronic respiratory disease, cancer, mental health disorders, or stroke; (3) were conducted in LMICs as defined by the World Bank classification OR had explicit applicability to LMIC settings; (4) reported quantitative outcomes on effectiveness (clinical, behavioral, educational) or feasibility (acceptability, cost, implementation metrics); (5) were original research (randomized controlled trials, quasi-experimental studies, pre-post studies, feasibility studies) or systematic reviews with relevance to LMICs; (6) were published in peer-reviewed journals in English.

Exclusion criteria included: (1) studies focused exclusively on infectious diseases or acute care without NCD relevance; (2) conference abstracts, editorials, or opinion pieces without original data; (3) studies where VR/AR was not the primary intervention; (4) studies conducted in HICs without clear applicability to LMIC contexts.

Study Selection and Data Extraction

Two reviewers independently screened titles and abstracts according to the eligibility criteria. Full texts of potentially eligible studies were then assessed independently by both reviewers. Disagreements were resolved by discussing or consulting with a third reviewer.

Data extraction was performed using a standardized form including: (1) study characteristics (author, year, country, study design, sample size); (2) intervention details (technology type, content, duration, comparator); (3) population (age, condition, setting); (4) outcomes (effectiveness measures, feasibility metrics); (5) implementation barriers and facilitators; (6) funding sources and conflicts of interest.

Quality Assessment

Quality assessment was conducted using suitable tools based on the design of study: the Cochrane Risk of Bias 2.0 tool for randomized controlled trials, the ROBINS-I tool for non-randomized studies, and the AMSTAR-2 tool for systematic reviews. Feasibility studies were assessed using the McGill Mixed Methods Appraisal Tool (MMAT). Two reviewers independently assessed quality, with discrepancies resolved by consensus.

Data Synthesis

Due to heterogeneity in study designs, populations, interventions, and outcomes, a narrative synthesis approach was adopted. Results were organized thematically by NCD type (cardiovascular, neurological/cerebrovascular, metabolic, mental health, multi-NCD) and by intervention purpose (prevention, rehabilitation, education/training). Where sufficient homogeneity existed, effect sizes were reported as mean differences (MD) or standardized mean differences (SMD) with 95% confidence intervals (CI).

Results

Study Selection

The systematic search yielded 412 records after duplicate removal. Title and abstract screening excluded 332 records. Full-text assessment of 80 articles resulted in the inclusion of 24 studies meeting eligibility criteria.

- Records identified (n = 524): PubMed (n = 186), Scopus (n = 198), Web of Science (n = 140)
- After duplicate removal (n = 412)
- Title/abstract screening (n = 412): excluded 332
- Full-text assessment (n = 80): excluded 56 (no LMIC focus/ applicability n = 24, not original research n = 15, no NCD focus n = 10, full text unavailable n = 4, duplicate n = 3)
- Total included (n = 24)

Study Characteristics

Of the 24 included studies, there were 6 randomized controlled trials, 3 systematic reviews with meta-analyses, 8 quasi-experimental or pre-post studies, 5 feasibility/usability studies, and 2 protocol papers for ongoing trials. Studies were published between 2010 and 20265, with 75% (n=18) published since 2022, reflecting growing research interest.

Geographically, 6 studies were conducted in LMICs (India, Pakistan, Ethiopia, Uganda, Egypt, Ghana, Peru), while 18 studies either were systematic reviews with LMIC analysis or described interventions with explicit LMIC applicability. The largest LMIC-focused studies came from India (medical education) , Pakistan (healthcare community XR perceptions) , Ethiopia (stroke rehabilitation development) , and Uganda (mental health protocol) .

Quality Assessment

Among the 6 RCTs, 3 were rated as low risk of bias, 2 as some concerns, and 1 as high risk (primarily due to lack of blinding). The 3 systematic reviews demonstrated moderate to high quality on AMSTAR-2, with the most recent review (2025) showing the highest methodological rigor . Feasibility studies generally showed lower methodological quality with small sample sizes (typically n=10-30) and short follow-up durations.

Effectiveness for Cardiovascular Disease Prevention and Rehabilitation

Cardiovascular disease (CVD) was the most studied NCD category. Evidence from LMIC-relevant studies demonstrated consistent benefits of VR-based interventions for cardiac rehabilitation.

A systematic review and meta-analysis including 11 studies with 1,093 patients found that VR-based cardiac rehabilitation significantly improved exercise capacity compared to conventional rehabilitation (mean difference: 53.26 meters on 6-minute walk test, 95% CI: 45.14–61.37, $p < 0.00001$) . The same review reported significant reductions in psychological outcomes: anxiety (SMD: -0.39, 95% CI: -0.69 to -0.08, $p = 0.01$), depression (SMD: -0.48, 95% CI: -0.79 to -0.17, $p = 0.003$), and stress (SMD: -0.72, 95% CI: -1.03 to -0.40, $p < 0.00001$) .

A separate systematic review on extended reality in cardiovascular care confirmed these findings, noting that VR reduces patient-reported pain, eases anxiety, and accelerates post-procedural recovery . The review highlighted that AR and VR provide detailed immersive visualizations of cardiac structures, aiding in diagnosis and intervention planning—capabilities particularly valuable in LMICs where advanced imaging expertise may be limited .

In the LMIC context specifically, Shrestha et al. (2024) noted that while AR/VR adoption in cardiovascular care is still emerging in LMICs, these technologies are gradually being integrated, with particular promise for life support training through immersive, controlled learning environments . The authors emphasized that enhanced accessibility and decreasing costs could significantly impact LMIC healthcare systems.

Effectiveness for Stroke and Neurological Rehabilitation

Stroke rehabilitation represents one of the most promising applications for VR in LMICs, given that two-thirds of stroke-related deaths occur in these settings and rehabilitation resources are severely limited .

The AdaptRehab VR system, developed through a participatory co-creation approach involving Ethiopian and Belgian physiotherapists, stakeholders, and patients, represents the most comprehensive LMIC-specific VR development effort

identified . This system includes six immersive VR games (Basket Bloom, Strike Zone, TapQuest, FruitFall Frenzy, Precision Pitch, and Bean Picker Pro) designed specifically for upper limb stroke rehabilitation. The development process integrated cultural considerations, local languages, and resource constraints from the outset, resulting in a platform compatible with standalone Oculus Quest headsets supporting both controllers and hand tracking .

The review by Cortés-Pérez et al. (2025) on immersive VR in cardiac rehabilitation (which shares rehabilitation principles with stroke care) found that VR interventions significantly reduced depression, anxiety, and stress in patients undergoing rehabilitation . These psychological benefits are particularly relevant for stroke rehabilitation in LMICs, where mental health support is often unavailable.

Key therapeutic features identified for effective stroke rehabilitation VR include: real-time feedback on movement quality, customizable and adaptive difficulty levels, enhanced motivation through gamification, safe and controlled environments for task practice, multisensory stimulation (visual, auditory, and haptic feedback), and facilitation of high-repetition exercise essential for neural recovery .

Effectiveness for Mental Health Prevention and Management

Mental health disorders, increasingly recognized as NCDs, were addressed in several studies. A protocol paper by Logie et al. (2024) describes an ongoing cluster randomized trial among urban refugee and displaced youth (aged 16-24 years) in Kampala, Uganda . This three-arm trial evaluates two youth-tailored mental health interventions: VR alone and VR combined with Group Problem Management Plus (GPM+), compared to standard of care. The study, which enrolled approximately 330 participants, assesses primary outcomes of depression and secondary outcomes including mental health literacy, attitudes toward help-seeking, adaptive coping, mental health stigma, well-being, and functioning .

This trial is particularly noteworthy as it represents one of the first rigorous evaluations of VR for mental health in a humanitarian LMIC setting. The authors note that while VR is a promising approach to reduce stigma and improve mental health and coping, such interventions had not previously been tested in LMICs where most forcibly displaced people reside .

A systematic review by Meshkat et al. (2024) on VR and stress management, while not LMIC-specific, provides supporting evidence that VR-based relaxation and mindfulness interventions effectively reduce acute stress . Similarly, Blackmore et al. (2024) demonstrated that VR environments can effectively support mindfulness meditation practice for individuals with anxiety and mood disorders .

Effectiveness for Health Professional Education and NCD Training

Given the severe shortage of healthcare professionals for NCD management in LMICs, VR/AR for medical education represents an indirect but critical prevention strategy. A systematic review by Siddiqui et al. (2025) specifically examined XR integration in healthcare and medical education in LMICs, analyzing 21 peer-reviewed studies (2021-2024) . The review found that 8 systematic reviews and 3 RCTs showed XR was effective for medical education (5 studies) and surgical planning (4 studies). However, six studies identified LMIC-specific limitations including costs and infrastructure challenges .

A meta-analysis by García-Robles et al. (2024) including 2,199 health sciences students across 27 studies found that XR significantly outperformed traditional methods (textbooks, lectures) for anatomy education, particularly as supplemental tools (SMD = 0.52). Undergraduate students benefited most (SMD = 0.41) . This has direct relevance to NCD prevention, as improved anatomical and clinical knowledge enhances NCD diagnosis and management capacity.

The systematic review by Li et al. (2024) specifically addressed VR and AR for medical education in LMICs, including 17 studies with 887 participants from Egypt and Ghana . Results demonstrated effectiveness in surgical training and student preference over 2D methods, with growing research interest (peak in 2023) and alignment with LMIC surgical priorities .

Practical examples of VR/AR training implementation in LMICs include: a partnership between U.K. institutions and Uganda launching VR-based courses for surgical, obstetrics, and trauma care procedures; Christian Medical College in Ludhiana, India implementing a VR-based pediatric trauma training workshop with McGill University; and MediSim VR establishing a VR medical training lab at Sri Ramachandra Institute in Chennai, India .

Feasibility and Implementation in LMICs

Identified Barriers

Multiple studies consistently identified implementation barriers specific to LMIC settings. Siddiqui et al. (2025) reported that 6 of 21 analyzed studies explicitly identified LMIC limitations including high costs, inadequate technical infrastructure, limited internet connectivity, shortage of trained personnel to maintain and operate systems, and lack of locally relevant content .

Khan et al. (2024) surveyed 406 medical professionals and students in Pakistan, finding that while 83.8% believed XR enhances education and patient care, 70% cited lack of technological advancements as a primary barrier. The study identified additional barriers including ethical concerns, inadequate infrastructure, and insufficient training opportunities .

The AdaptRehab VR development study explicitly enumerated LMIC-specific challenges: limited technical expertise for development and maintenance, insufficient multidisciplinary collaboration, inadequate government funding for rehabilitation technology, and a shortage of rehabilitation services and technologies generally . Critically, the study noted that existing imVR applications, primarily designed for HICs, often fail to address LMIC-specific needs and local technical realities, with cultural sensitivity issues, proprietary restrictions, and frequent technological updates posing major obstacles .

Facilitators and Solutions

Despite these barriers, several studies identified facilitators and innovative solutions. The decreasing cost of VR hardware was noted as a key enabler; standalone HMDs now cost $300-500, comparable to basic smartphones. Mobile-based AR applications can run on existing devices without additional hardware investment .

The participatory co-creation approach used in AdaptRehab VR represents a model for culturally appropriate design. By involving local physiotherapists, patients, and stakeholders from the earliest stages, the resulting system addresses language barriers, incorporates culturally relevant game scenarios, and respects local healthcare delivery realities .

Task-shifting and integration with existing mHealth platforms were identified as scalable implementation strategies. The Uganda mental health trial integrates VR with SMS text message check-ins and Group Problem Management Plus, a scalable brief psychological intervention already validated in humanitarian settings .

Partnership models are emerging: health ministries and medical schools in LMICs are partnering with tech companies or universities with skilled personnel to develop, pilot, and iterate VR/AR modalities . Authors suggest that entrepreneurs could establish private-sector companies to sell VR/AR training services to health ministries and medical schools, creating sustainable business models .

Cost-Effectiveness Considerations

Formal cost-effectiveness analyses of VR/AR interventions in LMICs remain scarce. However, several studies provided relevant data points. The cost of VR hardware has declined substantially: the Oculus Quest 2 (now Meta Quest 2) retails at approximately 299, whilesmartphone–based VR headsets (e.g.,Google Card board) cost as little as 299,whilesmartphone–based VR headsets (e.g.,Google Card board)cost as little as 10-15 per unit .

Training cost comparisons are instructive. Traditional simulation centers with mannequins cost $50,000-200,000 to establish, while VR-based training can be deployed at 10-20% of this cost . Moreover, VR enables distributed training without travel, reducing associated costs. One study noted that VR-based life support training could be particularly cost-effective in LMICs, where travel distances to training centers are often substantial.

However, software development and localization costs remain significant. The AdaptRehab VR development study emphasized that while hardware costs are decreasing, creating culturally adapted, evidence-based content requires substantial upfront investment in multidisciplinary collaboration .

Discussion

Summary of Principal Findings

This systematic review synthesizes current evidence on VR and AR interventions for NCD prevention in LMICs. The principal findings are threefold. First, VR/AR interventions demonstrate consistent effectiveness for NCD rehabilitation, particularly for cardiovascular conditions (improved exercise capacity and psychological outcomes) and stroke (upper limb motor recovery). Second, VR/AR shows promise for NCD-related health professional education, with evidence suggesting superiority to traditional methods for certain learning outcomes. Third, while feasibility barriers are substantial—including infrastructure limitations, costs, and lack of culturally adapted content—emerging solutions involving low-cost hardware, mobile-based platforms, and participatory co-creation approaches offer pathways to scalable implementation.

Comparison with Existing Literature

Our findings align with broader systematic reviews on VR/AR in healthcare. A comprehensive 2025 review of 21 quantitative studies post-2020 found generally positive outcomes from AR and VR interventions across multiple health conditions, while

noting persistent issues with technology usability, adherence, and methodological limitations . The present review extends these findings by specifically examining LMIC applicability and identifying context-specific implementation factors.

The cardiovascular rehabilitation findings (improved exercise capacity: MD 53.26 meters; anxiety reduction: SMD -0.39) are comparable to effect sizes reported in HIC studies, suggesting that VR benefits translate across settings . This is encouraging because it indicates that therapeutic mechanisms—engagement, repetition, feedback—are not setting-dependent. However, the lack of head-to-head HIC-LMIC comparisons limits definitive conclusions.

For stroke rehabilitation, the AdaptRehab VR development represents a paradigm shift from simply importing HIC technologies to co-creating LMIC-appropriate solutions . This participatory approach addresses critiques that digital health interventions often fail due to poor cultural fit. The emphasis on local language integration, culturally relevant game scenarios (e.g., fruit picking rather than skiing), and consideration of local infrastructure (e.g., intermittent electricity, variable internet connectivity) provides a replicable model.

Mechanisms of Action

Understanding why VR/AR interventions work is essential for adapting them to LMICs. Several mechanisms appear consistent across settings. First, immersive VR creates a sense of "presence" that enhances engagement and motivation—critical for rehabilitation adherence where conventional exercises are often perceived as boring . Second, real-time feedback on performance enables self-directed correction, reducing dependence on scarce rehabilitation personnel . Third, gamification elements (points, levels, rewards) tap into intrinsic motivation, potentially improving long-term adherence . Fourth, standardized delivery ensures intervention fidelity regardless of provider skill level, an important consideration in settings with variable training quality .

For education and training, VR/AR mechanisms include spatial learning advantages (understanding 3D anatomy), risk-free practice (no patient harm from errors), and repeatability (deliberate practice without resource constraints) .

Implementation Framework for LMICs

Based on the synthesized evidence, we propose a multi-level implementation framework for VR/AR NCD interventions in LMICs.

At the technology level: Prioritize standalone or mobile-based VR/AR systems that do not require continuous internet connectivity. Design for intermittent power availability (battery operation, offline functionality). Use modular software architectures that allow localization of language, cultural content, and clinical protocols without reprogramming .

At the health system level: Integrate VR/AR interventions into existing NCD care pathways rather than creating parallel systems. Leverage task-shifting by training community health workers to supervise basic VR/AR interventions. Align interventions with WHO Package of Essential NCD Interventions (PEN) protocols .

At the implementation level: Use participatory co-creation methodologies involving local clinicians, patients, and health administrators from the outset. Start with feasibility and pilot studies before large-scale rollout. Develop maintenance and technical support networks, potentially using train-the-trainer models. Establish monitoring and evaluation frameworks that capture both clinical outcomes and implementation metrics (cost, reach, adoption, fidelity) .

At the policy level: Advocate for inclusion of VR/AR in national e-health and NCD strategies. Engage professional associations to accredit VR/AR-based training. Seek diverse funding sources including government allocations, philanthropic foundations, and private-sector partnerships, particularly given recent cuts to traditional global health funding .

Limitations and Research Gaps

This review reported several limitations. The quantity of LMIC-specific primary research remains small, with only 6 of 24 studies actually conducted in LMICs; the remainder infer applicability without local validation. Study quality is variable, with sample sizes being small, the duration sof the follow-up was short, and lack of blinding in many studies. Publication bias may favor positive results. The review was limited to English-language publications, potentially missing relevant research in other languages. Meta-analysis was not feasible for most outcomes due to heterogeneity in interventions, comparators, and outcome measures.

Critical research gaps identified include: absence of cost-effectiveness analyses specific to LMIC settings; lack of long-term follow-up beyond 6 months; minimal research on primary prevention (most studies address tertiary prevention/rehabilitation); scarcity of studies on diabetes, cancer, and respiratory diseases compared to cardiovascular conditions; lack of head-to-head comparisons of different VR/AR delivery models (e.g., clinic-based vs home-based); and absence of implementation science research examining adoption, scale-up, and sustainability.

Implications for Policy and Practice

For policymakers, this review suggests that VR/AR interventions merit consideration within NCD strategies, particularly for rehabilitation and health workforce training where evidence is strongest. However, investments should be phased, beginning with pilot implementations in well-resourced tertiary centers before attempting rural scale-up. Public-private partnerships may accelerate access, but regulatory frameworks for digital therapeutic validation are needed .

For practitioners, VR/AR is not a replacement for existing evidence-based NCD interventions but rather a complement that can enhance engagement, enable self-management, and extend reach. Clinicians should seek training opportunities and collaborate with technology partners to ensure interventions remain clinically grounded. The co-creation model used in AdaptRehab VR exemplifies how clinical expertise can drive technology development rather than being driven by it.

For researchers, priorities include: conducting randomized controlled trials of VR/AR interventions in LMIC settings with adequate sample sizes and long-term follow-up; publishing negative results and implementation challenges to balance publication bias; developing and validating LMIC-appropriate outcome measures; conducting formal cost-effectiveness analyses; and examining implementation strategies using established frameworks (e.g., RE-AIM, CFIR).

Conclusion

Virtual reality and augmented reality interventions show significant promise for non-communicable disease prevention in low- and middle-income countries, particularly for cardiovascular rehabilitation, stroke recovery, mental health management, and health professional education. Evidence demonstrates consistent effectiveness for improving clinical outcomes (exercise capacity, motor function), psychological outcomes (anxiety, depression, stress), and educational outcomes (anatomy knowledge, surgical skills).

However, the evidence base remains limited in quantity and quality, with few rigorous studies conducted in actual LMIC settings. Feasibility barriers including infrastructure limitations, costs, and lack of culturally adapted content are substantial but not insurmountable. Emerging solutions involving low-cost hardware, mobile-based platforms, participatory co-creation methodologies, and task-shifting to community health workers offer pathways to scalable implementation.

Successful translation of VR/AR from HICs to LMICs requires intentional, context-sensitive approaches that prioritize local needs, leverage existing health system infrastructure, and integrate with evidence-based NCD care packages. With appropriate investment in implementation research and capacity building, these technologies have the potential to narrow the NCD prevention and management gap between high-income and resource-limited settings.

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