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# Universal Health Coverage and Geographical Barriers in Island and Remote Settings: A PRISMA-Guided Systematic Review (2010–2025)

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**ABSTRACT**

*Distance and travel time remain major barriers to healthcare use in island/remote settings despite financial protection under UHC/NHI; evidence from Indonesia's JKN and small island nations shows financial coverage does not guarantee equitable spatial access or service readiness (Fanda et al., 2024; Banks et al., 2022). To map (i) reported associations between distance/travel time/remoteness and utilization; (ii) supply-side readiness indicators under UHC/NHI; and (iii) documented mitigation strategies (transport, telehealth, workforce). Following PRISMA 2020, we searched Scopus, PubMed, ScienceDirect, and Oxford Academic (2010–2025) for observational and qualitative studies in English/Indonesian linking geographical access to utilization within UHC/NHI. Quality was appraised using QualSyst and NHMRC; "poor" studies were excluded. Given heterogeneity of exposure/outcome measures, we conducted no meta-analysis or narrative synthesis; findings are presented as study-level characteristics and effect-direction indications (↑/↓/0). Twenty-two studies met inclusion. Most reported inverse associations between distance/travel time (and inter-island fragmentation) and utilization, with uneven readiness in peripheral areas (Fanda et al., 2024; Nundoochan, 2020). Spatial analyses showed consistent distance–decay effects (e.g., older adults beyond primary-care catchments in rural Java) and limited proportions of Pacific populations within two hours of surgical care (Bratanegara et al., 2025; Cooper et al., 2016). Transport barriers and indirect costs persisted despite coverage (Banks et al., 2022). Several reports described mitigation such as VSAT-enabled telehealth and referral-transport arrangements (Borgelt et al., 2022; Cooper et al., 2016). Financial coverage coexists with spatial barriers. Heterogeneous definitions/metrics preclude pooled or narrative conclusions. Standardized travel-time thresholds, readiness indicators, and adjusted estimates are needed to assess whether geography-aware interventions—transport infrastructure, regionalization, telehealth—improve utilization (Fanda et al., 2024; Cooper et al., 2016; Borgelt et al., 2022).*

## 1. INTRODUCTION

Universal Health Coverage (UHC) aims to ensure that all individuals can access the health services they need without financial hardship. Yet, in archipelagic and remote settings, this ambition faces what researchers term the *"geography penalty"*—the enduring disadvantage shaped by distance, travel time, island separation, and terrain. Empirical evidence indicates that while UHC schemes mitigate financial barriers, they do not necessarily remove spatial or logistical obstacles to care, particularly for complex or recurrent services (Cooper et al., 2016; Cheikh Hassan et al., 2020; Banks et al., 2022). Indonesia exemplifies this paradox. As the world's largest archipelagic state and a leading UHC implementer through the *Jaminan Kesehatan Nasional* (JKN) scheme, it has achieved

major progress in service expansion and financial protection. Nonetheless, national assessments continue to reveal spatial disparities in facility readiness and medicine availability.

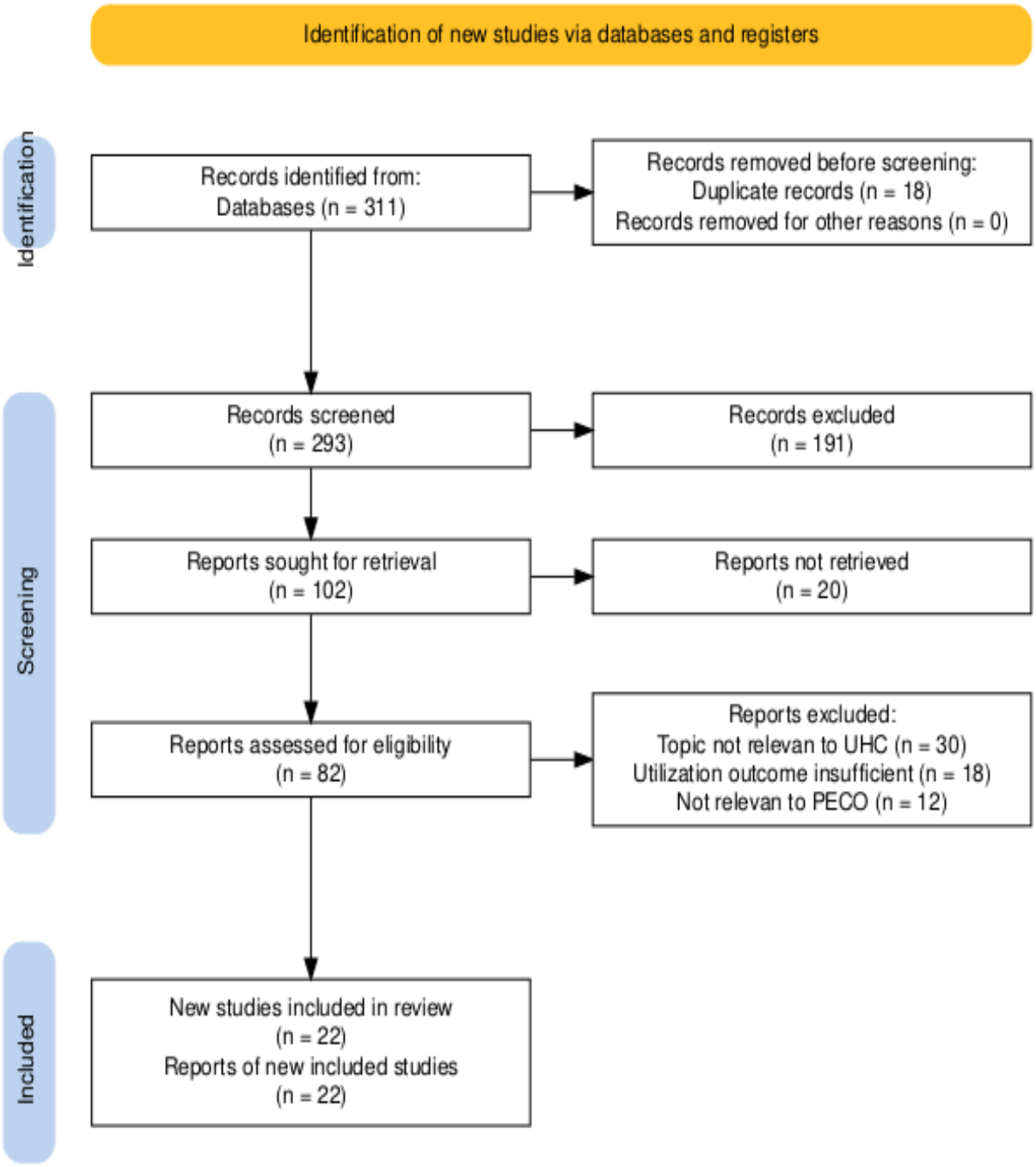
The median availability of 17 priority medicines in primary care reached 82%, whereas the mean availability across 60 essential medicines was only 58%, with deficits concentrated in more remote eastern provinces (Fanda et al., 2024). Districts with alternative dispensing points such as pharmacies or hospitals exhibited better availability, while those with larger shares of subsidized members showed lower stocks—illustrating that financial inclusion alone cannot offset logistical limitations in peripheral areas (Fanda et al., 2024). Decentralization reforms have expanded infrastructure but simultaneously widened inter-district disparities in managerial and fiscal capacity (Rintani & Wibowo, 2019). Similar patterns appear across other island and remote systems. In the Pacific, fewer than half of residents live within two hours of a surgery-capable facility, making timely access dependent on maritime and air evacuation systems (Cooper et al., 2016). Among remote Australian patients receiving renal replacement therapy, the hazard of relocation was 3.5 times higher than among urban residents, underscoring geography's role in shaping treatment possibilities even under universal coverage (Cheikh Hassan et al., 2020).

In the Maldives, adults with disabilities continued to report distance and transportation as major barriers despite full coverage under the Aasandha scheme (Banks et al., 2022). Geography determines not only where people live but also whether—and how—they can reach care. A geospatial analysis in Indonesia's Tasikmalaya district found that many older adults reside beyond functional catchment areas, particularly in upland subdistricts with limited road connectivity (Bratanegara et al., 2025). System-level innovations have sought to bridge this distance. In Tuvalu, Very Small Aperture Terminal (VSAT) telecommunication networks enabled remote consultations, continuing education, and tele-supervision, reducing unnecessary referrals when technical maintenance remained stable (Borgelt et al., 2022). Efficiency analyses from Mauritius estimated fiscal space of approximately 9% of total government health expenditure, suggesting that reallocating these gains toward primary-care readiness could transform financial protection into tangible access (Nundoochan, 2020). Conceptually, access represents a multidimensional continuum shaped by availability and readiness, geographical accessibility, affordability, acceptability, and spatial equity in governance. This review adopts that framework to examine how UHC and analogous national insurance schemes influence access across island and remote contexts. Yet, the evidence base remains fragmented: while financial protection and facility readiness have been widely examined, spatial dimensions—such as distance, travel time, and access indices—have seldom been integrated with utilization outcomes in a systematic manner. Accordingly, this review aims to map and critically appraise the available empirical evidence on how UHC implementation interacts with geographical barriers in island and remote settings, without performing narrative or quantitative synthesis.

## 2. METHOD

*Design and Reporting Framework*

This systematic review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement. All stages—from article identification to results presentation—were performed to ensure transparency, reproducibility, and methodological rigor. The selection process is illustrated in the PRISMA flow diagram (Figure 1).




*Search Strategy*

A comprehensive literature search was conducted in *Scopus*, *PubMed*, *ScienceDirect*, and *Oxford Academic* between 20 and 28 October 2025. Search strings combined free-text keywords and controlled vocabulary structured according to the PECO framework. The *Population* component included general populations in countries implementing or transitioning toward UHC/NHI schemes. *Exposure* terms captured geographical barriers such as distance, travel time, transport access, topography, and spatial accessibility indices. The *Comparator* referred to reference groups with shorter or easier access, whereas the *Outcome* comprised measures of healthcare utilization at primary or secondary care levels. Database-specific search strategies and yields are summarized in Table 1, while the overall selection process is illustrated in Figure 1. Reference lists of all included studies were manually screened to identify additional relevant publications.

**Table 1.**

| Database | Search Date | Search Framework / String | Articles Retrieved | Non-Original Excluded | Full Text Accessible | Articles Excluded |
|---|---|---|---|---|---|---|
| Scopus | 20 Oct 2025 | "JKN" OR "Jaminan Kesehatan Nasional" OR "health insurance" OR "universal health coverage") AND ("UHC" OR "universal coverage" OR "health access" OR "health equity") AND ("healthcare" OR "health services" OR "medical care" OR "health system") AND ("island" OR "archipelago" OR "remote" OR "coastal") AND ("population" OR "community" OR "demographics" OR "society") AND ("impact" OR "effect" OR "influence" OR "outcome") | 114 | 4 | 48 | 40 |
| PubMed | 25 Oct 2025 | ("JKN" OR "UHC" OR "universal health coverage" OR "healthcare access") AND ("geographical barriers" OR "accessibility" OR "location" OR "distance") AND ("island" OR "archipelago" OR "remote" OR "coastal") AND ("healthcare" OR "health services" OR "medical services" | 60 | 16 | 44 | 38 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | OR "health systems") AND ("impact" OR "effect" OR "influence" OR "outcome") | | | | |
| ScienceDirect | 27 Oct 2025 | JKN/UHC, geographical barriers, island/archipelago, access | 125 | 43 | 41 | 39 |
| Oxford Academic | 28 Oct 2025 | ("universal health coverage" OR "UHC" OR "health access" OR "health equity") AND ("geographical barriers" OR "accessibility" OR "location" OR "distance") AND ("island" OR "remote" OR "rural" OR "isolated") AND ("healthcare" OR "health services" OR "medical services" OR "health systems") | 12 | 3 | 8 | 2 |

In total, 311 articles were identified from all databases. After removing 18 duplicates, 293 records were screened by title and abstract. A total of 191 articles were excluded for not meeting inclusion criteria.Two independent reviewers conducted the screening of titles, abstracts, and full texts. Discrepancies were resolved by discussion to reach consensus. Among 102 full-text articles assessed for eligibility, 80 were excluded for the following reasons (Table 2).

**Table 2.**

| **Reason for Exclusion** | **Number of Articles** |
|---|---|
| Topic not relevan to UHC | 30 |
| Utilization outcome insuficcient | 18 |
| Not relevan to PECO | 12 |

As a result, 22 studies fulfilled all inclusion criteria and were included in the final synthesis. The PRISMA flow diagram summarizing this process is presented in Figure 1.

*Eligibility Criteria*

Eligibility criteria were pre-specified using the PECO framework. Studies were eligible if published between 2010 and 2025, conducted in settings implementing or transitioning toward Universal Health Coverage or National Health Insurance, and examined geographical or spatial barriers—such as distance, travel time, remoteness, transport availability, topography, or spatial accessibility indices—in relation to healthcare access or utilization at primary or secondary care levels. Observational, quasi-experimental, and qualitative designs were considered. Editorials,

commentaries, and case reports were excluded. Only peer-reviewed full-text journal articles in English or Indonesian were included, while grey literature, conference proceedings, and unpublished reports were not considered. Information sources comprised four bibliographic databases selected for coverage and indexing consistency in health systems research: Scopus, PubMed, ScienceDirect, and Oxford Academic. The search window ran from 20 to 28 October 2025. Search strategies combined controlled vocabulary and free-text terms structured according to the PECO logic, pairing UHC/NHI and access terms with geographical exposure terms and utilization outcomes. Database-specific strategies and yields are summarized in Table 1. To increase completeness, we also screened the reference lists of all included studies and traced forward citations where relevant.

*Study Selection*

Study selection followed PRISMA 2020 guidance. Records retrieved from all databases were merged and de-duplicated prior to screening. Two reviewers independently assessed titles and abstracts against the eligibility criteria, followed by full-text review for potentially relevant articles. Disagreements were resolved through discussion until consensus was reached. Of 311 records identified, 18 duplicates were removed, leaving 293 records for screening. After full-text assessment of 102 articles, 22 studies met all inclusion criteria. The selection process is depicted in Figure 1, and reasons for exclusion at the full-text stage are provided in Table 2.

*Data extraction*

Data extraction was undertaken independently by two reviewers using a standardized template derived from the PECO framework. Extracted variables included bibliographic details, country and setting, study design, population characteristics, operationalization of geographical exposure, outcome definitions, analytic approach, principal findings with adjusted estimates where available, and indices of study quality. Discrepancies in extracted items were reconciled by consensus, and the final dataset was curated for completeness and internal consistency.

*Quality Appraisal*

Methodological quality was appraised using the QualSyst instrument and the National Health and Medical Research Council hierarchy of evidence. Each study received a QualSyst score that informed classification as strong, good, fair, or poor. Studies rated poor were excluded from the final synthesis to preserve interpretive rigor. Quality ratings are reported alongside study characteristics in the summary tables 3.

**Tabel 3. Level of evidence and methodological quality ratings for the 22 included studies,**

| Author (Year) | Country/Setting | Design | NHMRC Level | QualSyst Rating |
|---|---|---|---|---|
| Ramadhan, 2021 | Indonesia | Cross-sectional + Propensity Score Matching (PSM) | IV (cross-sectional/analytic) | Good (60–79%) |
| Putri et al., 2025 | Indonesia (Papua Region) | Cross-sectional; GIS mapping for disparities | IV (cross-sectional/analytic) | Good (60–79%) |
| Darmawan et al., 2025 | Indonesia | Observasional potong lintang (analisis episode rawat inap) | IV (cross-sectional/analytic) | Good (60–79%) |

| | | | | |
|---|---|---|---|---|
| Soewondo et al., 2019 | Indonesia (Bengkulu, NTT, South Sulawesi) | Kualitatif deskriptif (facility survey & in-depth interview) | N/A (qualitative) | Good (60–79%) |
| Rahmah et al., 2025 | Indonesia (Makassar—Sangkarrang Islands: Barrang Caddi, Kodingareng, Barrang Lompo) | Observasional; Structural Equation Modeling (SmartPLS) | IV (observational/analytic) | Fair (50–59%) |
| Panganiban et al., 2024 | Philippines (NCR—urban; Bataan—rural; Sorsogon—remote) | Uncontrolled before–after (pre–post) primary care interventions | IV (observational/analytic) | Fair (50–59%) |
| Ayas et al., 2020 | United Arab Emirates (Sharjah) | Cross-sectional (DHS); multilevel logistic regression (3-level) with survey weights | IV (cross-sectional/analytic) | Good (60–79%) |
| Seidu et al., 2021 | Papua New Guinea (national DHS 2016–2018)) | Kualitatif (Participatory Action Research; manifest content analysis) | N/A (qualitative) | Good (60–79%) |
| Auld et al., 2023 | Australia (Queensland) | Retrospective cohort with GIS mapping of residence→care levels | III-2 (comparative cohort/registry) | Strong (≥80%) |
| Bratanegara et al., 2025 | Indonesia (Tasikmalaya, West Java) | Mixed methods; cross-sectional with GIS accessibility & spatial statistics | IV (cross-sectional/analytic) | Good (60–79%) |
| Blanchet et al., 2012 | Ghana (Accra Metropolitan Area) | Cross-sectional dengan | IV (cross-sectional/analytic) | Good (60–79%) |

| | | | | |
|---|---|---|---|---|
| | | Propensity Score Matching (PSM) | | |
| Nundoochan, 2020 | Mauritius | Stochastic Frontier Analysis (Cobb–Douglas, Translog, Multi-output distance) | IV (analytic modelling) | Good (60–79%) |
| Cheikh Hassan et al., 2020 | Australia | Retrospective cohort; Cox PH + Fine–Gray competing risks | III-2 (comparative cohort/registry) | Strong (≥80%) |
| Panko et al., 2023 | United States | Kualitatif; thematic analysis (Dedoose v8.3.35) | N/A (qualitative) | Good (60–79%) |
| Banks et al., 2022 | Maldives | Nested case–control within population survey; multivariat regresi | IV (observational/analytic) | Fair (50–59%) |
| Panday et al., 2024 | Nepal (Dhading—hill; Sarlahi—Terai) | Kualitatif (thematic analysis; Franco et al. motivation framework) | N/A (qualitative) | Good (60–79%) |
| Fanda et al., 2024 | Indonesia (national, 514 districts) | Survei fasilitas nasional (cross-sectional) dengan regresi linier multivariat | IV (cross-sectional/analytic) | Good (60–79%) |
| Borgelt et al., 2022 | Tuvalu | Kualitatif (semi-terstruktur; thematic analysis, general inductive approach) | N/A (qualitative) | Good (60–79%) |
| Abiiro et al., 2014 | Malawi (rural communities) | Qualitative cross-sectional: 12 FGDs + 8 key-informant | N/A (qualitative) | Good (60–79%) |

| | | | | |
|---|---|---|---|---|
| | | interviews; thematic analysis | | |
| Ihantamalala et al., 2020 | Madagascar (Ifanadiana District) | Analytical geospatial modelling: OSM participatory mapping, GPS-calibrated travel-time model, OSRM routing, remote sensing, R Shiny tool | IV (analytic modelling) | Good (60–79%) |
| Garchitorena et al., 2021 | Madagascar (Ifanadiana District, rural) | Quasi-experimental observational study: interrupted time-series with concurrent control; GLMM; GIS-calibrated travel distance/time | III-2 (comparative with concurrent controls) | Strong (≥80%) |
| Suzana et al., 2018 | Small Island Developing States (14 SIDS; incl. Maldives, Tuvalu) | Ecological multi-country panel (2003–2013) of IMF/WB/WHO indicators + policy document review | IV (observational/analytic) | Good (60–79%) |

*Data Synthesis*

Given the heterogeneity of designs, exposure metrics, and outcome measures across the included literature, neither meta-analysis nor narrative synthesis was performed. Findings are presented through structured tabulation of study-level characteristics and effect-direction indications—upward, downward, or null—derived from adjusted analyses when available. This presentation emphasizes comparability and transparency without pooling quantitative estimates or inferring causal effects across disparate contexts

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## 3. RESULT AND DISCUSSION

*Study characteristics*

Twenty-two studies met the inclusion criteria following comprehensive screening. Most were observational or qualitative and were conducted in island and remote contexts across the Asia–Pacific and Indian Ocean regions. Publication years spanned 2010–2025. Quality appraisal placed the

majority of studies in the good-to-strong range; low-quality studies were excluded. Summary tables report study characteristics, geographical settings, and effect-direction indications for each study.

*Geographical Barriers and Gaps in Achieving Universal Health Coverage in Remote*

Supply-side readiness improved under national health insurance schemes but remained spatially uneven. In Indonesia's JKN-linked primary care, nationwide surveys showed that while the median availability of 17 priority medicines reached 82%, the mean availability across 60 essential items was only 58%, with the lowest levels in the eastern provinces (Fanda et al., 2024). Similar disparities were observed in Mauritius, where average hospital efficiency (0.83–0.89) implied untapped fiscal space of approximately 9% of government health expenditure—resources that could be reinvested into peripheral readiness (Nundoochan, 2020). These findings confirm that financial protection alone does not secure last-mile access without addressing logistics, workforce, and supply-chain governance.

*Extreme Distance and the Geography of Morbidity*

Geographical barriers often translate into what may be termed geographic morbidity—where time, distance, and terrain shape health outcomes. In Madagascar, more than three-quarters of the population live beyond one hour's walk from a primary health facility (Ihantamalala et al., 2020). In Queensland, Australia, patients requiring specialized pediatric cardiology faced median travel distances of 953 km, or roughly ten hours by road (Auld et al., 2023). Elevation and terrain exacerbate vulnerability: in Tasikmalaya, Indonesia, every 100-meter increase in altitude corresponded to a 0.3-point decline in older adults' Activities of Daily Living (Bratanegara et al., 2025). Where travel becomes prohibitive, relocation becomes a coping mechanism; renal replacement therapy patients in very remote Australia had a relocation incidence of 48.8 per 100 patient-years (Cheikh Hassan et al., 2020). Together, these studies illustrate that physical distance is not merely a spatial variable but a determinant of morbidity, mortality, and social displacement

*Socioeconomic Inequality and Quality Gaps*

Geographical disadvantage intersects destructively with socioeconomic inequality. In Indonesia, members of the poorest JKN subsidy group (PBI-APBN) had significantly lower odds of receiving specialist cardiac care and higher mortality risks despite insurance coverage (Darmawan et al., 2025). This pattern aligns with the Inverse Equity Hypothesis, whereby system interventions yield early gains among urban and affluent populations while remote communities experience delayed benefits. Quality gaps further compound inequity. Facility surveys recorded stock-outs of essential medicines (38% of items missing) in remote areas, often due to logistical disincentives among suppliers. Human-resource maldistribution mirrors this pattern: physicians, pharmacists, and specialists remain concentrated in urban centers. In Nepal, Female Community Health Volunteers walked up to six hours to facilities and financed their own outreach activities, highlighting the fragility of volunteer-dependent primary-care models (Panday et al., 2024)

*Acceptability, Communication, and Cultural Access*

Beyond geography, communication and cultural responsiveness shape real access. Among American Sign Language users in the United States, lack of qualified on-site interpreters led to deferred or avoided perinatal care (Panko et al., 2023). Similarly, in rural and island communities, sociocultural perceptions and stigma toward illness and disability restrict care-seeking even when financial coverage is universal (Putri et al., 2025). True universality thus demands not only coverage and supply but communicative accessibility and inclusive governance.

*Innovation and Health-System Mitigation Strategies*

Innovation and system redesign emerged as key levers for bridging spatial inequities. In Tuvalu, VSAT-based satellite communication enabled teleconsultation, continuous medical education, and remote supervision, reportedly reducing unnecessary referrals (Borgelt et al., 2022).

In Sharjah, United Arab Emirates, tele-audiology and mobile outreach sustained continuity of care for children with cochlear implants during pandemic restrictions (Ayas et al., 2020). In Queensland, shared-care models between tertiary hospitals and local general practitioners reduced travel burden and enhanced service continuity (Auld et al., 2023). In contrast, centralized disability services in the Maldives illustrate the limitations of overcentralization, reinforcing the need for decentralization and regional equity

*Spatial Equity and Governance*

Governance determines how UHC translates into geographic fairness. In Indonesia, decentralization expanded infrastructure but widened inter-district disparities due to uneven fiscal and managerial capacity (Rintani & Wibowo, 2019). Mapping analyses confirmed systematic gradients in medicine availability, with provinces farther from the center consistently disadvantaged (Fanda et al., 2024). These findings echo regional experiences where spatially neutral financing models reproduce inequality, emphasizing the necessity of explicit geography-sensitive policy frameworks.

*Towards Geography-Responsive UHC*

Collectively, evidence from 22 studies yields three overarching insights. First, UHC financing expands coverage but not equity—distance, terrain, and dispersion remain binding constraints that translate into unequal outcomes. Second, readiness and quality, not merely affordability, define the real frontier of UHC in remote geographies; without strong logistics, human resources, and supply systems, financial protection remains nominal. Third, integrated, multi-level innovations—including digital connectivity, telehealth, transport networks, and decentralized service delivery—offer feasible pathways to bridge distance sustainably. Achieving geography-responsive UHC therefore requires embedding spatial intelligence into health-system design. Equity cannot be measured only by enrolment or utilization rates but by whether people can reach and meaningfully use services without relocation or hardship. When financing, governance, and geography align, UHC becomes not only a right on paper but an attainable, lived reality. The detailed synthesis of evidence and study characteristics supporting these conclusions is presented in Table 4.

**Table 4. Summary of Evidence from Twenty-Two Studies on Geographical Barriers and Universal Health Coverage (UHC) in Remote and Island Settings**

| No | Author/ Year | Study Type | Location | Main Geographical Barriers | Main Non-Geographical Barriers / | Impact of UHC or Related Interventions / |
|---|---|---|---|---|---|---|
| 1 | Abiiro et al. (2014) | Qualitative cross-sectional | Rural Malawi | Distance and poor transport; uneven facility distribution. | Cost barriers (private care, transport); supply shortages; provider attitudes. | EHP failed to remove access and financial barriers due to weak public supply. |
| 2 | Putri et al. (2025) | Quantitative cross-sectional | Papua, Indonesia | Rural residence (AOR 3.83 lower odds); difficult geography. | Low education; marital status; wealth status (missing middle). | NHI (JKN/PHI) insufficient to overcome socio-cultural and spatial barriers. |

| | | | | | | |
|---|---|---|---|---|---|---|
| 3 | Garchitorena et al. (2021) | Interrupted time-series | Rural Madagascar | Distance/time to PHC (75% >1h travel). | Focus on geographic effects post user-fee removal. | Facility-based interventions widened gap; community health mitigated distance decay in <5 children. |
| 4 | Soewondo et al. (2019) | Qualitative descriptive | Remote Indonesia (DTPK) | Poor roads; river/valley crossings; mean travel 99 min. | Staff shortage; short opening hours. | Public funds increased but under-allocated for facility repair. |
| 5 | Panganiban et al. (2024) | Uncontrolled before–after | Philippines (urban–rural–remote) | Remote mountainous areas; poor transport connectivity. | Low baseline resources; unstable internet connectivity. | Primary care improvements highest in urban, lowest in remote (Inverse Equity Hypothesis). |
| 6 | Ramadhan (2021) | Cross-sectional (PSM) | Indonesia (national) | Not directly measured (unobservable variable). | SES, health status, contraception use. | JKN significantly increased formal care access, greater in rural areas. |
| 7 | Rahmah et al. (2025) | SEM observational | Makassar islands, Indonesia | Distance to PHC (weak, non-significant effect on hypertension). | Medication adherence; physical activity; indirect cost. | JKN had weak/non-significant impact on hypertension control. |
| 8 | Darmawan et al. (2025) | Claims analysis | Indonesia (national) | Urban/rural and regional disparities. | Membership type, age, hospital ownership/class. | Poorer PBI had lower odds for specialist care and higher mortality risk. |
| 9 | Blanchet et al. (2012) | Cross-sectional (PSM) | Accra, Ghana | Not emphasized (urban study). | User fees (‘cash and carry’) as main barrier. | NHIS increased formal care use (83% higher inpatient probability). |
| 10 | Suzana et al. (2018) | Mixed cross-country | 14 Small Island Developing States (SIDS) | Island isolation; lack of economies of scale. | Infrastructure and health workforce shortages. | Publicly funded medical travel improved specialist access. |

| | | | | | | |
|---|---|---|---|---|---|---|
| 11 | Auld et al. (2023) | Retrospective GIS cohort | Queensland, Australia | Long travel distance (median 953 km to tertiary care). | Not highlighted. | Support for shared-care models outside metro areas reduces cost/travel burden. |
| 12 | Nundoochan (2020) | Efficiency analysis (SFA) | Mauritius | Not emphasized. | Technical inefficiency (11–15.9% waste); fiscal limits. | Hospital efficiency gains could create ~9% additional fiscal space. |
| 13 | Cheikh Hassan et al. (2020) | Retrospective cohort | Australia | Very remote residence; relocation risk 3.5x higher. | Ethnicity (ATSI); dialysis modality. | Geographical relocation key adaptation to service inaccessibility. |
| 14 | Bratanegara et al. (2025) | Mixed (GIS + survey) | Tasikmalaya, Indonesia | Elevation and poor roads; long distance (median 4.35 km). | Socioeconomic complexity; reliance on kinship; irregular visits. | Proximity not consistently predicting functional health. |
| 15 | Ayas et al. (2020) | Cross-sectional | Sharjah, UAE | Movement restriction during COVID-19. | Device malfunction; difficulty scheduling CI mapping. | Tele-audiology and mobile services proposed as innovative solutions. |
| 16 | Panko et al. (2023) | Qualitative thematic | United States | Long distance to culturally competent providers. | Communication inaccessibility; poor interpreter quality; limited health information. | Consistent on-site ASL interpreters improved patient experiences. |
| 17 | Borgelt et al. (2022) | Qualitative (inductive) | Tuvalu (SIDS) | Remote geography; weak infrastructure. | HR shortage; high overseas referral cost; limited IT skills. | VSAT telehealth reduced referrals and improved remote decision support. |
| 18 | Banks et al. (2022) | Case-control | Maldives | Service centralization in Malé; inter-island travel required. | Disability; travel cost (OR 2–3.7x higher); episodic expenses. | Aasandha improved coverage but failed to remove spatial/episodic barriers. |

| | | | | | | |
|---|---|---|---|---|---|---|
| 19 | Fanda et al. (2024) | Facility survey | Indonesia (514 districts) | Lowest readiness in eastern provinces; rural distance to outlets. | Supply gaps (38% stockout); low-income districts underperform. | Priority medicines (17 items) available at 82%; overall essential 58%. |
| 20 | Panday et al. (2024) | Qualitative | Rural Nepal (Hill & Terai) | 5-hour walking distance to nearest facility. | Volunteer FCHV burden; lack of compensation/support. | Volunteer model essential but weakened by poor incentives. |
| 21 | Ihantamalala et al. (2020) | Geospatial & mapping | Ifanadiana, Madagascar | Poor path data; steep terrain; >75% >1h from PHC. | Not highlighted (method focus). | GIS/crowdsourcing produced accurate access estimates for PHC policy. |
| 22 | Seidu et al. (2021) | Multilevel logistic (DHS) | Papua New Guinea (national) | Rural residence (1.87x); far distance (4.1x higher odds). | Wealth, education, health insurance, autonomy. | Insurance reduced financial difficulty; education and wealth reduce barriers. |

This systematic review demonstrates that the expansion of financial protection through Universal Health Coverage (UHC) and National Health Insurance (NHI) schemes broadens formal access entitlements but does not automatically neutralize the geography penalty. Distance, travel time, inter-island separation, and rugged terrain remain structural determinants that suppress effective access, particularly for services requiring complex or recurrent contact. The synthesis of twenty-two studies confirms that supply-side readiness in peripheral and island settings—spanning medicine availability, workforce distribution, and referral capacity—constitutes the primary constraint explaining why financial coverage alone cannot ensure timely utilization of health services (Fanda et al., 2024; Cooper et al., 2016). Findings from the availability and readiness domain underscore the importance of geographically sensitive logistics and supply-chain governance. In Indonesia, a national facility survey linked to JKN found a median availability of 17 priority medicines at 82 percent but an average of only 58 percent across 60 essential items, with pronounced deficits in remote eastern provinces.

Districts with access to alternative dispensing points reported higher availability, whereas those with larger subsidized membership shares experienced recurrent stockouts—signaling that financing protection, without logistics reform, can expose last-mile fragility (Fanda et al., 2024). In the Pacific islands, the two-hour benchmark for surgical access remains unattainable for most residents, highlighting the need for transport planning and regionalized service models alongside financial equity (Cooper et al., 2016). Evidence from Mauritius suggests that technical efficiency gains within public hospitals could create fiscal space equivalent to roughly nine percent of government health expenditure, potentially redeployable to strengthen primary-care readiness (Nundoochan, 2020). Across the geographical-access domain, consistent distance–decay gradients were evident. In Indonesia's Tasikmalaya district, GIS analysis showed that many older adults live

beyond functional primary-care catchments, especially in hilly regions with limited road connectivity (Bratanegara et al., 2025).

In Australia's renal replacement therapy registry, patients in very remote areas were 3.5 times more likely to relocate than urban patients, illustrating how remoteness transforms into residential displacement (Cheikh Hassan et al., 2020). In the Maldives, adults with disabilities under the Aasandha scheme continued to report distance and transport as significant barriers (Banks et al., 2022). Collectively, these findings reinforce that financial inclusion alone cannot dissolve spatial barriers embedded in geography. Affordability under UHC must be reconceptualized to encompass indirect and opportunity costs linked to distance. In the Maldives, the highest adjusted odds were recorded for out-of-pocket payment and the need for an escort (both 3.7), in addition to distance and transport barriers (Banks et al., 2022). In Indonesia, uneven medicine availability compelled repeated visits or private purchases, reintroducing household costs despite nominally universal coverage (Fanda et al., 2024). These results suggest that hidden layers of inequity—travel, accommodation, and time loss—persist beneath the surface of financial protection. The acceptability and communication dimensions reveal how social and geographic barriers intersect. Among American Sign Language users, the lack of qualified interpreters delayed or deterred care even when facilities were geographically closer (Panko et al., 2023).

In Nepal's hill districts, long travel times and uncompensated administrative workloads among Female Community Health Volunteers undermined service reliability and outreach (Panday et al., 2024). Communication accessibility—linguistic, cultural, or physical—thus constitutes a critical mediator of effective access in geographically challenging environments. System-level mitigation strategies demonstrate the value of coordinated digital, transport, workforce, and financing interventions. In Tuvalu, Very Small Aperture Terminal (VSAT) connectivity facilitated remote consultations and continuing medical education, reducing unnecessary referrals when technical stability was maintained (Borgelt et al., 2022). Pacific evidence emphasizes that achieving equitable surgical access requires regionalized service organization and dedicated evacuation systems rather than financing alone (Cooper et al., 2016). Similarly, in Mauritius, reallocation of efficiency dividends from hospital productivity gains was proposed to strengthen primary care and peripheral supply chains (Nundoochan, 2020).

Governance and spatial equity determine whether UHC resources translate into geographically fair outcomes. Indonesia's decentralization experience was associated with widening inter-district disparities despite infrastructure expansion, underscoring the need for enforceable national service standards and stronger central–local coordination (Rintani & Wibowo, 2019). Geographic gradients in medicine availability and the relocation of remote dialysis patients in Australia both exemplify how physical distance becomes a new axis of inequity within universal systems (Fanda et al., 2024; Cheikh Hassan et al., 2020). Policy implications are evident. Financial protection must be paired with explicit physical-access planning, including scheduled maritime and air transport, medical evacuation, and regionalized service design for high-acuity conditions. Peripheral readiness requires investment in logistics, supply chains, workforce redistribution, and minimum-service standards. Finally, digital transformation should prioritize interoperability, reliability, and maintenance sustainability to complement—not substitute—physical service delivery (Fanda et al., 2024; Cooper et al., 2016; Borgelt et al., 2022; Nundoochan, 2020)

*Study Limitations*

Several limitations should be acknowledged. First, heterogeneity in study design, exposure metrics (distance, travel time, 2SFCA, cost-distance, or remoteness indices), and outcome measures limited quantitative pooling. Many studies used administrative or self-reported proxies of geographic barriers, which may lead to exposure misclassification or perception bias. Second, the dominance of observational designs constrains causal inference; confounding by transport infrastructure, electricity availability, and governance quality cannot be entirely ruled out. Third, temporal heterogeneity—

studies collecting data before or during early phases of UHC implementation—may dilute policy effects. Fourth, small sample sizes in certain qualitative or specialized service studies limit generalizability. Fifth, cross-design quality assessment using QualSyst and NHMRC may under-represent strengths of qualitative evidence. Sixth, restricting the review to peer-reviewed English and Indonesian articles while excluding grey literature could introduce publication bias. Finally, contextual transferability is limited: findings from small island nations such as Tuvalu or Mauritius may not directly apply to Indonesia's multi-island system with distinct logistical ecologies.

*Future direction for research*

Future research should aim to standardize both exposure and outcome measurements to improve comparability and enable robust synthesis. Establishing consistent travel-time modeling with policy-relevant thresholds of 30 to 60 minutes for primary and referral care, and adopting spatial accessibility metrics such as the two-step floating catchment area or gravity-based indices, would enhance methodological coherence. Systematic reporting of adjusted odds or risk ratios across distance and travel-time strata would also allow for future meta-analytic integration once sufficient evidence becomes available. To better understand the relationship between geography and healthcare utilization, studies should link individual-level GIS data with service-use records to estimate the elasticity of demand relative to distance and travel time. Quasi-experimental approaches that exploit phased rollouts of transport subsidies, regionalized service arrangements, or telehealth implementation could provide stronger causal inference in contexts where randomization is impractical.

At the same time, including indirect and opportunity cost estimates—covering transportation, accommodation, and income loss—would ensure that affordability is evaluated comprehensively rather than at the point of service alone. Decision-makers require analytical tools that combine spatial precision with policy relevance. The development of spatial equity dashboards based on small-area estimation, integrating referral system performance, electricity reliability, and medicine availability, could support more granular and equitable resource allocation. For high-risk or time-sensitive services such as emergency surgery, obstetric care, and dialysis, optimizing location–allocation within realistic transport and geographic constraints can inform investment decisions that are both efficient and equitable. In conclusion, financial protection under UHC is necessary but not sufficient to bridge distance. Achieving equitable access in island and remote geographies requires an integrated strategy that aligns financial protection with spatial intelligence through resilient logistics, reliable transport networks, equitable workforce distribution, and sustainable digital connectivity. When financing, governance, and geography operate in concert, the distance penalty diminishes and the promise of equity within UHC becomes an attainable reality (Fanda et al., 2024; Cooper et al., 2016; Cheikh Hassan et al., 2020; Banks et al., 2022; Borgelt et al., 2022; Nundoochan, 2020; Bratanegara et al., 2025; Panko et al., 2023; Panday et al., 2024).

## 4. CONCLUSION

This systematic review shows that the expansion of financial protection through UHC and NHI has not eliminated the persistent geography penalty that constrains equitable access in island and remote settings. Across the included studies, distance, travel time, inter-island fragmentation, and infrastructural limitations continue to determine whether care is reached in time, irrespective of nominal coverage. Supply-side readiness—encompassing medicine availability, workforce distribution, and referral capacity—emerges as the binding constraint that explains why financial inclusion alone does not translate into effective utilization. Without geographically responsive planning, universal coverage risks reproducing inequality by favoring populations who live within reach of services. Bridging distance requires a systemic alignment of financing, logistics, and governance. Financial protection should be paired with explicit physical-access planning through

scheduled sea and air transport, medical evacuation arrangements, and regionalized networks for high-acuity care.

Investment priorities must strengthen last-mile logistics by securing essential medicines, redistributing human resources, and ensuring electricity and supply-chain reliability in peripheral facilities. Digital transformation should privilege interoperability and continuity of care so that technology functions as a bridge rather than a substitute for clinical proximity. Equity also depends on measuring affordability comprehensively. Indirect and opportunity costs—transport, accommodation, and time loss—should be incorporated into UHC metrics because the central question is not only who is covered, but who can use their entitlements without undue burden. Subnational governance capacity needs reinforcement through performance-linked financing, integrated logistics planning, and accountability mechanisms that recognize spatial heterogeneity within island systems.

From a policy standpoint, the success of UHC in archipelagic nations hinges on operationalizing spatial justice within health systems. Aligning infrastructure, workforce, and financing reforms with the lived geography of communities will convert universal coverage from a nominal right into an attainable reality. Future reforms should move beyond expanding insurance enrollment to embed geography-sensitive access planning as an explicit pillar of system design. Ultimately, financial coverage is necessary but not sufficient; equitable access requires integration across logistics, human resources, technology, and governance. When financing, infrastructure, and spatial intelligence act in concert, the distance penalty recedes and universal coverage becomes a lived and measurable equity outcome

## REFERENCES

Abiiro, G. A., Mbera, G. B., & De Allegri, M. (2014). Gaps in universal health coverage in Malawi: A qualitative study in rural communities. *BMC Health Services Research*, *14*(1), 234. https://doi.org/10.1186/1472-6963-14-234

Auld, B. C., Abell, B., Venugopal, P. S., & McPhail, S. (2023). Geographical challenges and inequity of healthcare access for high-risk paediatric heart disease. *International Journal for Equity in Health*, *22*(1), 229. https://doi.org/10.1186/s12939-023-02040-z

Ayas, M., Ali Al Amadi, A. M. H., Khaled, D., & Alwaa, A. M. (2020). Impact of COVID-19 on the access to hearing health care services for children with cochlear implants: a survey of parents. *F1000Research*, *9*, 690. https://doi.org/10.12688/f1000research.24915.1

Banks, L. M., O'Fallon, T., Hameed, S., Usman, S. K., Polack, S., & Kuper, H. (2022). Disability and the achievement of Universal Health Coverage in the Maldives. *PLOS ONE*, *17*(12), e0278292. https://doi.org/10.1371/journal.pone.0278292

Blanchet, N. J., Fink, G., & Osei-Akoto, I. (2012). The effect of Ghana's National Health Insurance Scheme on health care utilisation. *Ghana Medical Journal*, *46*(2).

Borgelt, K., Siose, T. K., Taape, I. V., Nunan, M., Beek, K., & Craig, A. T. (2022). The impact of digital communication and data exchange on primary health service delivery in a small island developing state setting. *PLOS Digital Health*, *1*(10), e0000109. https://doi.org/10.1371/journal.pdig.0000109

Bratanegara, A. S., Pitoyo, A. J., Widayani, P., & Hizbaron, D. R. (2025). Geospatial Disparities in Elderly Health: A GIS-Based Study of Functional Independence in Tasikmalaya Regency, Indonesia. *International Journal of Geoinformatics*, *21*(9). https://doi.org/10.52939/ijg.v21i9.4439

Cheikh Hassan, H., Chen, J. H. C., & Murali, K. (2020). Incidence and factors associated with geographical relocation in patients receiving renal replacement therapy. *BMC Nephrology*, *21*, 249. https://doi.org/10.1186/s12882-020-01887-6

Cooper, M. G., Wake, P. B., Morriss, W. W., Cargill, P. D., & McDougall, R. J. (2016). Global safe anaesthesia and surgery initiatives: implications for anaesthesia in the Pacific region. *Anaesthesia and Intensive Care*, *44*(3), 420.

Darmawan, E. S., Hasibuan, S. R., Permanasari, V. Y., & Kusuma, D. (2025). Disparities in health services and outcomes by National Health Insurance membership type for ischemic heart disease and stroke in Indonesia: analysis of claims, 2017–2022. *Global Health Research and Policy*, *10*(1), 33. https://doi.org/10.1186/s41256-025-00432-y

Fanda, R. B., Probandari, A., Yuniar, Y., Hendarwan, H., Trisnantoro, L., Jongeneel, N., & Kok, M. O. (2024). The availability of essential medicines in primary health centres in Indonesia: achievements and challenges across the archipelago. *Global Health Action*.

Garchitorena, A., Ihantamalala, F. A., Révillion, C., Cordier, L. F., Randriamihaja, M., Razafinjato, B., et al. (2021). Geographic barriers to achieving universal health coverage: evidence from rural Madagascar. *Health Policy and Planning*, *36*(10), 1659–1670. https://doi.org/10.1093/heapol/czab087

Ihantamalala, F. A., Herbreteau, V., Révillion, C., Randriamihaja, M., Commins, J., Andréambeloson, T., et al. (2020). Improving geographical accessibility modeling for operational use by local health actors. *International Journal of Health Geographics*, *19*(1), 27. https://doi.org/10.1186/s12942-020-00220-6

Nundoochan, A. (2020). Improving public hospital efficiency and fiscal space implications: the case of Mauritius. *International Journal for Equity in Health*, *19*(1), 152. https://doi.org/10.1186/s12939-020-01262-9

Panganiban, J. M. S., Loreche, A. M., De Mesa, R. Y. H., Camiling-Alfonso, R., Fabian, N. M. C., Dans, L. F., et al. (2024). Promoting equitable and patient-centred care: an analysis of patient satisfaction in urban, rural and remote primary care sites in the Philippines. *BMJ Open Quality*, *13*(1), e0002483. https://doi.org/10.1136/bmjoq-2023-002483

Panday, S., van Teijlingen, E., & Barnes, A. (2024). Exploring the motivations of female community health volunteers in primary healthcare provision in rural Nepal: A qualitative study. *PLOS Global Public Health*, *4*(8), e0003428. https://doi.org/10.1371/journal.pgph.0003428

Panko, T. L., Cuculick, J., Albert, S., Smith, L. D., Cooley, M. M., Herschel, M., & McKee, M. (2023). Deaf women's experiences of pregnancy and perinatal healthcare access: A qualitative study. *BJOG: An International Journal of Obstetrics and Gynaecology*, *130*(5), 514–521. https://doi.org/10.1111/1471-0528.17300

Putri, N. K., Laksono, A. D., Ernawaty, Kusrini, I., Astuti, Y., & Matahari, R. (2025). Factors associated with institutional delivery in remote areas: a cross-sectional survey in Papua Region, Indonesia. *BMC Pregnancy and Childbirth*, *25*(1), 1124. https://doi.org/10.1186/s12884-025-08231-6

Rahmah, N., Razak, A., Birawida, A. B., Irwandy, Darmawansyah, Sumantri, A., et al. (2025). Analysis of structural equation modeling (SEM) The most significant risk factor for Hypertension in the islands region. *Seminars in Medical Writing and Education*, *4*(429). https://doi.org/10.56294/mw2025429

Ramadhan, M. M. (2021). The impact of national health insurance on the access of maternal care service for women in Indonesia. *Public Health and Preventive Medicine Archive (PHPMA)*, *9*(1), 66–71.

Seidu, A.-A., Agbaglo, E., Dadzie, L. K., Ahinkorah, B. O., Ameyaw, E. K., & Tetteh, J. K. (2021). Individual and contextual factors associated with barriers to accessing healthcare among women in Papua New Guinea: insights from a nationwide demographic and health survey. *International Health*, *13*(6), 573–585. https://doi.org/10.1093/inthealth/ihaa097

Suzana, M., Walls, H., Smith, R., & Hanefeld, J. (2018). Achieving universal health coverage in small island states: could importing health services provide a solution? *BMJ Global Health*, *3*(1), e000612. https://doi.org/10.1136/bmjgh-2017-000612