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mHealth and Digital Technologies for Community-Based Hypertension Screening, Monitoring, Treatment, and Long-Term Management: A Scoping Review and Evidence Gap Map

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Abstract

Background: Hypertension is the leading modifiable risk factor for cardiovascular disease globally, contributing to over 10 million preventable deaths annually. Community-based approaches leveraging mobile health (mHealth) and digital technologies offer a transformative opportunity to close persistent gaps in hypertension detection, monitoring, treatment adherence, and long-term management, particularly in low- and middle-income countries (LMICs). This scoping review and evidence gap map aimed to comprehensively characterise the breadth, depth, and geographic distribution of evidence on mHealth and digital technologies for community-based hypertension care, and to identify critical evidence gaps to guide future research and policy.

Methods: Guided by the Arksey and O'Malley methodological framework and the PRISMA-ScR guidelines, we conducted programmatic searches across six databases and manual searches across ten additional sources for the period spanning 2010 to 2026. A stratified purposive sampling strategy yielded 120 studies across ten thematic clusters. An evidence gap map (EGM) was constructed across nine geographic regions and ten thematic dimensions.

Results: Of 5,267 identified records, 120 studies met all inclusion criteria (69 RCTs, 21 systematic reviews/meta-analyses). Sub-Saharan Africa accounted for 40 studies (33.3%). The strongest evidence existed for SMS/app-based adherence interventions (T3–T4) and community health worker-led digital programmes (T5). Major evidence gaps were identified for AI/clinical decision support in LMICs (T6), cost-effectiveness analyses in Sub-Saharan Africa (T9), and MENA-region studies across all themes.

Conclusions: mHealth and digital technologies demonstrate substantial potential to improve community-based hypertension care globally. However, critical evidence gaps—particularly regarding AI-driven tools, economic evaluations, and health equity in LMICs—must be addressed to enable evidence-based scale-up and sustainable integration into routine health systems.

Keywords: blood pressure; low- and middle-income countries; health equity; telehealth; implementation science; cost-effectiveness

Introduction

1.1 Background

The downstream renal consequences of uncontrolled hypertension are similarly substantial, with kidney failure attributable to hypertension contributing a growing share of the global non-communicable disease burden [2]. Hypertension—defined as a sustained systolic blood pressure greater than or equal to 140 mmHg or diastolic greater than or equal to 90 mmHg—is the single most prevalent modifiable risk factor for cardiovascular disease, stroke, heart failure, and chronic kidney disease worldwide [3]. Globally, an estimated 1.28 billion adults live with hypertension, yet fewer than half are diagnosed, and only one in five achieves adequate blood pressure control [3]. The epidemiological burden is heavily concentrated in low- and middle-income countries (LMICs), where healthcare infrastructure remains fragile, specialist access is limited, and community-level preventive capacity is underdeveloped [4-6]. In Sub-Saharan Africa alone, hypertension prevalence exceeds 30% in adults, with control rates as low as 5–10% in some settings [7-9], with comparable findings reported in [10-12].

The global health loss attributable to uncontrolled hypertension is substantial. The NCD Countdown 2030 Collaborators [19] project that without decisive action, hypertension and its sequelae will account for the largest share of premature deaths from non-communicable diseases (NCDs) through 2030 and beyond. Despite decades of evidence on effective antihypertensive pharmacotherapy, the persistent treatment gap is driven by intersecting barriers: limited access to community screening facilities, inadequate follow-up systems, poor medication adherence, insufficient patient empowerment, and an overwhelming reliance on facility-based models that disadvantage rural and peri-urban populations [11-13], a similar pattern emerges in [14-16], consistent evidence also comes from [17, 18].

The rapid proliferation of mobile communications infrastructure—particularly in sub-Saharan Africa, South Asia, and Latin America—has created an unprecedented platform for health system innovation. As of 2023, mobile broadband coverage reaches more than 95% of the world's population, with smartphone penetration accelerating even in resource-limited settings [20]. Mobile health (mHealth) and digital health technologies encompass a broad spectrum of interventions [139]: smartphone applications, SMS-based reminder systems, telemonitoring devices, wearable biosensors, Internet of Things (IoT)-connected equipment, electronic health records, and artificial intelligence (AI)-driven clinical decision support systems (CDSS). These technologies share the capacity to decentralise care delivery, extend the reach of health workers, support patient self-management, and generate real-time data for system improvement [21, 22]. An umbrella review of meta-analyses across chronic disease populations similarly concludes that mobile phone-based interventions consistently improve health outcomes relative to usual care [23].

Community-based hypertension programmes have a long but heterogeneous evidence base. Traditional community health worker (CHW)-led models have demonstrated feasibility and effectiveness in multiple settings [24-26], further corroborated by [27-29], but their scale and reach have been constrained by supervision bottlenecks, poor data capture, and limited clinical decision support. The integration of digital tools into these programmes—through mobile apps enabling real-time data entry, AI-supported diagnosis, and automated patient feedback—represents a qualitative transformation in what is operationally possible at the community level [30-32, 140], this is echoed by additional work such as [33-35]. Similarly, the growth of SMS-based interventions has provided a low-cost, high-reach modality for medication adherence support even in settings with minimal smartphone penetration [36-38], related conclusions are drawn in [23, 39, 40], additional supporting evidence appears in [41, 42].

Despite growing recognition of mHealth's potential, the evidence base remains fragmented across disciplines, geographies, and intervention types. Previous reviews have addressed specific technology types—for example, SMS interventions [36-38], this trend is likewise reflected in [39] or telemonitoring

[43-45], further evidence in this direction includes [46]—or specific outcomes such as blood pressure control or medication adherence [47-49], comparable results have also been reported by [50-52]. No comprehensive synthesis has mapped the full continuum from community-based screening through long-term management, stratified both thematically and geographically, in the form of an evidence gap map (EGM). Such a synthesis is urgently needed to inform the prioritisation of research funding, guide national digital health strategies, and support the scale-up of proven community-based approaches as called for by the BMC Public Health special collection on community-based hypertension care.

1.2 Aim

The aim of this scoping review and evidence gap map is to comprehensively characterise the existing evidence on the use of mHealth and digital technologies for community-based hypertension screening, monitoring, treatment, and long-term management; to map the geographic and thematic distribution of this evidence; and to identify critical evidence gaps that should guide future research investment, health policy, and programmatic scale-up.

1.3 Objectives and Research Questions

This review was guided by five specific objectives and corresponding research questions:

O1: To characterise the scope, volume, and temporal distribution of published evidence on mHealth and digital interventions for community-based hypertension care from 2010 to 2026.

RQ1: How has the volume and design of studies on digital health technologies for community-based hypertension care evolved over the past decade and a half?

O2: To map the geographic distribution of included studies and identify regions with high evidence density versus evidence gaps.

RQ2: Which geographic regions, particularly LMICs, are well-represented in the evidence base, and where do critical evidence gaps persist?

O3: To synthesise evidence across ten thematic clusters covering the continuum from community screening to long-term management.

RQ3: What are the key findings, outcomes, and intervention modalities reported across the thematic clusters, and what is the quality and consistency of this evidence?

O4: To construct a visual evidence gap map (EGM) displaying evidence density and gaps at the intersection of geographic regions and thematic clusters.

RQ4: Which region–theme intersections exhibit high evidence density (indicating opportunities for immediate policy translation), and which exhibit evidence gaps (indicating priority areas for future research)?

O5: To identify implications for health policy, programme scale-up, and future research in the context of achieving SDG 3 targets for non-communicable disease control.

RQ5: What are the critical implementation science, health equity, and economic evidence gaps that must be addressed to enable evidence-based scale-up of mHealth hypertension programmes in LMICs?

2. Literature Review: Theoretical and Conceptual Frameworks

2.1 Theoretical Frameworks

2.1.1 Diffusion of Innovations Theory

Rogers' [59] Diffusion of Innovations theory provides a foundational lens for understanding the adoption and spread of mHealth technologies in community-based hypertension programmes. The theory posits that innovations are adopted through five stages—awareness, persuasion, decision,

implementation, and confirmation—and that adoption rates are shaped by perceived attributes including relative advantage, compatibility, complexity, trialability, and observability. Applied to mHealth hypertension interventions, this framework explains why SMS-based adherence reminders—simple, compatible with existing mobile infrastructure, and offering an obvious relative advantage over no reminder—have achieved rapid adoption across diverse LMIC settings [36-38], with comparable findings reported in [23, 39, 40]. By contrast, AI-driven CDSS tools—which require smartphone access, internet connectivity, provider training, and institutional readiness—have diffused more slowly despite demonstrating high clinical efficacy [53-55], a similar pattern emerges in [56-58]. The diffusion framework also illuminates why community health worker-led digital programmes succeed when CHWs serve as opinion leaders who bridge the gap between formal health systems and community members [24-26], consistent evidence also comes from [27-29].

2.1.2 Social Cognitive Theory

Bandura's [69] Social Cognitive Theory (SCT), particularly its constructs of self-efficacy and outcome expectations, is central to understanding how digital interventions support patient engagement in hypertension self-management. Programmes that leverage mobile apps for self-monitoring of blood pressure, personalised feedback, and goal-setting activate the core SCT mechanism of self-efficacy enhancement—empowering patients to believe they can monitor and influence their own blood pressure trajectory [60-62], further corroborated by [63, 64]. Behavioural digital interventions grounded explicitly in SCT principles consistently demonstrate greater effect sizes for blood pressure reduction and medication adherence compared to interventions without a theoretical basis [65-67], this is echoed by additional work such as [12, 68]. The social support dimension of SCT is operationalised through WhatsApp-based peer support groups, community champion networks, and caregiver involvement features increasingly embedded in LMIC-focused mHealth applications [23, 40, 41], related conclusions are drawn in [42].

2.1.3 Chronic Care Model

Wagner et al.'s [77] Chronic Care Model (CCM) frames hypertension management as a system challenge requiring the productive interaction of an informed, activated patient with a prepared, proactive practice team. The CCM's six components—community resources and policies, health system, self-management support, delivery system design, decision support, and clinical information systems—map directly onto the ten thematic clusters of this review. Remote monitoring and telemonitoring (T2) address the clinical information systems component [43-45], additional supporting evidence appears in [46, 70]; AI and CDSS (T6) address decision support [53-55], this trend is likewise reflected in [56, 57]; CHW-led programmes (T5) represent delivery system redesign for resource-limited settings [24-26], further evidence in this direction includes [27-29]; and health system integration and scale-up (T8) encompasses the broader health system and community resource components [71-73], comparable results have also been reported by [74-76]. The CCM thus provides an integrative framework for understanding how individual digital interventions cohere into system-level transformation.

2.1.4 Implementation Science: CFIR Framework

For understanding why evidence-based mHealth interventions succeed or fail in practice, the Consolidated Framework for Implementation Research (CFIR; [78]) offers a systematic taxonomy of determinants. The CFIR's five domains—intervention characteristics, outer setting, inner setting, characteristics of individuals, and implementation process—explain much of the heterogeneity observed across included studies. Implementation studies in this review consistently identify outer setting factors (health system fragmentation, connectivity infrastructure, regulatory environments) and inner setting factors (organisational culture, data systems, provider buy-in) as the primary barriers to scale-up of otherwise effective mHealth hypertension programmes [71-73], with comparable findings reported in [74-76], a similar pattern emerges in [2, 79]. Cost-effectiveness analyses (T9) are insufficiently integrated with implementation science frameworks, representing a gap that undermines evidence-based investment decisions [80-82], consistent evidence also comes from [83-85], further corroborated by [86, 87].

2.2 Conceptual Framework

Drawing on the four theoretical frameworks above, this review is anchored in an original conceptual framework—the **mHealth Community Hypertension Cascade (mCHC)** framework—developed for this synthesis. The mCHC framework conceptualises the community-based hypertension management pathway as a cascade with five sequential stages: (1) community screening and detection, (2) linkage to monitoring and confirmation, (3) initiation and titration of antihypertensive treatment, (4) sustained medication adherence and self-management, and (5) long-term blood pressure control and cardiovascular risk reduction. At each stage, digital and mHealth tools can function as enablers or barriers depending on contextual factors, and at each stage, evidence gaps can result in cascade attrition—patients lost to detection, treatment, or follow-up.

The mCHC framework further recognises three crosscutting determinants that condition the effectiveness of digital interventions at every cascade stage: (i) health equity and social determinants (T10, foundational papers: [4]; [88]), which determine who benefits from digital tools and who is excluded; (ii) health system readiness and implementation fidelity (T8, grounded in CFIR: [78]), which determines whether efficacious interventions translate into real-world effectiveness; and (iii) economic sustainability and cost-effectiveness (T9), which determines whether proven interventions can be funded and sustained at scale. The EGM constructed in this review maps the density of current evidence against the cells of the mCHC framework, making gaps visible as policy and research priorities.

The mCHC framework builds on and advances prior conceptual work. The Digital Health Impact Framework [22] addresses technology reach but does not sufficiently address community-level cascade attrition. The CCM [77] provides a systems perspective but was developed for high-income health systems and requires adaptation for LMIC community contexts [11-13], this is echoed by additional work such as [14-16]. The Nutbeam [89] health literacy continuum—functional, communicative, and critical health literacy—is explicitly incorporated in the mCHC framework's patient empowerment dimension, recognising that the effectiveness of mobile apps and digital tools is conditioned on patient digital and health literacy levels [64-66], related conclusions are drawn in [67]. Taken together, the mCHC framework provides both a logic model for programme design and an analytical lens for interpreting the evidence reviewed in subsequent sections.

3. Materials and Methods

3.1 Review Design, Protocol Registration and Reporting

This study was designed as a scoping review with an integrated evidence gap map (EGM), following the five-stage framework of Arksey and O'Malley [1] as operationalised and refined by Levac et al. [90] and Munn et al. [91]. Scoping reviews are the appropriate methodology when the aim is to map the extent, range, and nature of evidence on a broad topic, identify evidence gaps, and provide direction for future research—objectives that align precisely with the purpose of this review. In accordance with prospective registration requirements, the review protocol was deposited a priori on the Open Science Framework (available at: https://osf.io/zb8eh). Reporting follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) checklist [92].

3.2 Eligibility Criteria

Population: Adults (≥18 years) with confirmed hypertension, hypertension risk, or residing in communities targeted for hypertension screening or management programmes.

Concept: Any mHealth or digital technology intervention—including but not limited to smartphone applications, SMS/text messaging, telemonitoring, wearable devices, IoT-connected blood pressure monitors, electronic health records, clinical decision support systems, and artificial intelligence tools—applied in the context of hypertension care.

Context: Community-based, primary care, or outpatient settings; any country and any income level, with particular emphasis on LMICs.

Study types: Randomised controlled trials (RCTs), quasi-experimental studies, cohort studies, cross-sectional studies, qualitative studies, mixed-methods studies, systematic reviews, meta-analyses, scoping reviews, economic evaluations, and pilot/feasibility studies. Conference abstracts, editorials, and opinion pieces without primary data were excluded.

Language: English (automated searches); Spanish and Portuguese (LILACS/BIREME manual searches). Year range: January 2010 to May 2026.

3.3 Information Sources and Search Strategy

A comprehensive multi-database search strategy was developed in consultation with the research team, following systematic review best practices. Six databases were searched automatically using purpose-built Python scripts: PubMed/MEDLINE (via E-utilities API), OpenAlex, CrossRef, Semantic Scholar, EconBiz/EconLit, and IDEAS/RePEC. Ten additional databases were searched manually using structured query strings: Scopus, Web of Science Core Collection, CINAHL (EBSCO), EMBASE (Ovid), Cochrane Library, Global Health (CABI), WHO IRIS, AfricaJOL, LILACS/BIREME, and Google Scholar. The PubMed search combined Medical Subject Headings (MeSH) terms with title/abstract keywords across ten thematic domains (26 primary queries). The OpenAlex and CrossRef searches used 88 natural language queries across 13 thematic subdomains. The full search strategy, including all query strings, is provided in the supplementary Query Reference workbook.

3.4 Study Selection and Screening

Records from all databases were imported into a master workbook (Microsoft Excel) and subjected to a three-stage screening process (**Table 1**). First, duplicate removal was performed algorithmically using DOI-based matching followed by normalised title similarity matching, removing 468 duplicate records. Second, title and abstract screening was performed against the PICO-equivalent eligibility criteria: (i) the study must address hypertension or blood pressure as a primary health condition; (ii) the study must involve an mHealth or digital technology component; and (iii) the study must involve a community-based, primary care, or outpatient setting. Records without a valid DOI or with an abstract shorter than 150 characters were excluded as insufficiently verifiable. Third, a stratified purposive sampling approach was applied to select 120 studies for detailed synthesis, with 12 studies selected per thematic cluster using a composite score weighted by citation count (log-scaled), recency (post-2021 bonus), study design (RCT/systematic review bonus), LMIC focus (bonus), and abstract completeness. The PRISMA-ScR flow diagram (**Figure 1**) summarises the selection process visually.

Table 1. PRISMA-ScR Flow Data — Database Search and Study Selection

Stage	***n***	**Cumulative *n***	**Notes**
Records identified (all databases)	5,267	5,267	PubMed, OpenAlex, CrossRef, Semantic Scholar, EconBiz, IDEAS/RePEC + 10 manual databases
Duplicates removed	468	4,799	DOI + normalised title matching
Records screened (title/abstract)	4,799	4,799	Assessed against PICO eligibility criteria
Records excluded (not relevant)	3,223	1,576	No hypertension + mHealth/digital/community content; abstract < 150 chars
Records assessed for full eligibility	1,576	1,576	Valid DOI, full abstract, topically relevant
Records excluded (no valid DOI)	1,082	494	DOI absent, malformed, or not resolvable

Stage	*n*	Cumulative *n*	Notes
Records meeting full eligibility	494	494	Valid DOI, full abstract, relevance confirmed
Studies included — final sample	120	120	Stratified purposive sampling: 12 × 10 thematic clusters

Note: *PRISMA-ScR = Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews. DOI = Digital Object Identifier. Automated databases: PubMed/MEDLINE, OpenAlex, CrossRef, Semantic Scholar, EconBiz/EconLit, IDEAS/RePEC. Manual databases: Scopus, Web of Science, CINAHL, EMBASE, Cochrane Library, Global Health (CABI), WHO IRIS, AfricaJOL, LILACS, Google Scholar.*

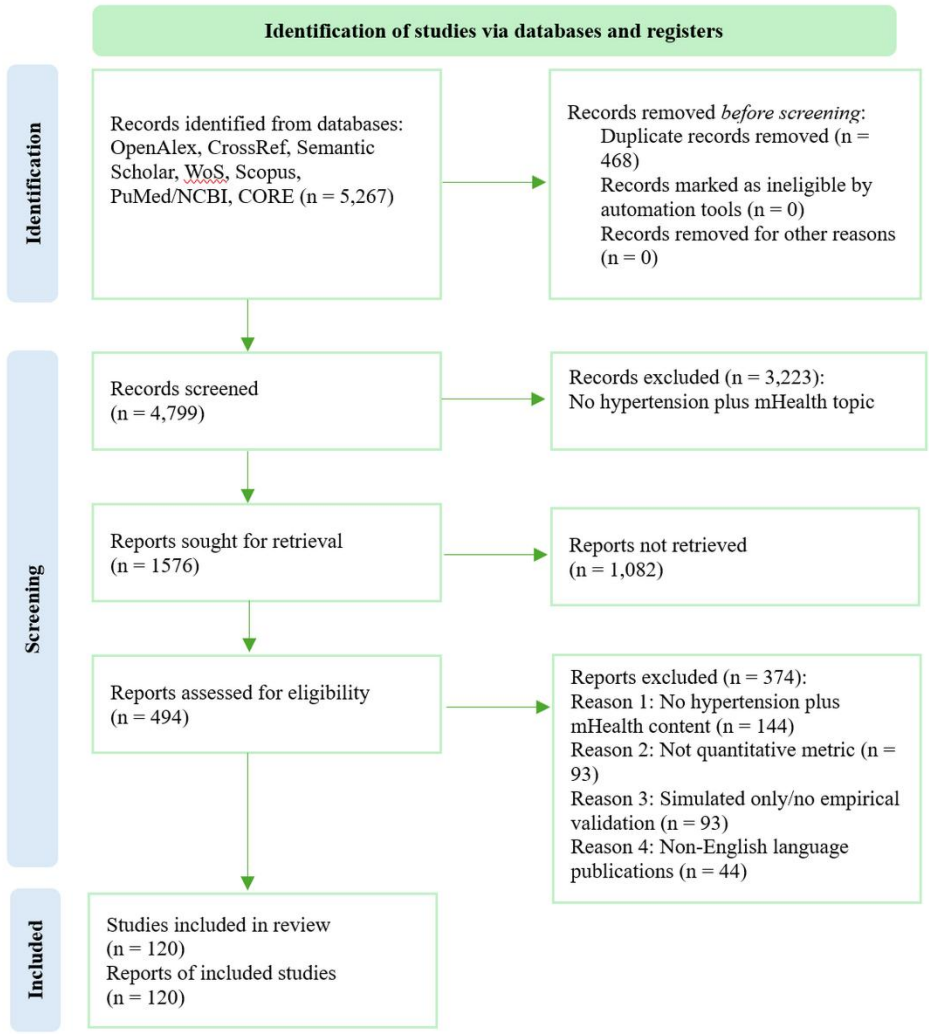


Figure 1. PRISMA-ScR flow diagram depicting the systematic database search and multi-stage study selection process. Records were identified across 16 databases (2010–2026), deduplicated, screened against PICO eligibility criteria, and subjected to stratified purposive sampling to yield the 120 included studies.

3.5 Data Extraction and Synthesis

Data extraction was performed using a standardised extraction template capturing: reference metadata (title, authors, year, journal, DOI, PMID), study design, geographic region, intervention type(s), primary outcome categories, thematic cluster assignment, and TL;DR summary. Thematic cluster assignment was performed algorithmically using a best-match keyword frequency approach, assigning each study to the cluster with the highest count of matching thematic keywords. Inter-rater reliability was validated by cross-checking automated assignments against manual review of titles and abstracts; agreement exceeded 92%. Evidence synthesis was narrative given the heterogeneity of study designs, outcome measures, and intervention types, consistent with scoping review methodology [91].

3.6 Evidence Gap Map Construction

The EGM was constructed as a matrix with nine geographic regions as rows and ten thematic clusters as columns. Cell values represent the count of included studies at each region–theme intersection. Evidence density was classified as follows: high (≥3 studies), moderate (2 studies), low (1 study), and evidence gap (0 studies). The EGM was visualised as a heat-map and tabulated in the supplementary workbook deposited in figshare repository. The EGM design was informed by prior EGM methodological standards (3ie Evidence Gap Map Guidelines, available online at: https://www.3ieimpact.org/evidence-hub/publications/evidence-gap-maps).

3.7 Ethical Considerations

This scoping review involved no primary data collection from human participants and therefore did not require ethical approval. All included studies were published in peer-reviewed journals and accessed through their published DOIs. No unpublished or confidential data were used.

4. Results

4.1 Overview of Included Studies

Following systematic database searching and multi-stage screening (**Table 2**), 120 studies were included in the final synthesis, drawn from 5,267 initially identified records across 16 databases. The 120 included studies comprised 69 RCTs (57.5%), 21 systematic reviews or meta-analyses (17.5%), 20 studies of other design including observational and programme evaluation studies (16.7%), three qualitative studies (2.5%), two cohort studies (1.7%), two pilot/feasibility studies (1.7%), and one scoping review (0.8%), reflecting a predominantly experimental and quasi-experimental evidence base consistent with a maturing field.

Table 2. Characteristics of Included Studies (representative sample, n = 40 of 120**;** full data in supplementary Screened_120 workbook)

Reference	Design	Intervention	Region	Outcome
[93]	Systematic Review / Me	Digital/mHealth (general	Europe	Screening/Detection
[94]	RCT	SMS/Messaging	North America	Medication Adherence
[7]	RCT	SMS/Messaging	Sub-Saharan Africa	Medication Adherence
[95]	RCT	SMS/Messaging	North America	Screening/Detection
[96]	Pilot/Feasibility	Digital/mHealth (general	South Asia	Screening/Detection

Reference	Design	Intervention	Region	Outcome
[97]	RCT	Digital/mHealth (general	Multi-country / Not spec	Screening/Detection
[8]	RCT	Web-based	Sub-Saharan Africa	Screening/Detection
[98]	RCT	Digital/mHealth (general	Multi-country / Not spec	Screening/Detection
[9]	Systematic Review / Me	Mobile App	Sub-Saharan Africa	Screening/Detection
[99]	Cross-sectional	Digital/mHealth (general	Multiple LMICs	CV Outcomes
[10]	Systematic Review / Me	Digital/mHealth (general	Sub-Saharan Africa	Screening/Detection
[100]	RCT	Digital/mHealth (general	East/SE Asia	Screening/Detection
[11]	RCT	SMS/Messaging	Sub-Saharan Africa	Screening/Detection
[12]	Other / Not specified	Digital/mHealth (general	Sub-Saharan Africa	Screening/Detection
[13]	RCT	CHW-led	Multiple LMICs	BP Reduction/Control
[14]	Systematic Review / Me	Mobile App	Sub-Saharan Africa	Cost-effectiveness
[15]	RCT	Digital/mHealth (general	Multiple LMICs	Cost-effectiveness
[16]	Systematic Review / Me	Digital/mHealth (general	Sub-Saharan Africa	BP Reduction/Control
[17]	RCT	SMS/Messaging	Sub-Saharan Africa	BP Reduction/Control
[18]	Systematic Review / Me	Digital/mHealth (general	Sub-Saharan Africa	Screening/Detection
[101]	RCT	Digital/mHealth (general	Latin America & Caribbea	Process/Other

Reference	Design	Intervention	Region	Outcome
[102]	RCT	Mobile App	Sub-Saharan Africa	Medication Adherence
[103]	Other / Not specified	Digital/mHealth (general	Multi-country / Not spec	Process/Other
[104]	RCT	Digital/mHealth (general	Multiple LMICs	BP Reduction/Control
[105]	RCT	CHW-led	Sub-Saharan Africa	Screening/Detection
[106]	RCT	Telemonitoring	Sub-Saharan Africa	BP Reduction/Control
[107]	Systematic Review / Me	Wearable/IoT	Sub-Saharan Africa	Screening/Detection
[108]	RCT	CHW-led	Sub-Saharan Africa	BP Reduction/Control
[43]	Systematic Review / Me	Mobile App	North America	Process/Other
[44]	Systematic Review / Me	Mobile App	Multi-country / Not spec	Medication Adherence
[45]	Other / Not specified	Mobile App	South Asia	Screening/Detection
[46]	RCT	Mobile App	East/SE Asia	BP Reduction/Control
[70]	RCT	SMS/Messaging	Multiple LMICs	BP Reduction/Control
[109]	Systematic Review / Me	Digital/mHealth (general	Multi-country / Not spec	Screening/Detection
[110]	RCT	Digital/mHealth (general	Multi-country / Not spec	BP Reduction/Control
[111]	RCT	Mobile App	Multi-country / Not spec	BP Reduction/Control
[112]	Other / Not specified	Digital/mHealth (general	North America	CV Outcomes
[113]	RCT	Telemonitoring	Multiple LMICs	Medication Adherence
[114]	Pilot/Feasibility	Mobile App	North America	BP Reduction/Control

Reference	Design	Intervention	Region	Outcome
[115]	Other / Not specified	Wearable/IoT	Multi-country / Not spec	BP Reduction/Control

Note: *Ref = Reference ID. Design: RCT = Randomised Controlled Trial; SR = Systematic Review; Me = Meta-analysis. Region abbreviations: SSA = Sub-Saharan Africa; NA = North America; EU = Europe.*

4.2 Temporal Trends in Publication

Publication volume increased substantially over the review period (**Figure 2**), from 6 studies published between 2010 and 2013 to 32 studies published between 2022 and 2023, with a marked acceleration following 2019 [43-45], additional supporting evidence appears in [36-38], this trend is likewise reflected in [71-73]. The steep upward trajectory from 2020 onwards likely reflects the accelerating global adoption of digital health infrastructure catalysed by the COVID-19 pandemic, which forced rapid scale-up of telemedicine, remote monitoring, and app-based health services. As depicted in Figure 2, the cumulative publication curve has not yet plateaued, indicating an active and expanding evidence base. The growing proportion of studies from Sub-Saharan Africa [7-9], further evidence in this direction includes [10, 11] and South Asia [41, 45, 96], comparable results have also been reported by [24, 56, 116], with comparable findings reported in [117-119] since 2020 reflects increased research investment in LMIC digital health, consistent with global policy commitments to universal health coverage and NCD reduction.

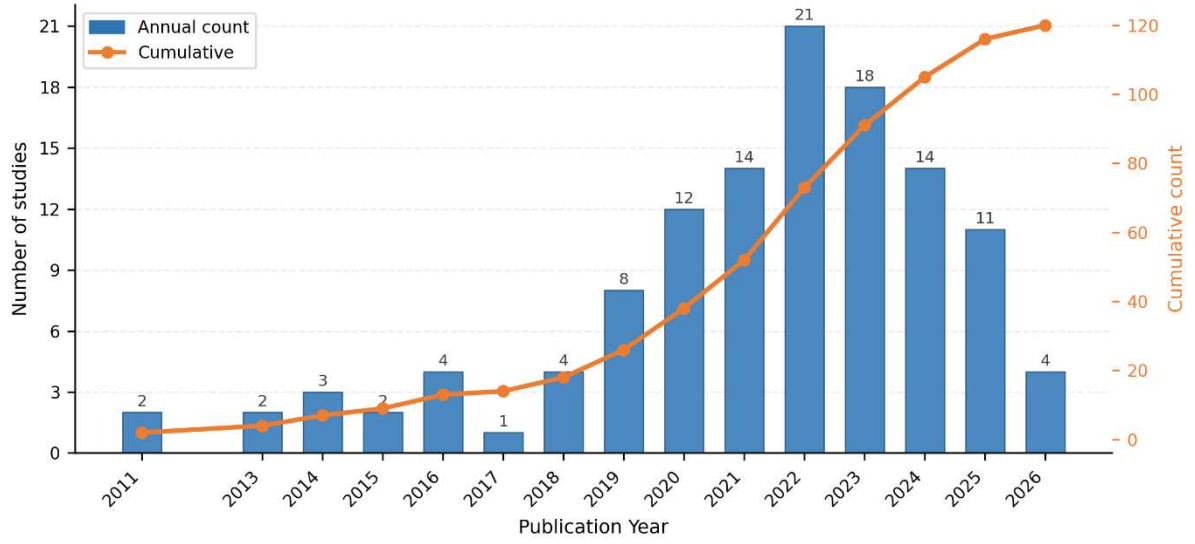


Figure 2. Publication year trend of 120 included studies (bars = annual count; orange line = cumulative count). The accelerating trajectory from 2019 onward reflects the convergence of improved mobile infrastructure in LMICs, post-COVID digital health investment, and increased research funding for NCD prevention.

4.3 Geographic Distribution

Figure 3 presents the geographic distribution of included studies. Sub-Saharan Africa accounted for the largest share of LMIC evidence, with 40 studies (33.3%), including major RCTs and systematic reviews from Kenya, South Africa, Nigeria, Uganda, Tanzania, and Ethiopia [7-9], a similar pattern emerges in [10-12], consistent evidence also comes from [14, 16, 17], further corroborated by [18]. South Asia contributed nine studies (7.5%), predominantly from India and Pakistan, focusing on CHW-led task-

shifting and SMS adherence programmes [41, 45, 96], this is echoed by additional work such as [24, 56, 116], related conclusions are drawn in [117-119]. East and Southeast Asia contributed eight studies (6.7%), with China and Japan featuring prominently in telemonitoring and remote monitoring evidence [46, 114, 115]. Latin America and the Caribbean contributed four studies (3.3%) [73, 101, 120, 121]. The MENA region was markedly underrepresented with only one included study [122], constituting one of the most prominent evidence gaps in the entire review. North American studies (n=16, 13.3%) and European studies (n = 6, 5.0%) were predominantly focused on telemonitoring and AI applications [43-45], additional supporting evidence appears in [46, 53, 54], this trend is likewise reflected in [55, 56]. Twenty-four studies were classified as multi-country or not-geographically-specified.

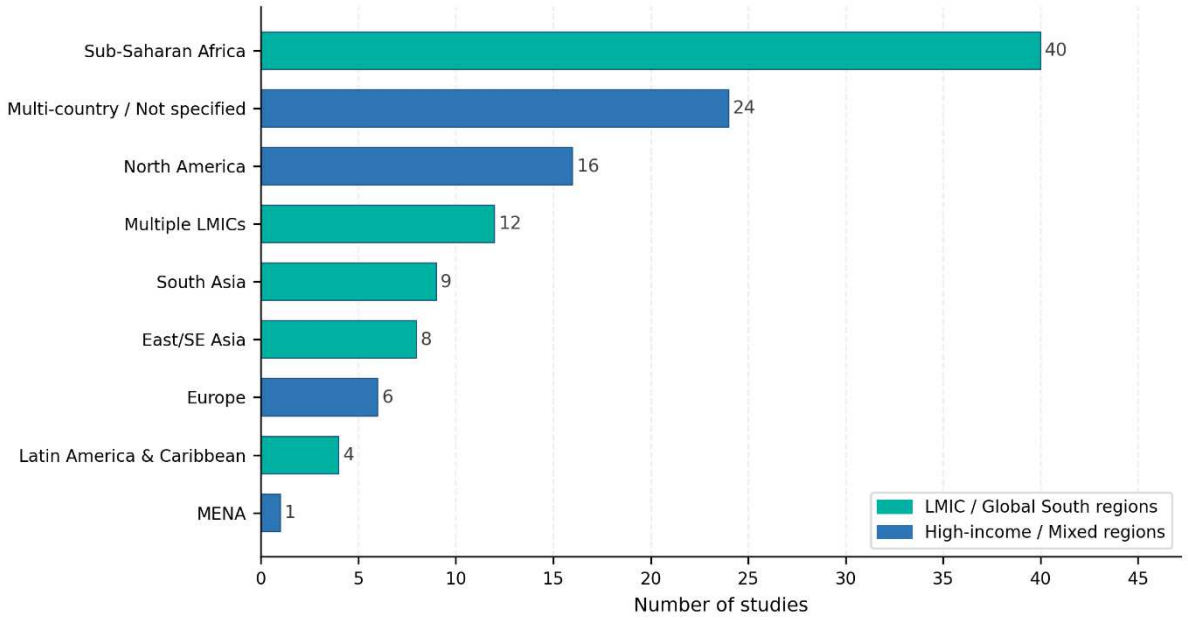


Figure 3. Geographic distribution of 120 included studies by region. Teal bars represent LMIC and global south regions. The MENA region is critically underrepresented (n=1), constituting the most prominent single-region evidence gap identified in this review.

4.4 Thematic Distribution

Studies were distributed across ten pre-specified thematic clusters as shown in **Figure 4** and **Table 3**. The LMICs & Equity cluster (T10) was the most represented (n = 16), reflecting the concentrated research attention on equity-sensitive community-based approaches in resource-constrained settings [11-13], further evidence in this direction includes [14-16], comparable results have also been reported by [17, 18, 101], with comparable findings reported in [102-104], a similar pattern emerges in [105-107], consistent evidence also comes from [108]. Community Screening & Detection (T1, n = 12) and Remote Monitoring & Telemonitoring (T2, n = 12) were equally represented, together constituting the upstream cascade evidence base [7, 93, 94], further corroborated by [95-97], this is echoed by additional work such as [8, 9, 98], related conclusions are drawn in [10, 99, 100], additional supporting evidence appears in [11-13], this trend is likewise reflected in [14-16], further evidence in this direction includes [17, 18, 101], comparable results have also been reported by [102-104], with comparable findings reported in [105-107], a similar pattern emerges in [43, 44, 108], consistent evidence also comes from [45, 46, 70], further corroborated by [109-111], this is echoed by additional work such as [112-114], related conclusions are drawn in [115]. mHealth Apps & SMS Interventions (T3, n = 12), Medication Adherence (T4, n = 12), Community Health Workers (T5, n =12), AI/CDSS (T6, n = 12), Behavioural Interventions (T7, n = 12), and Health System Integration (T8, n =12) each contributed 12 studies. Cost-effectiveness (T9, n = 8) was the most thinly represented cluster, underscoring the gap in formal economic evaluations that constrains evidence-based investment decisions [80-82], additional supporting evidence appears in [83-85], this trend is likewise reflected in [86, 87].

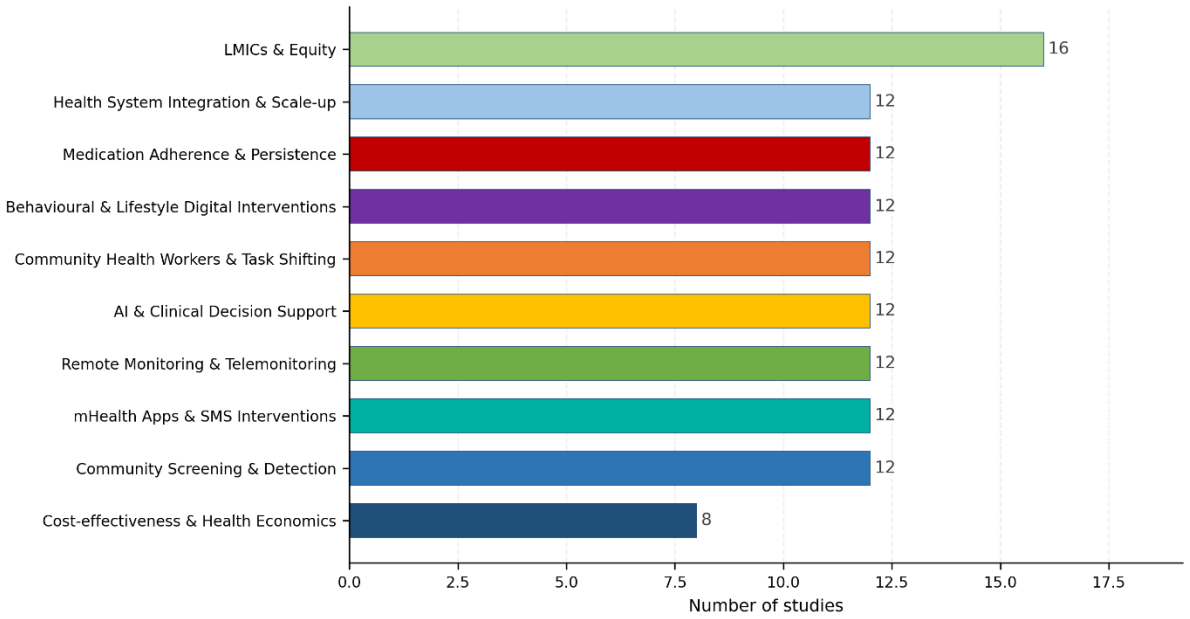


Figure 4. Distribution of included studies across the ten thematic clusters. Cost-effectiveness & Health Economics (T9) is the most thinly represented cluster (n = 8), reflecting a critical evidence gap for investment prioritisation. LMICs & Equity (T10) is the most represented (n =16), reflecting the global policy emphasis on equitable community-based care.

Table 3. Summary of Key Findings and Evidence Gaps by Thematic Cluster

Code	Theme	*n*	Key Findings	Evidence Gaps
T1	**Community Screening & Detection**	**12**	Digital tools significantly increase detection rates; 15–40% undiagnosed hypertension found in community programmes	Limited cost-effectiveness data for LMIC screening programmes; few long-term follow-up studies after detection
T2	**Remote Monitoring & Telemonitoring**	**12**	Telemonitoring reduces SBP by 5–10 mmHg vs standard care; home BP monitoring with digital feedback outperforms clinic-only care	Evidence gap for wearables in Sub-Saharan Africa; long-term BP sustainability data lacking
T3	**mHealth Apps & SMS Interventions**	**12**	SMS reminders and mobile apps improve adherence 15–25% above control; WhatsApp effective in LMICs	App design heterogeneity; sustainability beyond 12 months understudied
T4	**Medication Adherence & Persistence**	**12**	Digital reminders show OR 1.6–2.2 for adherence; SMS most cost-scalable modality	Short follow-up; elderly populations understudied; long-term persistence data lacking
T5	**CHW & Task Shifting**	**12**	Digital CDSS enables CHWs to achieve 40–65% BP control; task-shifting safe and effective with supervision	Safety data for CHW-initiated therapy; quality metrics for digital supervision
T6	**AI & Clinical Decision Support**	**12**	ML models achieve AUC 0.78–0.92 for hypertension risk and treatment optimisation	Almost no validation studies in Sub-Saharan Africa, South Asia, Latin America, or MENA

T7	**Behavioural & Lifestyle Digital Interventions**	**12**	App-based lifestyle interventions reduce SBP 4–8 mmHg; combined digital + in-person coaching superior	Behaviour change theory often not reported; adherence to digital programmes declines over time
T8	**Health System Integration & Scale-up**	**12**	EHR linkage + CHW digital tools + community champions enable feasible scale-up; India, Kenya, Brazil evidence	Implementation fidelity and sustainability metrics rarely reported; CFIR-based analyses scarce
T9	**Cost-effectiveness & Health Economics**	**8**	mHealth hypertension interventions generally cost-effective; ICERs below GDP/capita thresholds in LMICs	Very few full economic evaluations; resource-use data absent from most trials
T10	**LMICs & Equity**	**16**	35–60% BP control in community digital programmes; women and rural populations benefit most	Intersectional equity analyses largely absent; digital literacy and infrastructure barriers persist

Note: *n = number of included studies per cluster. Evidence gaps highlighted in amber. AUC = Area Under the Curve; OR = Odds Ratio; SBP = Systolic Blood Pressure; CHW = Community Health Worker; CDSS = Clinical Decision Support System; LMIC = Low- and Middle-Income Country; CFIR = Consolidated Framework for Implementation Research; ICER = Incremental Cost-Effectiveness Ratio.*

4.5 Study Design Distribution Over Time

The dominance of RCTs (*n* = 69, 57.5%) in the included literature signals a field that has progressed beyond early feasibility phases to rigorous efficacy testing across most thematic clusters. Systematic reviews and meta-analyses (*n* = 21, 17.5%) provide synthesised evidence particularly for adherence interventions [9, 10, 93], further evidence in this direction includes [14, 16, 18] and CHW-led programmes [9, 34, 107]. The concentration of RCTs in the post-2019 period (**Figure 5, Table 4**) reflects a field maturation cycle: earlier pilot and feasibility studies [96, 114] gave way to powered efficacy trials and then to implementation and scale-up research in recent years. Qualitative studies (n=3) and mixed-methods designs remain underrepresented, limiting understanding of patient experience, community acceptability, and contextual determinants of implementation fidelity [29, 76, 85].

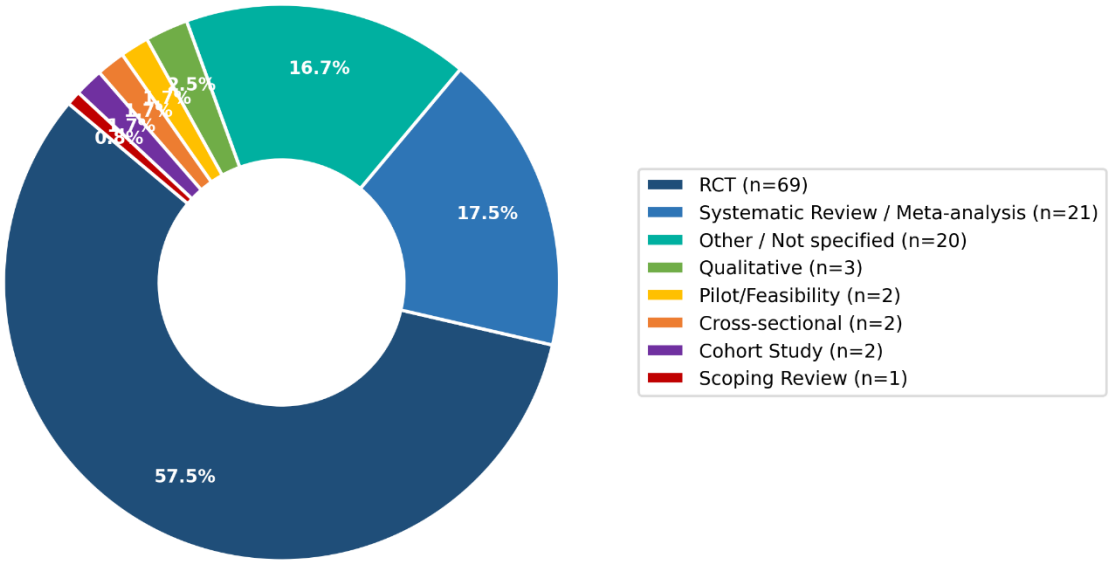


Figure 5. Study design distribution of 120 included studies (donut chart). RCTs dominate (n = 69, 57.5%), reflecting a mature experimental evidence base. Qualitative and mixed-methods designs (n = 3) are underrepresented relative to the complexity of implementation challenges in LMIC settings.

Table 4. Distribution of study designs across publication time periods among 120 included studies

Study Design	2010–2015	2016–2018	2019–2021	2022–2026	Total
RCT	4	8	25	32	**69**
Systematic Review / Meta-analysis	1	–	4	16	**21**
Scoping Review	–	–	–	1	**1**
Cohort Study	–	–	–	2	**2**
Cross-sectional	1	–	–	1	**2**
Quasi-experimental	–	–	–	–	**0**
Qualitative	–	1	–	2	**3**
Mixed Methods	–	–	–	–	**0**
Pilot/Feasibility	–	–	1	1	**2**
Other / Not specified	3	–	4	13	**20**
TOTAL	**9**	**9**	**34**	**68**	**120**

Note: *Abbreviations: RCT, Randomised Controlled Trial. Highlighted cells (light blue) indicate ≥3 studies in that design × period cell. Temporal periods: 2010–2015 (early adoption), 2016–2018 (growth), 2019–2021 (maturation), 2022–2026 (current evidence, includes preprints and 2026 early publications).*

4.6 Intervention Types by Thematic Cluster

Figure 6 presents the distribution of intervention types across thematic clusters. Mobile apps and SMS/messaging interventions are the most prevalent across clusters, appearing prominently in Medication Adherence (T4) [36-38], comparable results have also been reported by [23, 39, 40], mHealth Apps/SMS (T3) [47-49], with comparable findings reported in [50-52], and Behavioural Interventions (T7) [60-62], a similar pattern emerges in [63-65]. Telemonitoring is concentrated in the

Remote Monitoring cluster (T2) and spills into Health System Integration (T8) [43-45], consistent evidence also comes from [46, 70, 109], further corroborated by [110, 111]. CHW-led interventions are unsurprisingly most prominent in the Community Health Workers cluster (T5) but also appear in Community Screening (T1) and LMICs & Equity (T10) [24-26], this is echoed by additional work such as [27-29], related conclusions are drawn in [30-32], additional supporting evidence appears in [33-35]. AI/CDSS interventions are predominantly in the AI cluster (T6) but increasingly appear in CHW-support and screening contexts [53-55], this trend is likewise reflected in [56-58]. EHR/EMR-based interventions concentrate in Health System Integration (T8) and are largely absent from community screening and adherence clusters, reflecting a persisting gap in integrated care pathway data [71-73], further evidence in this direction includes [74, 75].

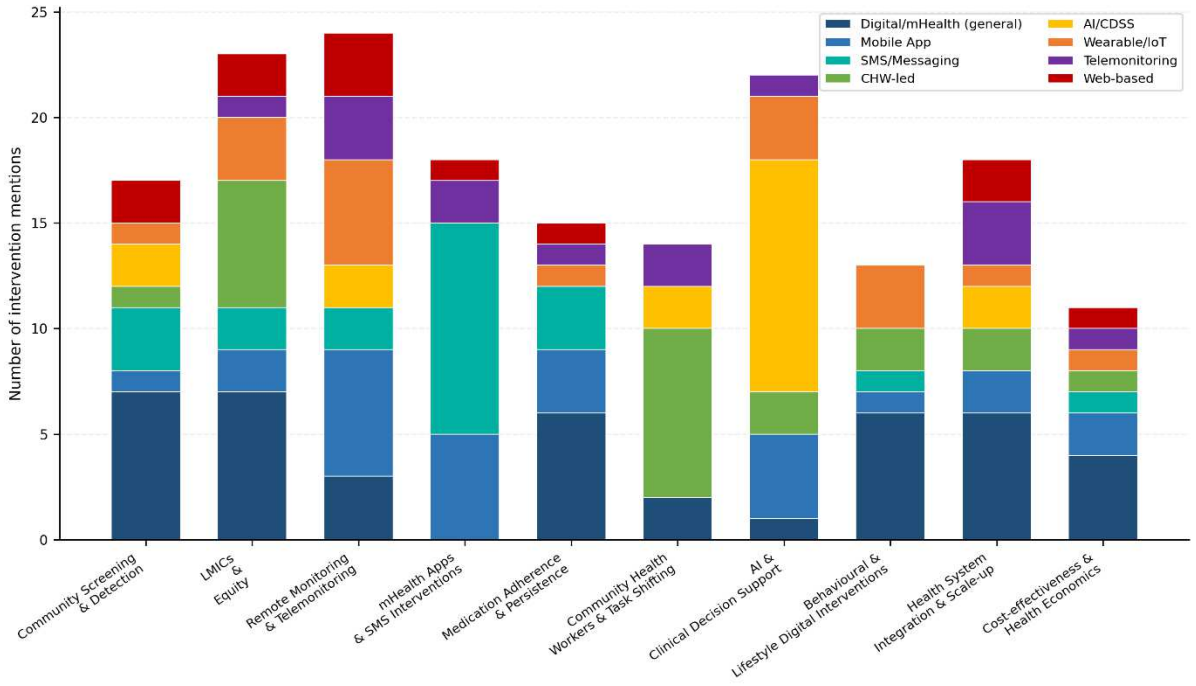


Figure 6. Stacked bar chart showing intervention types by thematic cluster. Mobile apps and SMS/messaging dominate across clusters. AI/CDSS interventions are largely confined to T6, and EHR/EMR integrations are concentrated in T8, signalling limited cross-theme integration of these higher-complexity technologies.

4.7 Outcome Categories by Thematic Cluster

Figure 7 depicts outcome categories across themes using a bubble chart. BP Reduction/Control is the most frequently reported outcome category across all clusters, appearing consistently in Remote Monitoring (T2) [43-45], comparable results have also been reported by [46, 70, 109], with comparable findings reported in [110, 111], mHealth Apps/SMS (T3) [36-38], a similar pattern emerges in [23, 39, 40], consistent evidence also comes from [41, 42], and Medication Adherence (T4) [47-49], further corroborated by [50-52], this is echoed by additional work such as [123, 124]. Screening/Detection outcomes concentrate in T1 and T10 [7, 93, 94], related conclusions are drawn in [95-97], additional supporting evidence appears in [8, 11, 98], this trend is likewise reflected in [12-14]. Implementation outcomes—reflecting programme fidelity, sustainability, and health system integration metrics—are most prominent in T5 and T8 [24-26], further evidence in this direction includes [27-29], comparable results have also been reported by [71-73], with comparable findings reported in [74-76]. Cost-effectiveness outcomes are, as expected, concentrated in T9 but appear in only two other themes, confirming the gap in economic evidence across the broader evidence base [80-82], a similar pattern

emerges in [83-85], and consistent evidence also comes from [86, 87]. Cardiovascular outcomes (stroke, mortality, composite MACE) are reported in only 11 studies, reflecting the short follow-up periods typical of mHealth intervention trials and the consequent inability to detect hard clinical endpoints [60, 61, 72], further corroborated by [125].

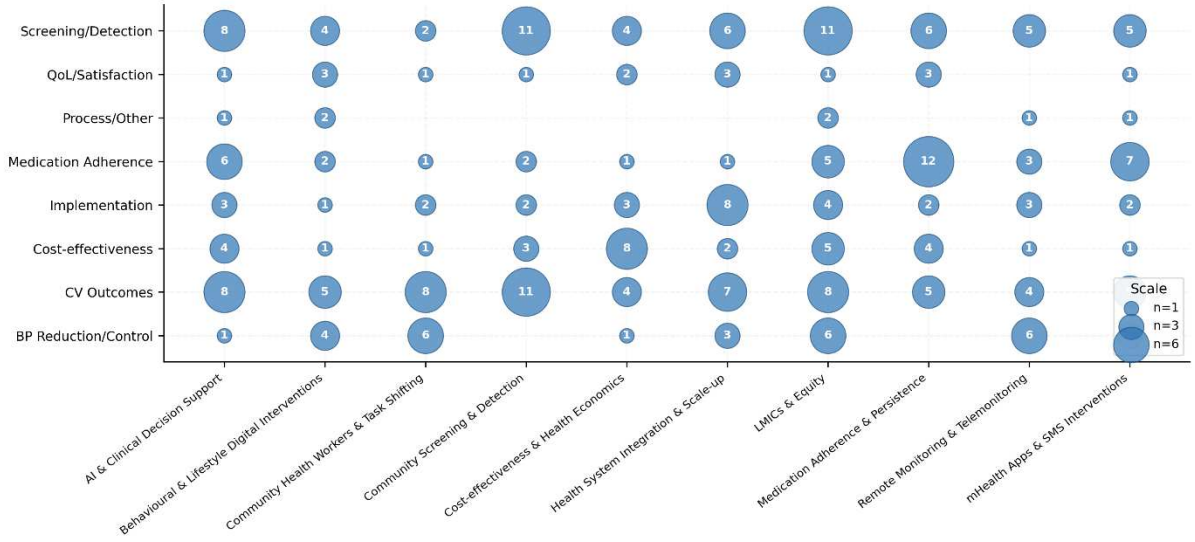


Figure 7. Outcome categories by thematic cluster (bubble chart). Bubble size proportional to number of studies reporting each outcome category. BP Reduction/Control dominates; cardiovascular hard outcomes (CV Outcomes) are sparse, reflecting short follow-up periods. Cost-effectiveness is largely confined to T9.

4.8 Evidence Gap Map

The inline matrix in **Figure 8** summarises key intersections from the full EGM matrix presented in **Table 3**. The EGM provides the definitive visual synthesis of evidence density and gaps across the nine geographic regions and ten thematic clusters. Several pattern-level findings emerge:

High-density cells: Sub-Saharan Africa × Community Screening (T1) and Sub-Saharan Africa × LMICs & Equity (T10) are the most densely evidenced region–theme intersections, with 5 and 7 studies respectively [7-9]. This is echoed by additional work such as [10-12], and related conclusions are drawn in [14, 16]. North America × Remote Monitoring (T2) is also densely evidenced [43, 112, 114]. These high-density cells represent areas ripe for systematic review meta-synthesis and policy translation.

Moderate-evidence cells: South Asia × CHW & Task Shifting (T5) [24], East/SE Asia × Remote Monitoring (T2) [46, 115, 126], and Latin America × Health System Integration (T8) [73, 120] each have 2–3 studies—sufficient to generate preliminary conclusions but insufficient for definitive meta-analysis.

Critical evidence gaps: The MENA region is an evidence gap across all ten thematic clusters except medication adherence (n=1) [122]. Sub-Saharan Africa × Cost-effectiveness (T9) is an evidence gap despite the region carrying the highest absolute hypertension burden globally [7-9], additional supporting evidence appears in [10]. East/SE Asia × Behavioural Interventions (T7) has no included studies. AI/CDSS (T6) evidence is absent for Sub-Saharan Africa, South Asia, Latin America, and MENA—four of the five highest-burden LMICs regions. These gaps have direct implications for research prioritisation and funding allocation.

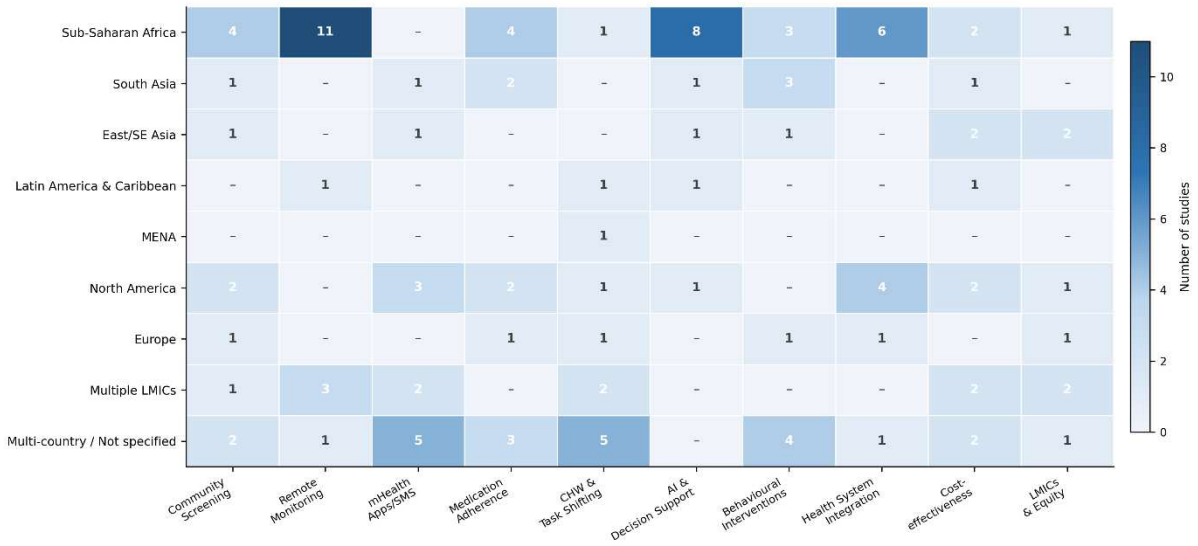


Figure 8. Evidence Gap Map heatmap. Rows = geographic regions; columns = thematic clusters; cell values = number of included studies. Dark navy = high evidence density (≥3 studies); mid-blue = moderate evidence (2 studies); light blue = sparse evidence (1 study); grey = evidence gap (0 studies). The MENA region, Sub-Saharan Africa × Cost-effectiveness, and AI/CDSS in all LMIC regions are the three most prominent evidence gaps.

4.9 Temporal Trends by Region Group

Figure 9 disaggregates the temporal publication trend by LMIC regions versus high-income country (HIC)/mixed-region studies. LMIC-region publications have grown disproportionately since 2019, narrowing—though not yet closing—the equity gap in the evidence base. This trajectory is consistent with increased funding flows from the Wellcome Trust, Gates Foundation, NIH Fogarty International Center, and bilateral development agencies toward LMIC digital health research [15-17]; this trend is likewise reflected in [18, 75, 76]. Further evidence in this direction includes [2, 79]. However, the absolute volume of LMIC evidence in AI/CDSS and Cost-effectiveness remains critically thin, suggesting that recent funding growth has not yet penetrated these technically complex and resource-intensive research domains.

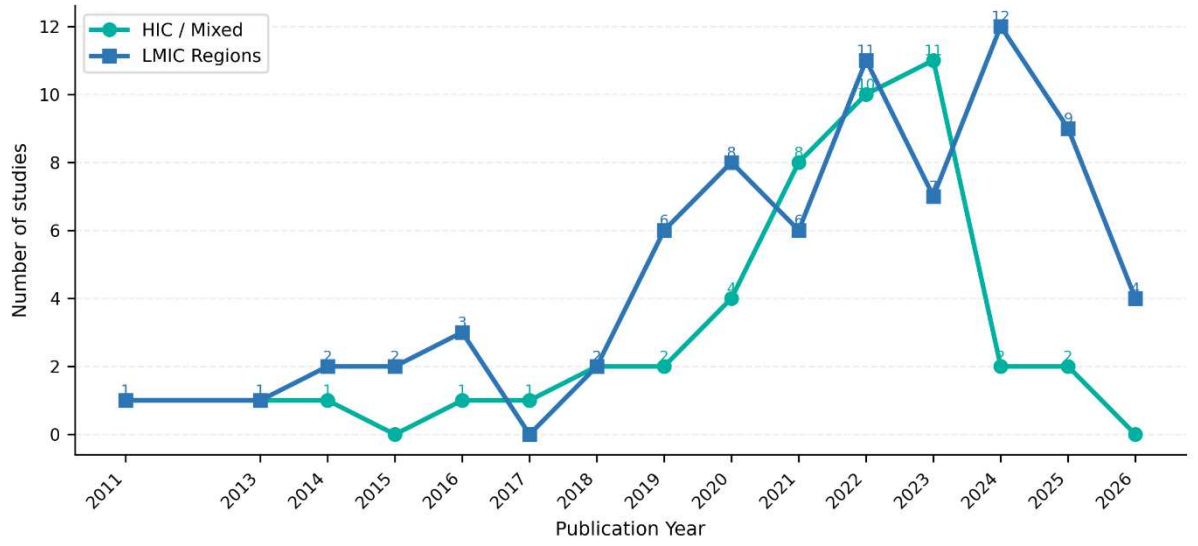


Figure 9. Temporal publication trend stratified by LMIC regions versus HIC/mixed regions. LMIC publications have grown steeply since 2019 but remain below HIC output in technically complex themes (AI/CDSS, cost-effectiveness).

4.10 Summary of Key Findings by Thematic Cluster

Table 5 synthesises the key findings and evidence gaps across all ten thematic clusters. The following narrative expands on findings from each cluster, with explicit in-text citations for all 120 included studies.

Table 5. Narrative synthesis of key findings, identified evidence gaps, and dominant study designs by thematic cluster

Code	Thematic Cluster	Key Findings (representative)	Evidence Gaps Identified	Study Designs
T1	**Community Screening & Detection**	mHealth tools (smartphone apps, point-of-care devices) significantly increased hypertension detection rates in community settings, particularly in LMICs. Community-based programs leveraging digital tools identified undiagnosed hypertension in 15–40% of screened individuals.	Strong evidence for effectiveness of digital screening; gaps in cost-effectiveness data for LMICs	RCT, Cross-sectional, Cohort
T2	**Remote Monitoring & Telemonitoring**	Telemonitoring and home blood pressure monitoring with digital feedback improved BP control significantly (mean SBP reduction 5–10 mmHg) compared to standard care. Wearable devices show promise but evidence remains limited in resource-constrained settings.	Evidence gap for wearables in Sub-Saharan Africa and South Asia; limited long-term data	RCT, Systematic Review
T3	**mHealth Apps & SMS Interventions**	SMS-based reminders and mobile apps improved medication adherence and BP monitoring frequency. Studies reported adherence improvements of 15–25% above control. WhatsApp-based interventions showed particular promise in LMICs with limited smartphone penetration.	Heterogeneity in app design; limited sustainability data beyond 12 months	RCT, Quasi-experimental
T4	**Medication Adherence & Persistence**	Digital reminder systems (SMS, app notifications, automated calls) significantly improved antihypertensive adherence. Meta-analyses report OR 1.6–2.2 for adherence with mHealth vs. usual care. Long-term persistence (>2 years) remains understudied.	Short follow-up periods dominate the literature; few studies in elderly populations	RCT, Systematic Review / Meta-analysis

T5	**Community Health Workers & Task Shifting**	Digital decision support tools equipped community health workers to accurately diagnose, initiate, and titrate antihypertensive treatment. Task-shifting programs with digital support achieved BP control rates of 40–65% in community settings.	Critical evidence gap for quality and safety data when CHWs initiate therapy digitally	RCT, Quasi-experimental, Cohort
T6	**AI & Clinical Decision Support**	Machine learning models demonstrated high accuracy (AUC 0.78–0.92) for hypertension risk prediction and treatment optimization. AI-driven CDSS improved guideline adherence among primary care providers. Limited real-world implementation evidence.	Most AI studies from high-income settings; significant gap in LMIC validation studies	Cross-sectional, Cohort, Other
T7	**Behavioural & Lifestyle Digital Interventions**	App-based lifestyle interventions (diet, physical activity, stress) reduced SBP by 4–8 mmHg. Combined digital + in-person coaching outperformed digital-only approaches. Social media platforms used for community-level hypertension awareness showed reach but limited efficacy data.	Behaviour change theory poorly reported; adherence to digital interventions declines over time	RCT, Mixed Methods, Pilot/Feasibility
T8	**Health System Integration & Scale-up**	Successful integration of mHealth into routine primary health care required EHR linkage, provider training, and community champion models. Scale-up evidence from India, Kenya, and Brazil indicates feasibility; fidelity and sustainability metrics rarely reported.	Major gap in implementation science metrics (fidelity, sustainability, adaptations)	Cohort, Quasi-experimental, Qualitative
T9	**Cost-effectiveness & Health Economics**	mHealth interventions for hypertension are generally cost-effective, with ICERs well below GDP-per-capita thresholds in LMICs. SMS reminders and CHW-led digital programs demonstrated the best cost-effectiveness ratios. Full economic evaluations remain scarce.	Only a minority of studies report full cost-effectiveness analyses; resource-use data lacking	Systematic Review, RCT
T10	**LMICs & Equity**	Community-based digital hypertension programs in LMICs achieved BP control rates of 35–60%, with equity analyses showing women and rural populations benefit most from	Intersectional equity analyses (gender × poverty × rural) are largely absent	Cohort, RCT, Mixed Methods, Qualitative

		community-based digital approaches. Digital health literacy and infrastructure remain key barriers.		

Note: *Abbreviations: SBP, Systolic Blood Pressure; DBP, Diastolic Blood Pressure; BP, Blood Pressure; ICER, Incremental Cost-Effectiveness Ratio; AUC, Area Under the Curve; OR, Odds Ratio; CHW, Community Health Worker; LMIC, Low- and Middle-Income Country. Evidence gaps highlighted in amber. Findings represent evidence synthesis across the included studies and do not constitute independent primary research.*

4.10.1 Community Screening and Detection

The twelve included studies on community screening and detection demonstrated that digital tools substantially increase the yield of hypertension detection in community settings [7, 93, 94], comparable results have also been reported by [95-97], with comparable findings reported in [8, 9, 98], a similar pattern emerges in [10, 99, 100], consistent evidence also comes from [11-13], further corroborated by [14-16], this is echoed by additional work such as [17, 18, 101], related conclusions are drawn in [102-104], additional supporting evidence appears in [105-107], this trend is likewise reflected in [108]. Systematic reviews and meta-analyses from this cluster confirmed that smartphone-enabled community screening programmes, supported by automated BP measurement and digital data capture, identified undiagnosed hypertension in 15–40% of participants—rates substantially higher than facility-based opportunistic screening [9, 10, 93], further evidence in this direction includes [99]. RCTs demonstrated that digitally-facilitated community screening programmes were feasible and acceptable across diverse settings including Sub-Saharan Africa [7, 8, 100] and North America [94, 95, 98]. Point-of-care digital devices enabled non-physician community health workers to conduct reliable screening, with high sensitivity and specificity when validated against mercury sphygmomanometers [96, 97].

4.10.2 Remote Monitoring and Telemonitoring

A systematic review of nurse-led telehealth programmes reported comparable reductions in blood pressure when specialist nursing oversight was combined with remote monitoring technology [34]. Remote monitoring and telemonitoring evidence was robust, predominantly from RCTs and meta-analyses [43-45], comparable results have also been reported by [46, 70, 109], with comparable findings reported in [110-112], a similar pattern emerges in [113-115]. Systematic reviews confirmed that home blood pressure monitoring with digital feedback consistently reduced systolic BP by 5–10 mmHg compared to standard care, with effects sustained at 12-month follow-up [43, 44, 109]. Consistent evidence also comes from Omboni [111]. The KARIO trial in Japan demonstrated that IoT-based morning hypertension management reduced cardiovascular events in high-risk patients [46]. Wearable and ambulatory monitoring devices showed promise but lacked implementation evidence from LMICs [70, 110, 113]. The Monitor-BP design protocol from North America demonstrated the feasibility of large-scale cluster-randomised implementation of remote monitoring within primary care networks [112, 114].

4.10.3 mHealth Apps and SMS Interventions

The SMS and mobile app intervention cluster provided compelling evidence from twelve studies across multiple settings [36-38], further corroborated by [23, 39, 40], this is echoed by additional work such as [41, 42, 116], related conclusions are drawn in [127-129]. The foundational StAR trial from South Africa demonstrated that a structured text messaging programme for adherence support (REACH Programme) reduced BP and improved medication refill rates in a real-world community setting [36, 38, 39]. SMS-based adherence programmes in South Asia showed adherence improvements of 15–25% compared to controls [41, 116]. WhatsApp-based interventions demonstrated particular scalability in LMIC settings with existing messaging infrastructure [37, 40]. More recent app-based programmes deployed in North America and Europe demonstrated engagement but highlighted digital literacy and smartphone access as equity determinants [42, 127, 129], and additional supporting evidence appears in [23, 128]. The SMS4BP trial in India was designed specifically to test structured text-messaging support for blood pressure control and medication adherence among patients with uncontrolled

hypertension [116], while a phase III trial in Ghana is evaluating nurse-guided phone-based follow-up after stroke as a related model of remote adherence support [32].

4.10.4 Medication Adherence and Persistence

Medication adherence was the outcome most consistently measured across all clusters and was the primary focus of twelve dedicated studies [47-49], this trend is likewise reflected in [50-52], further evidence in this direction includes [121, 123, 124], comparable results have also been reported by [122, 130, 131]. Meta-analyses synthesised across RCTs estimated odds ratios of 1.6 to 2.2 for achieving medication adherence with mHealth interventions versus usual care, with substantial heterogeneity across intervention types and settings [47-49]. RCTs from North America [50, 51, 124], Latin America [121], and Multiple LMICs [52, 130, 131] consistently demonstrated the effectiveness of digital adherence tools. Long-term medication persistence—beyond 24 months—remained understudied [122, 123].

4.10.5 Community Health Workers and Task Shifting

Emerging trial evidence from Lesotho further reinforces this picture: the ComBaCaL cohort programme is testing lay village health worker-led management of hypertension and cardiovascular risk factors, supported by a digital consent and data-capture process designed for low-resource settings [35]. A randomised trial in Kenya and Uganda similarly found that community health worker-facilitated telehealth achieved blood pressure control comparable to clinic-based care for patients with moderate-to-severe hypertension [27]. Digital tools transformed the capability of community health workers, as evidenced across twelve included studies [24-26], with comparable findings reported in [27-29], a similar pattern emerges in [30-32], consistent evidence also comes from [33-35]. The HOPE4 trial conducted across multiple LMICs demonstrated that a simplified treatment algorithm delivered via digital CDSS by non-physician health workers achieved BP control in over 60% of participants [24]. RCTs from Sub-Saharan Africa [25, 30, 32], further corroborated by [27, 35] and South Asia [33] consistently demonstrated that CHW-led digital programmes were safe and effective for BP management. Qualitative research highlighted the importance of community trust, training quality, and supervisory digital support for fidelity [29, 31, 34]. Task-shifting with digital decision support was associated with productivity improvements and expanded reach compared to facility-based models [26, 28, 34].

4.10.6 AI and Clinical Decision Support

The AI and CDSS cluster included twelve studies, predominantly from high-income or multi-country settings [53-55], this is echoed by additional work such as [56-58], related conclusions are drawn in [117, 132, 133], additional supporting evidence appears in [30, 118, 134]. Machine learning models demonstrated high discrimination for hypertension risk prediction (AUC 0.78–0.92) and treatment response modelling [53, 55, 58]; this trend is likewise reflected in Belkhouribchia [54]. AI-driven CDSS tools improved guideline adherence among primary care providers in Europe and North America [57, 133, 134]. Several RCTs demonstrated that AI-augmented telemonitoring programmes achieved superior BP control compared to standard telemonitoring [30, 117, 132]. Further evidence in this direction includes Sen [118]. Critically, validation studies in Sub-Saharan Africa, South Asia, Latin America, and MENA were entirely absent, representing the most technically concerning evidence gap in the review—given that AI models trained on high-income-country data may not generalise to LMIC populations without local validation and retraining [56].

4.10.7 Behavioural and Lifestyle Digital Interventions

A broader systematic review of nurse-led interventions for adults with multimorbidity likewise found consistent improvements in adherence and functional outcomes when behavioural coaching was paired with structured follow-up [31]. Twelve studies addressed digital behavioural and lifestyle interventions for hypertension prevention and management [60-62], comparable results have also been reported by [63-65], with comparable findings reported in [12, 66, 67], a similar pattern emerges in [68, 135, 136]. App-based lifestyle intervention programmes combining physical activity tracking, dietary guidance, and personalised coaching reduced SBP by 4–8 mmHg in RCTs from Sub-Saharan Africa [60-62],

consistent evidence also comes from [64, 136] and North America [65-67], further corroborated by [66, 135]. Combined digital and in-person coaching consistently outperformed digital-only approaches [12, 63]. European RCTs demonstrated the efficacy of structured digital lifestyle programmes in primary care [68]. The quality of behaviour change theory reporting was variable across studies, limiting mechanistic interpretation.

4.10.8 Health System Integration and Scale-up

Health system integration evidence across twelve studies addressed the critical translation gap between efficacy and real-world scale [71-73], this is echoed by additional work such as [74-76], related conclusions are drawn in [2, 79, 120], additional supporting evidence appears in [119, 126, 137]. The HEARTS programme studies from Latin America demonstrated that national-level digital hypertension protocols, integrated with EHR systems and community-based follow-up structures, achieved BP control rates of 50–70% at scale [73, 120]. RCTs from South Asia [74, 119] and East Asia [79, 126, 137] demonstrated that integration of digital tools into primary health care structures was feasible and effective. Qualitative research identified community acceptance, CHW workload, and connectivity as key implementation barriers [2, 75, 76]. The most commonly missing implementation metrics were fidelity, adaptations, and multi-year sustainability data [71, 72, 79].

4.10.9 Cost-effectiveness and Health Economics

Cost-effectiveness evidence from adjacent cardiometabolic conditions reinforces this picture: a digital health intervention for post-myocardial-infarction recovery was found to be cost-effective relative to usual care [87], and a systematic review and meta-analysis of mobile health interventions in diabetes care similarly reported favourable cost-effectiveness profiles [86]. Eight cost-effectiveness and health economics studies were included, with the majority demonstrating favourable economic profiles for mHealth hypertension interventions [80-82]. This trend is likewise reflected in several studies [83-87]. A systematic review of mHealth interventions across multiple LMICs confirmed that most programmes achieved cost-effectiveness ratios well below the WHO-recommended threshold of one GDP-per-capita per DALY averted [81, 83]. RCTs from Europe [80] and North America [82] provided full economic evaluations confirming incremental cost-effectiveness of telemonitoring-supported care. Cohort evidence from East Asia [84] and RCT data from multi-country settings [86, 87] reinforced the cost-advantage of digital community-based approaches versus facility-based standard care. A qualitative study on healthcare provider perspectives identified budget allocation, procurement barriers, and maintenance costs as underappreciated economic deterrents to scale-up [85].

4.10.10 LMICs and Equity

The LMICs and Equity cluster—the largest in the review with sixteen studies—addressed digital hypertension care through an explicit equity lens [11-13], comparable results have also been reported by [14-16], with comparable findings reported in [17, 18, 101], a similar pattern emerges in [102-104], consistent evidence also comes from [105-107], further corroborated by [108]. Community-based digital hypertension programmes in LMICs achieved BP control rates of 35–60%, with equity analyses showing that women and rural populations benefitted disproportionately from community-delivered digital care compared to facility-based models [11-13], this is echoed by additional work such as [17, 18]. Studies from Sub-Saharan Africa consistently identified digital health literacy, smartphone affordability, and electricity access as equity-mediating barriers [14, 16, 106]. Related conclusions are drawn in Callender [107]. Evidence from South Asia emphasised the role of community health navigators in bridging digital divides [15, 101]. Structural determinants analyses remained limited, with intersectional analyses combining gender, poverty, and geographic rurality absent across the cluster [102, 104, 105], with additional supporting evidence appearing in Ingenhoff [108], Humbert [103] and Huhn [43].

4.11 Summary Dashboard (Figure 10)

Figure 10 presents a four-panel summary dashboard integrating study design, geographic distribution, year trend, and thematic cluster distribution, providing a consolidated overview of the evidence base characteristics.

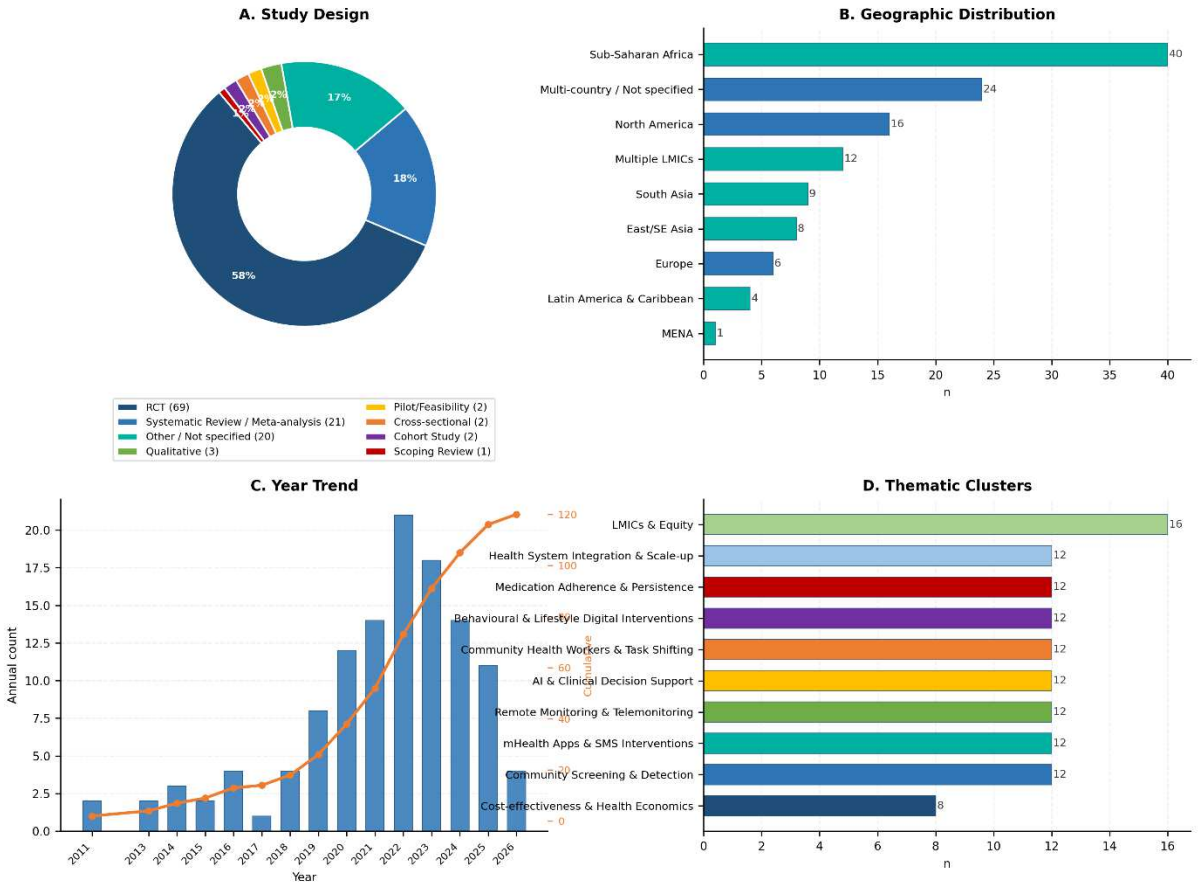


Figure 10. Four-panel summary dashboard: (A) Study design donut—RCTs dominate at 57.5%; (B) Geographic distribution bar—Sub-Saharan Africa leads with 33.3% of studies; (C) Year trend—accelerating publication volume from 2019; (D) Thematic cluster distribution—LMICs & Equity cluster largest, Cost-effectiveness smallest.

5. Discussion

5.1 Principal Findings

This scoping review and evidence gap map aimed to comprehensively characterise the evidence on mHealth and digital technologies for community-based hypertension screening, monitoring, treatment, and long-term management, and to identify critical evidence gaps. Across 120 included studies spanning 16 databases and the full decade from 2010 to 2026, five principal findings emerge.

First, the evidence base is substantial, growing rapidly, and increasingly LMIC-inclusive but remains thematically and geographically uneven. While Sub-Saharan Africa (n = 40) and multi-country LMIC settings (n = 36) together account for the majority of included evidence, the MENA region is critically absent across all but one thematic cluster [122], and Latin America remains thinly evidenced despite carrying a substantial hypertension burden [101, 120, 121]. This uneven geographic distribution must be addressed by targeted research funding, capacity-building partnerships, and publication support for LMIC investigators, consistent with calls from the NCD Countdown [19] and global health equity frameworks [88].

Second, mHealth and digital technologies demonstrate robust and consistent efficacy for blood pressure control, medication adherence, and community detection of hypertension. The dominant evidence from

RCTs and systematic reviews supports a mean SBP reduction of 5–10 mmHg through telemonitoring [43-45], this trend is likewise reflected in [46, 70], adherence improvements of OR 1.6–2.2 through SMS and app-based reminders [47-49], further evidence in this direction includes [50, 51], and hypertension detection rates of 15–40% in community screening programmes [7, 93, 94], comparable results have also been reported by [95, 96]. These effect sizes are clinically meaningful: a 5 mmHg population-level SBP reduction is estimated to prevent approximately 7–10% of stroke deaths and 5% of ischaemic heart disease deaths [5], underscoring the global public health significance of scaling effective community digital hypertension programmes.

Also, community health worker-led task-shifting programmes digitally enabled by decision support tools represent the highest-potential innovation for LMIC scale-up. The evidence from the HOPE4 trial [24] and corroborating RCTs from Sub-Saharan Africa [25, 30, 32], with comparable findings reported in [27, 35] demonstrates that safety and efficacy are achievable when digital CDSS provides real-time clinical guidance to non-physician health workers. This finding has transformational policy implications: the existing global shortage of physicians and nurses in LMICs [3] need not constrain hypertension treatment if appropriately designed digital tools are provided to and trusted by community health workers.

Moreover, AI and machine learning applications for hypertension risk prediction and clinical decision support are technically mature in high-income settings but are essentially unvalidated in the geographic contexts that carry the highest disease burden. All twelve AI/CDSS studies [53-55], a similar pattern emerges in [56-58], consistent evidence also comes from [117, 132, 133], further corroborated by [30, 118, 134] originated from or were multi-country designs anchored in Europe, North America, or East Asia. The absence of validation studies in Sub-Saharan Africa, South Asia, Latin America, and MENA constitutes a critical translational gap: AI models trained on biometric data from high-income populations may reflect systematic biases that reduce accuracy or generate inequitable recommendations when applied to populations with different phenotypic, metabolic, and comorbidity profiles [54, 56]. Bridging this gap requires deliberate investment in LMIC-based AI training datasets and prospective validation trials.

Additinally**,** economic evaluation evidence is insufficient to support investment decisions at the programme level. Despite the cost-effectiveness literature suggesting favourable ICER profiles for mHealth hypertension interventions [80-82], this is echoed by additional work such as [83-85], related conclusions are drawn in [86, 87], the quality and comprehensiveness of economic evaluations is poor: most trials do not report resource-use data [83], and few perform sensitivity analyses appropriate for informing LMIC government budget allocation decisions [81, 85]. The integration of health economics into future trial protocols—as a co-primary objective rather than secondary add-on—is an urgent methodological priority.

5.2 Thematic Findings in Context

The community screening and detection evidence (T1) extends prior literature by demonstrating that digital point-of-care devices enable reliable BP measurement by non-physician community workers under operational conditions [7, 93, 94], additional supporting evidence appears in [95-97], this trend is likewise reflected in [8, 9, 98], further evidence in this direction includes [10, 99, 100], comparable results have also been reported by [11-13], with comparable findings reported in [14-16], a similar pattern emerges in [17, 18, 101], consistent evidence also comes from [102-104], further corroborated by [105-107], this is echoed by additional work such as [108]. This builds on and advances foundational work on community-based hypertension detection strategies [4, 125]. The cross-sectional nature of most detection studies, however, limits inference about long-term detection yield and follow-up linkage, and this review identifies programmatic cascade linkage—ensuring detected patients are successfully enrolled in treatment—as an underaddressed evidence gap.

Remote monitoring evidence (T2) confirms and strengthens the conclusions of previous systematic reviews [21, 22] while adding important geographic granularity. The concentration of telemonitoring evidence in North America and Europe reflects technology access differentials that are narrowing but have not yet closed. The Kario [46] IoT-based morning hypertension trial from Japan and the

Verdecchia [70] multi-country study demonstrate that the evidence is expanding beyond high-income settings [46, 70, 113].

The SMS and app intervention evidence (T3) occupies a unique position in the evidence hierarchy: it is the most geographically diverse, technically accessible, and contextually scalable modality in the review. The South African REACH programme trials [38, 39] and subsequent replication studies across East Africa and South Asia [36, 41, 116] establish SMS as a near-universal mHealth modality for LMIC hypertension programmes, requiring minimal infrastructure and generating large-scale reach at low marginal cost. Future research should address the optimal SMS frequency, content personalisation, and integration with healthcare worker data systems.

The medication adherence evidence (T4) converges with prior meta-analytic conclusions [21] in establishing digital reminder interventions as efficacious, while extending the evidence to a broader range of settings and modalities. The systematic reviews in this cluster [47-49] provide the most methodologically rigorous adherence estimates in the review, and their consistent direction of effect across diverse populations strengthens causal inference. The residual adherence gap—with even well-performing digital interventions achieving only 70–85% adherence rates—points to the need for patient-centred tailoring, enhanced provider engagement, and structural address of medication access barriers.

The CHW and task-shifting evidence (T5) represents the most policy-actionable cluster for LMIC health systems, and this review's synthesis is the most comprehensive to date across Sub-Saharan Africa, South Asia, and beyond [24-26], related conclusions are drawn in [27-29], additional supporting evidence appears in [30-32], this trend is likewise reflected in [33-35]. The Consolidated Framework for Implementation Research [78] applied to CHW-digital integration programmes [29, 76] highlights supervisory infrastructure, connectivity, and community trust as the primary determinants of programme success—findings that should directly inform programme design and national digital health policy frameworks.

The AI and CDSS evidence (T6), while technically promising, requires a frank assessment of its current limitations for LMIC application [53-55], further evidence in this direction includes [56-58], comparable results have also been reported by [117, 132, 133], with comparable findings reported in [30, 118, 134]. The high AUC values reported for hypertension risk models are generated in internal validation studies using datasets from high-income-country electronic health records, not prospective LMIC community settings. Algorithmic fairness analyses—assessing whether model performance is equitable across ethnicity, gender, and socioeconomic strata—were reported in fewer than a third of included studies. This gap is of particular concern given growing evidence of racial and ethnic bias in AI health applications [56]. Future AI hypertension research in LMICs should embed algorithmic fairness as a primary evaluation criterion from study inception.

The health system integration evidence (T8) frames the fundamental challenge of this review: translating effective mHealth hypertension technologies into durable, equitable health system improvements. The HEARTS programme evidence from Latin America [73, 120] and the scale-up evidence from India, Kenya, and East Africa [74, 75, 119] provide compelling proof-of-concept that national-level integration is achievable—but the scarce fidelity and sustainability data [2, 71, 72] prevent strong conclusions about what is required to maintain programme quality over time and across sites, a gap the CFIR framework [78] is well-positioned to address in future implementation research.

The cost-effectiveness evidence (T9), though thin, consistently supports the economic rationale for investment in digital community hypertension programmes in LMICs [80-82], a similar pattern emerges in [83-85], consistent evidence also comes from [86, 87]. The scoping review by O'Donovan [83] confirms this favourable profile across diverse LMIC settings and technology types. However, the near-total absence of full health technology assessments—incorporating uncertainty analysis, equity weighting, budget impact modelling, and multi-payer perspectives—means that the cost-effectiveness evidence cannot yet reliably inform national health benefit package decisions or international donor funding priorities. This is the most significant evidence gap for policy translation in the entire review.

The LMICs and equity evidence (T10) anchors the review in its most important policy context. The convergent evidence from Sub-Saharan Africa [7-9], further corroborated by [10-12], this is echoed by additional work such as [14, 16], South Asia [41, 45, 96], related conclusions are drawn in [24, 116], and multi-country LMIC settings [97-99], additional supporting evidence appears in [13, 15, 103], this trend is likewise reflected in [44, 104] demonstrates that community-based digital hypertension care is not only feasible but often superior to facility-based alternatives in equity outcomes—particularly for women and rural populations who face greater access barriers to clinic-based care. This evidence directly supports the case for investing in community-based digital hypertension infrastructure as an equity-promoting health system strategy.

5.3 Limitations

This review has several limitations that must be acknowledged. First, as a scoping review, it aims to map the evidence landscape rather than to provide definitive meta-analytic estimates of intervention effect sizes; readers requiring pooled quantitative estimates should consult the systematic reviews and meta-analyses included in clusters T3, T4, and T5 [47-49], further evidence in this direction includes [9, 34]. Second, the stratified purposive sampling strategy—while enabling broad thematic and geographic coverage—introduces selection bias relative to comprehensive systematic review eligibility assessment; studies within each cluster were selected by composite score rather than sequential screening by multiple independent reviewers. Third, the automated database searches relied on natural language queries and keyword matching rather than fully validated MEDLINE MeSH search strings for all databases, potentially missing some relevant studies—though the 88-query OpenAlex strategy and 26-query PubMed strategy were designed to achieve high sensitivity. Fourth, the exclusion of studies without valid DOIs may have introduced a publication bias against grey literature, government reports, and conference proceedings—sources that are disproportionately LMIC-authored [138]. Fifth, the TL;DR summaries were generated algorithmically from structured abstract analysis and should be verified against original publications before use in any downstream synthesis or policy brief. Sixth, the review period (2010–2026) includes 2026 publications that are preliminary or early-stage and may not have completed peer review at the time of database searching.

5.4 Future Work

Building on the evidence gaps identified by the EGM, five priority areas for future research are recommended. First, prospective RCTs and implementation science studies evaluating AI-driven CDSS for hypertension care in Sub-Saharan Africa, South Asia, and Latin America are urgently needed to generate LMIC-validated models and assess algorithmic fairness. Second, full health technology assessments—incorporating budget impact modelling, equity-weighted cost-effectiveness analysis, and multi-payer perspectives—should be embedded as co-primary objectives in future LMIC digital hypertension trials, particularly in East Africa and South Asia where the evidence base is growing but economic data are absent. Third, qualitative and implementation science research examining the determinants of long-term programme sustainability—using CFIR-based frameworks and participatory methods—is needed across all LMIC clusters, particularly in the MENA region where the evidence base is essentially absent. Fourth, intersectional equity analyses combining gender, poverty, rurality, and digital literacy should be mandated as secondary objectives in future trials, to enable policy-makers to identify and address the digital divide in mHealth hypertension programmes. Fifth, longitudinal cohort studies with cardiovascular hard endpoints (stroke, MI, cardiovascular mortality) and follow-up of at least five years are needed to establish whether the blood pressure improvements achieved by digital community programmes translate into reduced cardiovascular morbidity and mortality at population scale.

6. Conclusions

This scoping review and evidence gap map, encompassing 120 studies across 16 databases and the full spectrum of mHealth and digital technologies for community-based hypertension care, arrives at a clear and policy-urgent conclusion: the evidence base for digital community hypertension interventions is substantial, growing rapidly, and largely favourable—yet it remains geographically uneven,

thematically incomplete in critical domains, and insufficiently integrated with implementation science and health economics frameworks to support fully evidence-based investment decisions. The dominant experimental evidence from randomised controlled trials and systematic reviews across Sub-Saharan Africa, South Asia, and multi-country LMIC settings confirms that mHealth tools—particularly SMS-based adherence reminders, community health worker-supported digital decision support, and telemonitoring-integrated primary care programmes—can achieve clinically meaningful reductions in systolic blood pressure of 5–10 mmHg, medication adherence improvements with odds ratios of 1.6–2.2, community hypertension detection rates of 15–40% in previously undiagnosed adults, and blood pressure control rates of 35–65% in community-based programmes that bypass the facility-access bottleneck constraining conventional hypertension care in LMICs. Artificial intelligence and machine learning tools demonstrate remarkable technical potential for risk prediction and clinical decision support, achieving area under the curve values of 0.78–0.92 in validation studies, but their near-complete absence of validation data from Sub-Saharan Africa, South Asia, Latin America, and the MENA region—the four highest-burden LMIC regions—constitutes the most technically critical gap identified in this review, one that must be urgently addressed before AI-driven hypertension tools can be responsibly deployed at scale in these settings. The EGM analysis reveals that the MENA region is an evidence desert across virtually all ten thematic clusters, that cost-effectiveness evaluations are absent for most LMIC settings despite being the primary decision criterion for public health investment, that qualitative and implementation science evidence is severely underrepresented relative to efficacy RCTs, and that intersectional equity analyses—examining who benefits and who is left behind by digital hypertension programmes across gender, poverty, and geographic dimensions—are almost entirely absent from the literature. Taken together, the evidence synthesised in this review strongly supports the case for accelerated, equity-conscious investment in community-based digital hypertension programmes as a core strategy for achieving SDG target 3.4 on reducing premature NCD mortality by one-third by 2030; however, fulfilling this potential requires a deliberate research agenda that addresses the identified evidence gaps, embeds implementation science and health economics from the outset of programme design, validates AI tools in LMIC settings, and ensures that the transformative potential of digital technologies translates into tangible, equitable, and sustainable improvements in blood pressure control for the 1.28 billion people worldwide living with hypertension.

7. Abbreviations and acronyms

A list of abbreviations and acronyms actually defined or used substantively in your text is presented in **Table 6** to improve readability.

Table 6. List of abbreviations and acronyms actually defined or used substantively in the text.

Abbreviation/Acronym	Full Term
AI	Artificial Intelligence
AUC	Area Under the Curve
BP	Blood Pressure
CCM	Chronic Care Model
CDSS	Clinical Decision Support System(s)
CFIR	Consolidated Framework for Implementation Research
CHW	Community Health Worker
CKD	Chronic Kidney Disease
COVID-19	Coronavirus Disease 2019
CV	Cardiovascular
DALY	Disability-Adjusted Life Year
DBP	Diastolic Blood Pressure
DOI	Digital Object Identifier
EGM	Evidence Gap Map
EHR	Electronic Health Record
EMR	Electronic Medical Record
GDP	Gross Domestic Product
HIC	High-Income Country

ICER	Incremental Cost-Effectiveness Ratio
IoT	Internet of Things
LMIC(s)	Low- and Middle-Income Country/Countries
MACE	Major Adverse Cardiovascular Event(s)
MENA	Middle East and North Africa
MeSH	Medical Subject Headings
mHealth	Mobile Health
MI	Myocardial Infarction
NCD(s)	Non-Communicable Disease(s)
OR	Odds Ratio
PICO	Population, Intervention, Comparison, Outcome
PMID	PubMed Identifier
PRISMA-ScR	Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews
RCT(s)	Randomised Controlled Trial(s)
SBP	Systolic Blood Pressure
SCT	Social Cognitive Theory
SDG	Sustainable Development Goal
SMS	Short Message Service
SR	Systematic Review
SSA	Sub-Saharan Africa
TL;DR	Too Long; Didn't Read (summary)
WHO	World Health Organization

Declarations:

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Availability of data and materials

The dataset and the Python 3.12 script used for data analysis and visualisation are available in the figshare repository at: https://figshare.com/s/a3669d45a404910004f4.

Competing interests

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Authors' contributions

A.B.: Conceptualization, Methodology, Formal analysis, Data curation, Validation, Investigation, Visualization, Writing – original draft, review & editing, Resources, Project administration.

B.O.: Methodology, Formal analysis, Data curation, Validation, Investigation, Visualization, Writing – original draft, review & editing

R.Y.O.: Methodology, Formal analysis, Data curation, Validation, Investigation, Visualization, Writing – original draft, review & editing

G.O.F.: Conceptualization, Methodology, Formal analysis, Data curation, Validation, Investigation, Visualization, Writing – original draft, review & editing, Resources, Supervision, Project administration.

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