

## Nursing challenges and system-level barriers to hypertension management in geographically isolated and disadvantaged areas: A mixed-methods systematic review

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Responsible Editor: Ferry Efendi

Received: 2 November 2025 ◦ Revised: 12 April 2026 ◦ Accepted: 1 April 2026

### ABSTRACT

**Introduction:** Hypertension control remains critically low in geographically isolated and disadvantaged areas (GIDAs), where nurses are the primary healthcare providers. Despite growing evidence on hypertension interventions, fragmentation in recognizing barriers specific to nursing practice in GIDAs persists. This review synthesizes the nursing challenges and system-level barriers to hypertension management in GIDAs.

**Methods:** A mixed-methods systematic review following the PRISMA 2020 guidelines searched five databases (Scopus, PubMed, Web of Science, CINAHL, and ScienceDirect) from January 1, 2010, to January 31, 2025. Quality appraisal was performed using the MMAT version 2018. Thematic analysis was performed following Braun and Clarke.

**Results:** Of 2,294 records, 33 studies met the inclusion criteria. Most (78.8%) were from LMICs, predominantly South Asia (n = 10) and Sub-Saharan Africa (n = 9). Quality appraisal rated 15 studies (45.5%) as high-quality, 17 (51.5%) as moderate, and 1 (3.0%) as low. Five interrelated domains were identified: (1) geographic isolation and transport burden (27/33); (2) fragmented health systems and insurance barriers (23/33); (3) low health literacy and limited self-management (21/33); (4) culturally incongruent interventions (17/33); and (5) limited implementation and scalability (15/33). Task-shifting and nurse-led partnerships achieved systolic blood pressure reductions of 5–12 mmHg and improved medication adherence, yet they remain underutilized in GIDA settings.

**Conclusions:** Nursing practice is central to addressing hypertension inequities in GIDAs. Strengthening community-based nursing, integrating cultural adaptation, and expanding implementation research are crucial for equitable hypertension management.

**Keywords:** community nursing; geographically isolated areas; hypertension management; nursing barriers; primary health care

### Introduction

Hypertension affects more than 1.2 billion adults globally, with the highest burden concentrated in low- and middle-income countries (LMICs), where detection, treatment, and control rates remain low (Mahiroh et al., 2019). Despite decades of progress in clinical guidelines, antihypertensive pharmacotherapy, and community-based prevention, control rates have stagnated or regressed in many regions. The gap is most acute in geographically isolated and disadvantaged areas

(GIDAs), including rural, remote, mountainous, or island settings, where limited healthcare capacity, transport burden, and the absence of culturally adaptable models compound disease risk (Chow, 2013; Ojo et al., 2017; Villarino et al., 2023a). Environmental stressors, such as climate change, further constrain physical activity and health behaviors in these communities (Bernard et al., 2022; Chauvin et al., 2023).

In resource-constrained GIDAs, nurses perform screening, counseling, follow-up, and chronic disease



monitoring, frequently through task-shifting arrangements that extend hypertension care beyond physician-led facilities (Chowdhury et al., 2020; Geldsetzer et al., 2019; Jafar et al., 2020; Li et al., 2025; Vedanthan et al., 2020). Community-based studies in rural South Asia and sub-Saharan Africa indicate that nurse- and community health worker (CHW)-led models can produce clinically meaningful systolic blood pressure (SBP) reductions of 5–12 mmHg and improve adherence (Bhattarai et al., 2024; Jafar et al., 2020; Vedanthan et al., 2020). The evidence, however, is not uniform: while cluster RCTs by Jafar et al. (2020) and Bhattarai et al. (2024) demonstrate significant effects, others report modest or null findings (Vedanthan et al., 2020), and the sustainability of gains beyond trial periods remains largely unestablished (Krishnan et al., 2019). Nurses also operate within infrastructural constraints such as missing diagnostic equipment, irregular medication supply, weak referral pathways, and unsupportive institutional environments unsuited to sustained chronic-disease management (Apte et al., 2018; Dayrit et al., 2018; Legido-Quigley et al., 2019).

Beyond infrastructure, cultural and behavioral barriers are also pervasive. In remote settings, hypertension is often understood through local explanatory models rather than biomedical frames, for example, "*nasa dugo*" ("something in the blood") in the Philippines (Lasco et al., 2020), with analogous constructions documented across South Asia, Africa, and Latin America (Joo & Liu, 2021; Owolabi et al., 2017). Patients also face low health literacy, financial constraints, and transport difficulties that limit the impact of nurse-led education (Bobrow et al., 2016; Suleiman et al., 2024; Villarino et al., 2023b; Zamani-Alavijeh et al., 2019). Existing evidence on these barriers is fragmented, with qualitative studies providing rich context but limited generalizability, while cross-sectional surveys document prevalence but do not establish relative impact. Earlier reviews have addressed adherence (Abegaz et al., 2017; Burnier & Egan, 2019), home BP monitoring (Fletcher et al., 2015; Tucker et al., 2017), and lifestyle interventions (Villarino et al., 2021), but none have synthesized barriers through a nursing-practice lens in GIDA settings. Most prior syntheses are clinician-focused, conducted in urban, well-resourced contexts, and limited to single study designs, predominantly RCTs, rather than integrating mixed-methods evidence (Khetan et al., 2019; Krishnan et al., 2019; Laar et al., 2021; Li et al., 2025). Nonetheless, promising approaches, including CHW-based models in Peru (Gupta et al., 2025), nurse-led models in Australia (Chowdhury et al., 2020), and task-shifting in rural South Asia (Bhattarai et al., 2024; Jafar et al., 2020), suggest that outcomes improve when adequate resources, personnel, and supportive infrastructure are in place.

The central problem this review addresses is that, despite an extensive global evidence base on hypertension interventions, fragmentation persists in recognizing the barriers specifically experienced by the nursing workforce in GIDAs, who are often the sole frontline providers in these settings. Furthermore, this review uniquely addresses these gaps by integrating evidence through a nursing-practice and system-level lens. Its theoretical contribution lies in integrating multilevel barrier analysis (patient, provider, and system) within a nursing-centered framework; its methodological contribution is a mixed-methods design that combines quantitative effectiveness data with qualitative experiential evidence; and its contextual contribution is the focus on GIDA settings, which remain underrepresented despite carrying disproportionate disease burden. Specifically, the objectives are to (a) systematically identify and synthesize the nursing challenges and system-level barriers to hypertension management in GIDAs; (b) evaluate the evidence for nurse-led and community-based models; and (c) derive implications for nursing practice, policy, and future research.

## Materials and Methods

### Review Design and Registration

This study employed a mixed-methods systematic review design, incorporating quantitative, qualitative, and mixed-methods primary studies to comprehensively examine the nursing challenges and system-level barriers to hypertension management in GIDA settings (Hong et al., 2018). The mixed-methods approach was selected because the research question requires the integration of both measurable outcomes (e.g., blood pressure control, adherence rates) and experiential data (e.g., patient perceptions, cultural beliefs, and healthcare provider experiences) to fully capture the complexity of hypertension management in underserved settings. The review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines (Page et al., 2021) and guided by the Joanna Briggs Institute (JBI) methodology for mixed-methods systematic reviews (Lizarondo et al., 2020). Although this review was not prospectively registered in PROSPERO, all methods were pre-specified prior to data extraction, and the full protocol is available from the corresponding author, upon request.

### Operational Definition of GIDA Settings

For this review, GIDAs were operationally defined as settings meeting at least two of the following criteria: (1) official government classification as rural, remote, or geographically isolated; (2) travel time exceeding 60 min to the nearest secondary or tertiary health facility; (3) healthcare provider density below national or regional

averages; (4) high poverty incidence or socioeconomic disadvantage per national indices; and (5) island, mountainous, or otherwise physically isolated communities with limited transport infrastructure. Borderline cases were resolved through discussions between the reviewer and a research collaborator. Urban slum settings were included only when the study explicitly documented barriers equivalent to GIDA. Studies set in non-GIDA urban primary care (Bobrow et al., 2016; Morawski et al., 2018; Tan et al., 2024) were retained as comparators to illustrate the efficacy ceiling achievable when geographic and structural barriers are absent and are explicitly flagged as comparator evidence rather than core GIDA findings throughout the synthesis.

### Search Strategy

A systematic search was conducted in five electronic databases: Scopus, PubMed/MEDLINE, Web of Science Core Collection, CINAHL (via EBSCOhost), and ScienceDirect. The final search will be conducted on January 31, 2025. Database-specific search strategies were developed using MeSH terms, CINAHL headings, and free-text keywords. The complete search strings are provided in Supplementary [Appendix S1](#).

The core PubMed strategy was: ("Hypertension"[MeSH] OR "Blood Pressure"[MeSH] OR hypertens\*[tiab] OR "high blood pressure"[tiab]) AND ("Rural Health Services"[MeSH] OR "Medically Underserved Area"[MeSH] OR "Healthcare Disparities"[MeSH] OR rural[tiab] OR remote[tiab] OR "geographically isolated"[tiab] OR disadvantaged[tiab] OR underserved[tiab]) AND ("Nursing"[MeSH] OR "Community Health Nursing"[MeSH] OR "Primary Health Care"[MeSH] OR nurs\*[tiab] OR "community health worker\*" [tiab] OR "task shifting"[tiab] OR "primary care"[tiab] OR barrier\*[tiab])). Filters: English; 2010/01/01–2025/01/31; Humans.

ScienceDirect was primarily searched to capture review articles, and recently indexed primary studies from Elsevier were also included. Review articles retrieved from this database were used solely for backward citation chasing and were not included as primary evidence. Backward citation chasing was conducted by screening the reference lists of all the included studies. Forward citation tracking was performed using Google Scholar for the key articles. No hand-searching of specific journals was performed.

### Search Timeframe Justification

The search period of January 1, 2010, to January 31, 2025 (15 years) was selected to align with the modern era of hypertension management guidelines, including WHO HEARTS (2016), ACC/AHA (2017), and JNC 8 (2014), which shifted emphasis toward community-based, primary care-oriented, and task-shifting approaches, particularly relevant to GIDA settings; the increase from 2010 onward in CHW and nurse-led intervention trials in

LMICs; and the emergence of mHealth strategies for chronic disease management in underserved populations.

### Eligibility Criteria

Studies were eligible if they (1) investigated hypertension treatment in settings meeting the GIDA operational definition, (2) identified barriers relevant to nursing practice, patient, and health system issues, (3) were primary data based on quantitative, qualitative, or mixed-methods designs, and (4) were peer-reviewed and published in English-language journals.

Scoping reviews (Joo and Liu, 2021; Li et al., 2025) and cost-effectiveness analyses (Krishnan et al., 2019; Pozo-Martin et al., 2021) were retained for thematic context only and were not included in the formal evidence synthesis or MMAT-based methodological appraisal of the 29 empirical primary studies; they are clearly demarcated in the supplementary tables. The inclusion of all three design types (quantitative, qualitative, and mixed-methods) was intentional from the outset, reflecting a mixed-methods systematic review design. This approach was necessary to capture both measurable intervention outcomes and the experiential dimensions of barriers that purely quantitative reviews would miss. The exclusion criteria included editorials, conference presentations, dissertations, study protocols without reported results, and studies not directly addressing hypertension management or lacking nursing practice/system-level barrier relevance.

### Screening and Data Extraction Procedures

Screening was conducted in two phases: (a) title and abstract screening and (b) full-text review. Both phases were conducted by the author. To minimize single-reviewer bias, a random 20% sample of studies at each screening phase was cross-checked by an independent expert consultant. Disagreements or ambiguous cases were resolved through discussion until consensus was reached. Inter-rater agreement on the cross-checked sample was >90% at both phases. At the full-text screening stage, studies were excluded for the following reasons: (a) the study setting did not meet the GIDA operational definition (n = 442); (b) the study did not address hypertension management (n = 364); (c) the study lacked relevance to nursing practice or system-level barriers (n = 119); (d) the study was a protocol, editorial, conference abstract, or dissertation (n = 178); (e) the full text was unavailable (n = 31). The complete PRISMA flow diagram is presented in the succeeding results section below. Data extraction was performed by the author using a standardized extraction matrix that was pilot-tested on five studies prior to full extraction to ensure consistency and completeness. Extracted fields included: author(s), year, country/region, study design, setting, sample size, population, intervention/focus, key barriers identified, clinical outcomes (where reported), and

nursing-relevant findings. Extraction for a randomly selected subset of 10 studies was independently verified by the independent expert consultant, with discrepancies resolved through discussion. No extraction software was used; data were managed in Microsoft Excel® (Microsoft Corporation, Redmond, WA).

### Study Selection and Eligibility Audit

After duplicates were removed, studies were screened in two phases as described above. At the full-text stage, each study was assessed against all three core eligibility requirements: (a) hypertension management focus, (b) GIDA context as operationally defined, and (c) relevance to nursing practice, system-level barriers, or nursing-relevant implementation factors. An eligibility audit was conducted after initial full-text screening to verify alignment. Six studies initially included were subsequently excluded upon audit: Apte et al. (2018) focused on rotavirus vaccine barriers rather than hypertension; Gyawali et al. (2018) was a diabetes management protocol; Omboni et al. (2019) was set in Italian community pharmacies, not a GIDA setting; Patel et al. (2016) examined obesity-hypertension associations without GIDA-specific or nursing barriers; Kario et al. (2022) involved a population-based study in a non-GIDA setting; and Zhang et al. (2021) was conducted in a specialized hospital ward in Shanghai. After the eligibility audit, 33 studies satisfied the final inclusion criteria.

### Data Analysis

Themes of interest were clustered into three categories: (1) patient-level themes such as health literacy, compliance, home-monitoring availability, and cultural beliefs, (2) provider-level themes such as nursing role, availability, skill-mix, and task shifting, and (3) system-level themes such as infrastructural support, finance, referral pathways, insurance policies, supply availability, and continuity of care. Clinical outcomes (e.g., blood pressure reductions, hypertension control rates) were not treated as primary outcomes of this review; however, they were extracted as secondary contextual data to evaluate the effectiveness of interventions within included studies and to provide evidence for the impact of identified barriers on patient outcomes. Braun and Clarke's (2006) six-step approach to thematic analysis was employed to analyze the data, facilitating inductive subgrouping of barriers into themes. The five overarching thematic domains were derived through an iterative process: after initial coding of all extracted data, codes were grouped into candidate themes, which were then reviewed against the full dataset, refined through comparison across studies and settings, and finalized when thematic saturation was achieved (i.e., no new conceptual categories emerged from additional studies). The five domains represent the highest-order conceptual grouping of barriers that consistently recurred across the included evidence base.

### Quality Appraisal

Methodological quality was assessed using the MMAT version 2018 (Hong et al., 2018) MMAT-based appraisal was applied only to the 29 empirical primary studies. Consistent with MMAT guidance (Hong et al., 2018), scoping reviews and cost-effectiveness analyses were excluded from formal MMAT appraisal because the tool is designed for empirical primary research only. These special-case studies are reported separately in Supplementary [Appendix S2](#) with adapted criteria solely for transparency and were not used to derive any quality-weighted conclusions. Each study was evaluated using two screening questions and five design-specific criteria. The studies were rated as high quality (5/5 criteria), moderate (3–4/5), or low ( $\leq 2/5$ ). Quality ratings were used to contextualize the strength and weight of the evidence and the interpretive emphasis; low-quality studies were not excluded but received less weight in the interpretation. In the discussion section, the findings are interpreted with explicit reference to whether they are supported primarily by high-quality or lower-quality studies, enabling readers to assess the internal validity of each thematic conclusion. The detailed results of this quality appraisal are presented in table 1.

## Results

### Study Selection

The electronic database search yielded 2,294 records: Scopus (n = 388), PubMed (n = 1452), Web of Science (n = 59), CINAHL (n = 254), and ScienceDirect (n = 141). After removing 387 duplicates, 1907 records were screened based on their titles and abstracts. Of these, 734 were excluded, leaving 1,173 articles for the full-text review. At the full-text stage, 1134 articles were excluded. A total of 39 studies were initially included after full-text screening; however, a post-hoc eligibility audit removed six off-scope studies. The complete PRISMA flow diagram is shown in Figure 1.

### Quality Appraisal Results

Of the 33 studies, 15 (45.5%) were rated high quality, 17 (51.5%) moderate, and 1 (3.0%) low quality. Common limitations included inadequate reporting of sampling strategies, incomplete accounting for confounders, and limited reflexivity in qualitative studies. Four of the five thematic domains were supported by multiple high-quality empirical studies, while the cultural incongruence domain relied predominantly on qualitative and cross-sectional evidence and should therefore be interpreted with greater caution given the heterogeneity of the underlying evidence base (Bhattarai et al., 2024; Bobrow et al., 2016; Gamage et al., 2020; He et al., 2017; Jafar et al., 2020; Josephson et al., 2018; Khetan et al., 2019; Mini et al., 2022; Morawski et al., 2018; Neupane et al., 2018; Schwalm et al., 2019; Suseela et al.,

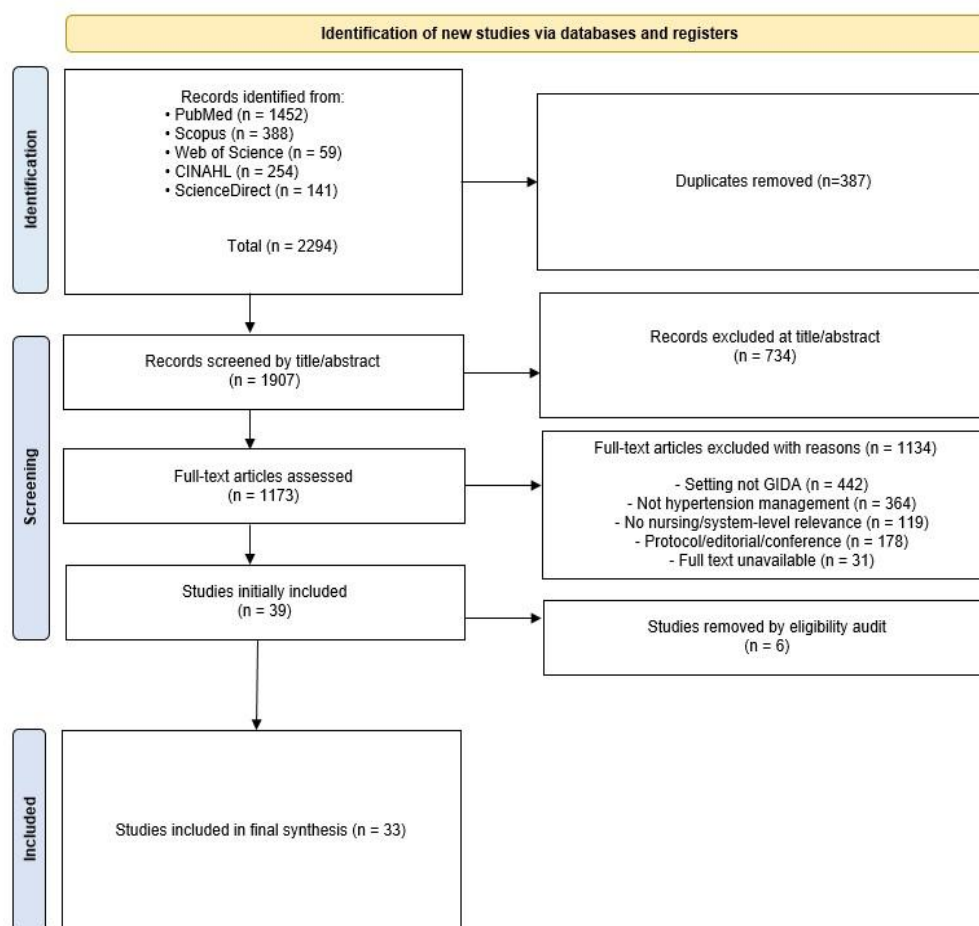


Figure 1. PRISMA Flowchart

2022; Tan et al., 2024) provided the strongest intervention evidence, supplemented by retrospective and prospective cohort analyses (Adler et al., 2019; Vedanthan et al., 2020). The qualitative studies (Lasco et al., 2020; Legido-Quigley et al., 2019) are both of high quality. Meanwhile, studies rated as low quality (Son et al., 2019) contributed to the breadth of themes but were given less weight in the interpretive conclusions. Detailed ratings are in Table 1. Additionally, the MMAT criterion-level ratings by study category are provided in Supplementary Appendix S2.

### Thematic Analysis

The five thematic domains, their derivation processes, and the relative contributions of the included studies are described below. Each domain was inductively derived through the six-step thematic analysis described in the Methods section. Not all studies contributed equally to all domains; the distribution of study contributions is summarized below and in Table 2.

#### *Domain 1: Geographic Isolation and Transport Burden (27/33 studies; most dominant domain).*

Long distances, unreliable transportation, and patient out-of-pocket expenses have led to late follow-up, irregular medication availability, and loss to follow-up, especially in rural South Asia, sub-Saharan Africa, and

island settings (Chow, 2013; Gamage et al., 2020; Legido-Quigley et al., 2019; Owolabi et al., 2017). In some studies, community members traveled for more than two hours to reach a health facility. When facilities moved to community-based or nurse-led models, significant improvements in treatment compliance and BP control were observed (Bhattarai et al., 2024; Jafar et al., 2020; Khetan et al., 2019; Villarino & Villarino, 2023). This domain was the most consistently supported across all study designs and geographic regions, with evidence from both high-quality RCTs and qualitative studies converging on the centrality of geographic access barriers to care.

#### *Domain 2: Fragmented Health Systems and Insurance Barriers (23/33 studies).*

Disintegration of healthcare systems was identified as an underlying structural barrier. Poor referrals between primary and secondary health facilities, shortages of antihypertensive medications, and inadequate insurance coverage have been identified in various LMIC settings (Dayrit et al., 2018; Pozo-Martin et al., 2021; World Health Organization, 2019). This was the second most frequently represented domain, with particularly strong evidence from multi-country qualitative studies (Legido-Quigley et al., 2019) and health system analysis.

Table 1. MMAT Quality Appraisal Summary of Included Studies (n = 33)

Study	MMAT Category & Design	Criteria Met (Y/N/CT)	Rating	Key Limitation	Domain(s)
Adler et al. (2019)	Prospective cohort	3/5 (Y/Y/N/CT/Y)	Moderate	High loss to follow-up (75% without 12-mo visit); confounders partially addressed	1, 5
Bhattarai et al. (2024)	Cluster RCT	4/5 (Y/Y/Y/N/Y)	High	Open-label (unblinded outcome assessment)	1, 5
Bobrow et al. (2016)	Single-blind RCT	5/5 (Y/Y/Y/Y/Y)	High	None noted	3, 5
Gamage et al. (2020)	Cluster RCT	4/5 (Y/Y/Y/N/Y)	High	Open-label design	1, 3, 5
Geldsetzer et al. (2019)	Cross-sectional (44 LMICs)	4/5 (Y/CT/Y/Y/Y)	Moderate	Limited GIDA-specific disaggregation	1, 2
Haughtigan et al. (2023)	Community program evaluation	2/5 (CT/Y/Y/N/CT)	Moderate	Small sample; limited confounder control; unclear fidelity	4, 3
He et al. (2017)	Cluster RCT	4/5 (Y/Y/Y/N/Y)	High	Open-label design	1, 5
Hickey et al. (2025)	Pilot RCT	4/5 (Y/Y/Y/N/Y)	High	Small pilot; open-label	1, 2, 5
Jafar et al. (2020)	Cluster RCT	4/5 (Y/Y/Y/N/Y)	High	Open-label (cluster design)	1, 5
Joo & Liu (2021)	Scoping review†	3/5 (Y/Y/Y/CT/CT)	Moderate†	Secondary analysis; coherence partially demonstrated	4
Josephson et al. (2018)	Cluster RCT	3/5 (Y/Y/CT/N/Y)	Moderate	Incomplete outcome reporting; open-label	1, 3
Khetan et al. (2019)	Cluster RCT	4/5 (Y/Y/Y/N/Y)	High	Open-label design	1, 5
Khuong et al. (2020)	Quasi-experimental (repeated measures)	4/5 (Y/Y/Y/CT/Y)	Moderate	Non-randomized; partial confounder adjustment	3, 2
Krishnan et al. (2019)	Cost-effectiveness analysis‡	4/5 (Y/Y/Y/Y/CT)	Moderate‡	Model-based; assumptions limit external validity	5
Laar et al. (2021)	Quasi-experimental (before-after)	3/5 (Y/Y/CT/N/Y)	Moderate	No true control; confounders not fully addressed	2, 5
Lamprey et al. (2017)	Cross-sectional (baseline survey)	4/5 (Y/Y/Y/CT/Y)	Moderate	Baseline data only; nonresponse partially reported	2
Lasco et al. (2020)	Qualitative (lay conceptions)	5/5 (Y/Y/Y/Y/Y)	High	None noted	4
Legido-Quigley et al. (2019)	Qualitative (semi-structured interviews)	5/5 (Y/Y/Y/Y/Y)	High	None noted	1, 2, 4
Li et al. (2025)	Scoping review†	3/5 (Y/Y/Y/CT/CT)	Moderate†	Secondary analysis; interpretive depth limited	3, 5
Mini et al. (2022)	Cluster RCT	4/5 (Y/Y/Y/N/Y)	High	Open-label; school-based sample	3, 5
Morawski et al. (2018)	RCT	5/5 (Y/Y/Y/Y/Y)	High	Urban setting (non-GIDA primary)	3
Neupane et al. (2018)	Cluster RCT	4/5 (Y/Y/Y/N/Y)	High	Open-label design	1, 5
Ojo et al. (2017)	Cross-sectional	2/5 (CT/CT/Y/CT/Y)	Moderate	Narrow geographic scope; sampling unclear; nonresponse unclear	1, 2
Owolabi et al. (2017)	Cross-sectional	4/5 (Y/Y/Y/CT/Y)	Moderate	Cross-sectional design precludes causality; nonresponse unclear	1, 3
Pakhare et al. (2021)	Prospective cohort	4/5 (Y/Y/Y/Y/CT)	Moderate	Urban slum; exposure fidelity unclear	1, 2
Pozo-Martin et al. (2021)	Cost-effectiveness analysis‡	4/5 (Y/Y/Y/Y/CT)	Moderate‡	Markov model; limited to a single setting	2, 5
Prenissl et al. (2019)	Nationally representative cross-sectional	5/5 (Y/Y/Y/Y/Y)	High	None noted	1, 2
Schwalm et al. (2019)	Cluster RCT	4/5 (Y/Y/Y/N/Y)	High	Open-label design	5
Son et al. (2019)	Community program evaluation	1/5 (CT/CT/Y/N/CT)	Low	Limited representativeness; no validated measures; confounders not addressed	3
Suleiman et al. (2024)	Cross-sectional	3/5 (Y/CT/Y/CT/Y)	Moderate	Self-report adherence measure; nonresponse unclear	3
Suseela et al. (2022)	Cluster RCT (pragmatic)	4/5 (Y/Y/Y/N/Y)	High	Open-label pragmatic trial	3, 5
Tan et al. (2024)	Cluster RCT	3/5 (Y/Y/CT/N/Y)	Moderate	Incomplete long-term data; urban primary care	3, 5
Vedanthan et al. (2020)	Retrospective analysis	3/5 (Y/Y/N/CT/Y)	Moderate	Low 12-month retention (42%); partial confounder adjustment	1, 5

**Note.** Y = Yes; N = No; CT = Cannot Tell. The criteria are category-specific per MMAT 2018: qualitative (1.1–1.5), RCT (2.1–2.5), non-randomized (3.1–3.5), and descriptive (4.1–4.5). **Domains:** 1 = geographic isolation and transport burden; 2 = fragmented health systems and insurance barriers; 3 = low health literacy and limited self-management; 4 = culturally incongruent interventions; 5 = limited implementation and scalability of nurse-led models. † Scoping reviews appraised using adapted qualitative criteria (MMAT Category 1). ‡ Cost-effectiveness analyses appraised using adapted non-randomized criteria (MMAT Category 3). The findings of these studies were given less weight in the interpretation.

### Domain 3: Low Health Literacy and Limited Self-Management (21/33 studies).

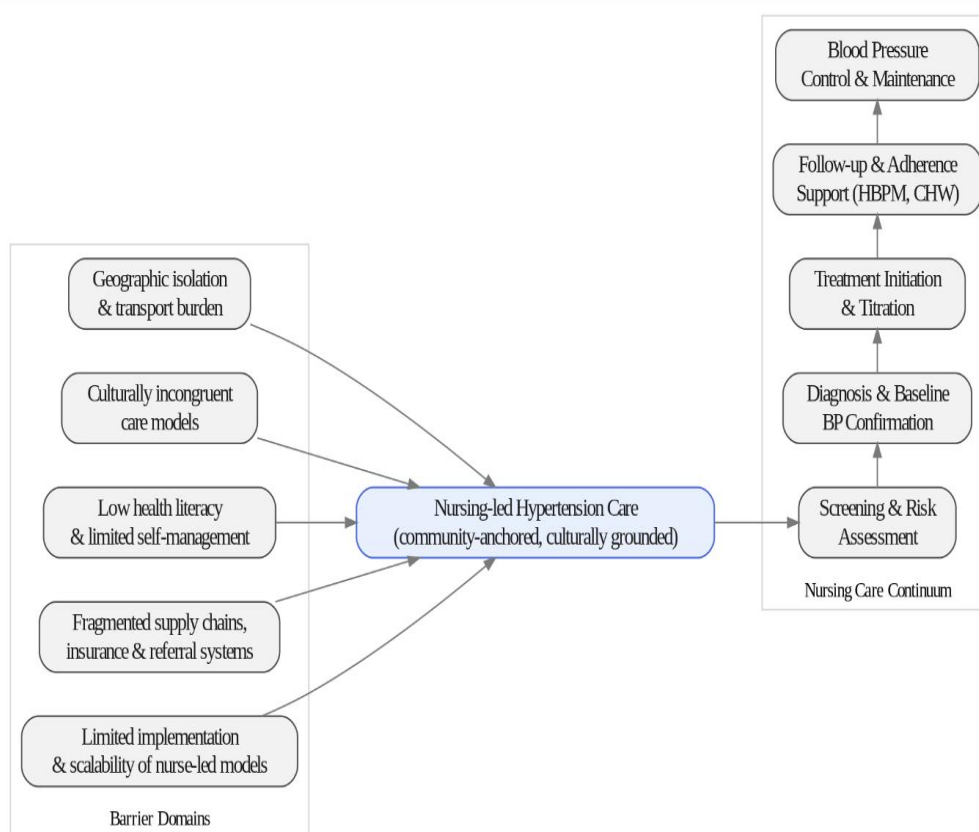
Low health literacy is compounded by the absence of culturally appropriate educational materials (Hickey et al., 2025; Khuong et al., 2020). Meanwhile, patient

rotation between facilities due to medication unavailability disrupts nurse–patient care continuity and decreases patient compliance due to insurance renewal challenges, especially among geriatric and low-income populations (Laar et al., 2021; Suleiman et al., 2024).

Table 2. Study Contribution to Thematic Domains (n = 33)

Thematic Domain	Studies(n)	% of Total	High-Quality Studies (n)	Moderate Studies (n)	Low Studies (n)	LMIC Studies	Evidence Consistency
1. Geographic isolation & transport burden	27	81.8%	12	14	1	22	Strong
2. Fragmented health systems & insurance barriers	23	69.7%	9	13	0	19	Strong
3. Low health literacy & self-management	21	63.6%	8	12	1	16	Moderate
4. Culturally incongruent interventions	17	51.5%	5	12	0	14	Variable
5. Limited implementation & scalability	15	45.5%	9	6	0	11	Strong (RCTs)

**Note.** This study could contribute to multiple domains. Evidence consistency was rated as follows: Strong = convergent findings across multiple regions and study designs; Moderate = convergent in the majority but with some regional variation; Variable = divergent findings across regions, warranting context-specific interpretation.



Note. HBPM = Home Blood Pressure Monitoring; CHW = Community Health Worker.

*Domain 4: Culturally Incongruent Interventions (17/33 studies).*

Misconstrued physiological explanations, such as hypertension being ‘transient’ or ‘stress-related’, impact compliance and the perceived need for ongoing management (Joo & Liu, 2021; Lasco et al., 2020). Up to 60% of rural hypertensive patients stop medications when symptoms resolve or turn to alternative treatments (Josephson et al., 2018; Owolabi et al., 2017; Suleiman et al., 2024). Nurses’ teaching functions are constrained by staffing shortages and a scarcity of culturally responsive materials (Haughtigan et al., 2023; Li et al., 2025; Villarino et al., 2025). This domain showed the greatest variability across regions, with stronger representation in

Philippine and South Asian studies, where ethnographic data were available.

*Domain 5: Limited Implementation and Scalability of Nurse-Led Models (15/33 studies).*

Task-shifting approaches achieved mean SBP reductions of 5–12 mmHg over 6–12 months (Chowdhury et al., 2020; Jafar et al., 2020; Schwalm et al., 2019; Ukoha-Kalu et al., 2023). These clinical outcomes were extracted as secondary contextual data to demonstrate the effectiveness of nurse-led models and highlight the gap between pilot efficacy and routine implementation. Only a minority of interventions were scaled or institutionalized into national primary care systems (Krishnan et al., 2019). Where telemonitoring or mHealth was introduced, adherence improved only when digital

literacy and infrastructure were sufficient (Bobrow et al., 2016; Morawski et al., 2018; Tan et al., 2024). This domain, while represented in fewer studies, was disproportionately supported by high-quality RCTs, lending strong internal validity to the finding that effective models exist but are rarely sustained.

Figure 2 depicts how the five barrier domains intersect with the nursing care continuum, recognizing that there is a layered, rather than linear, approach to reducing nursing practice in terms of screening, diagnosis, treatment initiation and dosage adjustment, follow-up with support in patient adherence, and achieving durable blood pressure control in GIDAs (Dayrit et al., 2018; Li et al., 2025; Pozo-Martin et al., 2021; Suleiman et al., 2024; World Health Organization, 2019).

Overall, the evidence suggests that although clinical expertise in hypertension treatment is well-defined, its implementation in GIDAs is challenged by factors beyond the capacity of frontline nursing professionals (Mills et al., 2020). Successful models shared three elements: community affiliation, culturally specific patient engagement, and institutional integration of nursing with decentralized chronic health service systems. Specifically for nursing practice, the synthesis points to five concrete implications across the care continuum: (a) community-based opportunistic screening protocols led by nurses and CHWs to overcome geographic access barriers; (b) culturally adapted patient education delivered in local languages using lay explanatory models; (c) standing nurse-initiated referral pathways to bridge primary-secondary care fragmentation; (d) structured nurse-led follow-up using home BP monitoring and SMS reminders to sustain adherence; and (e) continuity-of-care coordination through nurse case management to address medication supply gaps and insurance barriers (Joo & Liu, 2021; Villarino et al., 2021).

## Discussions

This mixed-methods systematic review highlights that the management of hypertensive disease in geographically isolated and disadvantaged areas (GIDAs) is influenced by multiple structural, cultural, and health system factors, rather than a single barrier. The five thematic domains identified, including geographic isolation, fragmented health systems, poor health literacy, culturally discordant care, and weak implementation support, interact with one another, compounding the challenges of delays in screening, diagnosis, treatment compliance, and sustained BP control. This pattern is consistent with previous studies, emphasizing that inequities in hypertension in resource-constrained settings often lie not with individual-level factors, such as high BP levels, but with 'systemic' factors embedded in place, culture, and health systems (Chow, 2013; Lacey et al., 2018; Mills et al., 2020). Importantly, geographic isolation emerged as the most robustly

supported domain (27/33 studies; strong consistency across regions and designs, supported by multiple high-quality RCTs and qualitative studies), while cultural incongruence showed the greatest variability across regions, suggesting that culturally adapted interventions require context-specific development rather than universal application.

The first important finding was that physical inaccessibility was associated with poorly controlled BP in GIDAs. Similar to previous assessments in South Asia and sub-Saharan Africa, transportation costs, facility distances, and workforce density continue to hinder BP measurements and treatment adjustments (Geldsetzer et al., 2019; Legido-Quigley et al., 2019; Ojo et al., 2017). This finding is supported by high-quality RCTs (Bhattarai et al., 2024; Jafar et al., 2020) and high-quality qualitative evidence (Lasco et al., 2020; Legido-Quigley et al., 2019), lending strong internal validity. Nursing professionals must recognize that clinical practice guidelines may not always be reconcilable with the realities of practice in GIDAs (Lampthey et al., 2017).

The second theme was that the fragmentation of health systems further limits BP control, specifically through medicine shortages, cost-sharing mechanisms, and loss of follow-up data in referrals. These results support previous evidence from the Philippines, Bangladesh, and Vietnam, where health service improvements have remained elusive despite health reforms (Dayrit et al., 2018; Khuong et al., 2020; Laar et al., 2021). Nurses in such health settings function as agents of continuity, although their contributions to health reforms, given their high efficacy in BP management, remain invisible in health architecture (Chowdhury et al., 2020; Li et al., 2025; Vedanthan et al., 2020).

Furthermore, poor health literacy appeared as the third factor, confirming previous results, which pointed out the strong correlation between medication non-adherence, poor self-monitoring, and late attendance due to poor understanding of high BP in low-income communities (Abegaz et al., 2017; Burnier & Egan, 2019; Morawski et al., 2018). Thus, there is a clear implication, especially in the nursing community, that patient education activities cannot be treated as add-ons but as central therapeutic procedures, combined with visual assistance, locally contextual metaphors, and simplified BP feedback, such as home BP monitoring (Fletcher et al., 2015; Li et al., 2025; Tucker et al., 2017).

The fourth theme accentuates the lack of culturally congruent interventions, which aligns with previous evidence showing that biomedical risk talk is ineffective in changing behaviors related to hypertension when local ideas of illness, symbolism, and supportive care practices are not considered (Lasco et al., 2020). Culturally informed nursing practice, particularly when delivered in partnership with community health workers, appears to

be more acceptable and effective in maintaining self-management practices in related studies (Joo & Liu, 2021; Kario et al., 2022). However, qualitative and cross-sectional studies primarily supported this domain, and the evidence for the effectiveness of culturally adapted interventions, specifically in GIDA hypertension management, remains limited to a small number of trials.

Finally, limited implementation research suggests that innovative nurse-led or community-based approaches are not typically scaled up. Even where studies have demonstrated success in enhancing patient compliance and lowering blood pressure, such projects have been one-off pilots lacking sustainability strategies, rather than being incorporated into primary healthcare financing mechanisms (Jafar et al., 2020; Krishnan et al., 2019; Pozo-Martin et al., 2021). Notably, this domain was disproportionately supported by high-quality RCTs, providing strong evidence that effective models exist but face systemic barriers to institutionalization. This evidence further supports the need to move away from efficacy studies and toward more practical GIDA implementation effectiveness studies (Gyawali et al., 2018).

Taken together, the findings support the interpretation that inequities in hypertension incidence in rural settings persist, not in the absence of clinical knowledge, but in disalignments between health systems' expectations and the structural realities of their lives (Pakhare et al., 2021; Prenissl et al., 2019). Here, nursing practice is envisioned not just as an implementer, but rather as an actor in the redesign of health systems (Haughtigan et al., 2023; Son et al., 2019).

Four policy priorities emerge from this review. First, GIDA health systems could formally recognize and resource nurses as primary providers of hypertension management by expanding scopes of practice, including prescriptive authority for antihypertensives where legislation permits. Second, CHW programs may be integrated into national primary healthcare financing rather than remaining dependent on external project funding. Third, culturally adapted health education materials could be co-developed with local communities rather than translated from urban, biomedically oriented sources. Fourth, supply chains for essential antihypertensive medications require dedicated attention through decentralized distribution and buffer-stock systems.

Future research priorities include (a) implementation-effectiveness studies of nurse-led hypertension models beyond pilot phases, with attention to cost-effectiveness and policy integration; (b) mixed-methods studies that embed process evaluation within RCTs to clarify why interventions succeed or fail in specific GIDA contexts; (c) comparative effectiveness research across GIDA typologies (island communities, mountainous regions, urban slums) to identify

transferable elements of successful models; and (d) longitudinal studies tracking BP control over  $\geq 5$  years following implementation to assess sustainability.

This review's strengths include a mixed-methods design that integrates quantitative effectiveness data with qualitative experiential evidence, an explicit GIDA operational definition, a post-hoc eligibility audit, an MMAT-based quality appraisal, and a nursing-centered analytical lens that addresses a recognized gap in hypertension reviews, which are dominated by clinician- or disease-outcome-focused syntheses.

Limitations are also acknowledged. First, although single-reviewer bias was mitigated by 20% independent cross-checking at each phase, full dual-reviewer screening would have further strengthened reliability. Second, the review was not prospectively registered in PROSPERO, although all methods were pre-specified. Third, the GIDA operational definition, while explicit, may not capture all forms of healthcare disadvantage. Fourth, the heterogeneity of designs (RCTs, cross-sectional, qualitative, cost-effectiveness) precluded meta-analysis; the thematic domains therefore represent associative patterns rather than established causal pathways. Fifth, the English-language restriction may have excluded relevant non-English studies, particularly from LMIC contexts. Sixth, including both LMIC and HIC GIDA-equivalent settings introduce contextual heterogeneity that may limit transferability. Seventh, publication bias likely affects the implementation domain, where failed scale-ups are underrepresented. Finally, secondary clinical-outcome data should not be interpreted as definitive evidence of efficacy.

## Conclusion

This mixed-methods systematic review indicates that uncontrolled hypertension in geographically isolated and disadvantaged areas (GIDAs) is driven less by gaps in clinical knowledge than by the convergence of geographic, structural, cultural, and literacy-related barriers, with system-level constraints explicitly geographic isolation (27/33 studies) and health-system fragmentation (23/33) which consistently dominating patient-level factors; even where patient-level barriers were prominent, they were typically mediated by structural determinants, as low health literacy was compounded by the absence of culturally adapted materials and non-adherence was amplified by supply-chain failures, while community-based, nurse-led, and CHW-supported interventions that addressed these structural barriers consistently improved BP outcomes (5–12 mmHg SBP reductions) as compared with the more modest effects of patient education alone, indicating that closing hypertension inequities in GIDAs requires positioning nurses as primary actors across screening, education, referral, follow-up, and continuity-of-care, supported by culturally responsive education,

decentralized medication distribution, accessible self-monitoring, and rigorous implementation research to sustain these models beyond pilot phases.

## Acknowledgments

The author would like to thank the support from the Séjours Scientifiques de Haut Niveau (SSHN) research mobility grant from Campus France and the Embassy of France to the Philippines.

## Declaration Of Generative Artificial Intelligence (AI) Use

The article was written independently by the author. The author states did not use any artificial intelligence tools.

## Funding source

No external funding was received for this study, and no sponsor had any role in the design, analysis, interpretation, or decision to publish the manuscript.

## Availability of data and materials

All data used in this review were derived from previously published sources. No new datasets were generated or collected in this study. Full search strings, article selections, and extracted data matrices are available from the authors upon reasonable request.

## Authors' contributions

The author solely conceptualized the study, designed the search strategy, screened and analyzed the literature, interpreted the findings, drafted and revised the manuscript, and approved the final version for publication.

## Declaration of Interest

The authors declare no conflicts of interest, financial or otherwise, related to the publication of this manuscript.

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**How to cite this article:** Villarino, R. T. (2026) 'Nursing Challenges and System-Level Barriers to Hypertension Management in Geographically Isolated and Disadvantaged Areas: A Mixed-Methods Systematic Review', *Jurnal Ners*, 21(2), pp. 267–277. doi: <http://dx.doi.org/10.20473/jn.v21i2.81249>