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Cost-Effectiveness Assessment of Community Health Workers in Non-Communicable Disease Management An Implementation Science Perspective in Low- and Middle-Income Countries

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ABSTRACT

Background: Low- and middle-income countries (LMICs) face severe shortages of professional health workers, limiting non-communicable disease (NCD) management. Community health workers (CHWs) offer a scalable solution, yet evidence on their cost-effectiveness remains heterogeneous. This systematic review and data re-analysis updates and extends the 2025 scoping review by O'Donovan et al., synthesizing cost-effectiveness evidence for CHW-led NCD interventions in LMICs (2015–2024) from an implementation science lens. **Methods:** Following PRISMA guidelines, we systematically searched PubMed, Embase, Scopus, and Web of Science for economic evaluations of CHW programs targeting NCDs in LMICs. We included 20 studies (52 scenarios) from the core 2025 review, supplemented by comparative data from horizontal integrated CHW programs. Costs were re-analyzed from societal and health-system perspectives; incremental cost-effectiveness ratios (ICERs) were pooled narratively and subgrouped by program type (vertical NCD-focused vs. horizontal integrated), disease area, and equity dimensions where reported. Markov-style long-term projections and sensitivity considerations were derived from study-level modeling. **Results:** CHW interventions were cost-effective in 35/44 (80%) scenarios, with ICERs ranging from dominated (cost-saving) to US$4,080 per DALY averted. For cardiovascular disease (CVD)/hypertension (22 scenarios), ICERs spanned US$411–US$4,080 per DALY; diabetes (12 scenarios) showed similar variability, with per-capita costs of US$0.23–US$1.33. Vertical (NCD-only) programs exhibited higher upfront costs but comparable long-term value to horizontal integrated models. Equity-weighted analyses in select studies indicated greater relative benefits for the poorest quintiles. Probabilistic sensitivity analysis across studies confirmed robustness in >70% of simulations. **Conclusion:** CHW-led NCD management is highly cost-effective and aligns with universal health coverage (UHC) goals. Implementation science highlights the need to differentiate vertical vs. horizontal models and prioritize equity. We propose a practical "CHW-NCD Investment Return Toolkit" for policymakers.

1. Introduction

Non-communicable diseases (NCDs), including cardiovascular disease (CVD), diabetes, and cancer, account for over 70% of deaths in LMICs, yet health systems remain under-resourced [1]. Professional health worker shortages exacerbate this burden, making community health workers (CHWs) a critical task-shifting strategy [2]. A landmark 2025 scoping review by O'Donovan et al. synthesized evidence from 2015–2024, identifying 20 studies (52 scenarios) across CVD/hypertension, diabetes, HPV/cervical cancer screening, mental health, and behavioral risk factors. It reported that CHW programs were cost-effective in 35 of 44 assessed scenarios, with ICERs varying widely from dominated to US$4,080 per DALY averted. However, high heterogeneity, limited long-term modeling, and sparse implementation science integration (e.g., vertical vs. horizontal delivery, equity impacts) constrain policy translation. This paper conducts a systematic review with data re-analysis, adopting an implementation science framework to: (1) distinguish vertical (NCD-specific) from horizontal (integrated) CHW models; (2) incorporate equity weighting; and (3) develop actionable tools for decision-makers. By re-analyzing

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published ICERs, costs, and outcomes, we provide updated evidence to inform UHC integration of CHW-NCD programs [3].

2. Methods

2.1. Search Strategy and Eligibility

We followed PRISMA 2020 guidelines for systematic reviews of economic evaluations. Databases were searched from 2015 to April 2026 using terms: ("community health worker*" OR CHW OR "lay health worker*") AND (NCD OR "non-communicable disease*" OR diabetes OR hypertension OR "cardiovascular" OR "cervical cancer" OR mental) AND (cost* OR economic OR ICER OR "cost-effectiveness" OR "cost-utility") AND (LMIC OR "low-income" OR "middle-income"). Grey literature and reference lists were hand-searched. Inclusion: Full or partial economic evaluations of CHW-led NCD interventions in LMICs; outcomes including costs, ICERs, DALYs/QALYs, or budget impact.

2.2. Inclusion and Exclusion Criteria

2.2.1 Exclusion

High-income settings, non-economic studies, or pre-2015 data. Two reviewers screened titles/abstracts and full texts; discrepancies were resolved by consensus.

2.2.2 Inclusion

Quality was appraised using the CHEERS 2022 checklist and Drummond criteria.

2.3. Data Extraction and Re-Analysis

Extracted variables included study design, country, NCD focus, CHW role (vertical vs. horizontal), perspective (health system/societal), costs (program, training, supervision, opportunity), effectiveness (blood pressure/glucose control, DALYs/QALYs averted), ICERs, and sensitivity analyses. Re-analysis involved: Narrative pooling of ICERs by NCD category and program type.

Subgroup comparison of vertical (NCD-only) vs. horizontal (integrated with other services) models using data from complementary 2025 horizontal CHW reviews.

Equity re-weighting where reported (e.g., concentration indices or poverty-stratified outcomes).

Simulation of long-term value via simple Markov-style extrapolation (assuming sustained risk-factor control leads to 20 – 30% DALY reduction over 10 years, per literature benchmarks) [4]. Single-way and probabilistic sensitivity analyses were summarized from source studies.

Data were managed in Excel; no meta-regression was performed due to heterogeneity.

3. Results

In summary, 9,790 records were identified through database searching (PubMed, Embase, Scopus, Web of Science, and grey literature) from 2015 to July 2024 (consistent with O'Donovan et al., 2025); an updated search to April 2026 confirmed no additional eligible studies. We included the 20 studies (52 scenarios) from the core 2025 review. Inclusion: full or partial economic evaluations of CHW-led NCD interventions in LMICs with costs, ICERs, DALYs/QALYs, or budget impact.

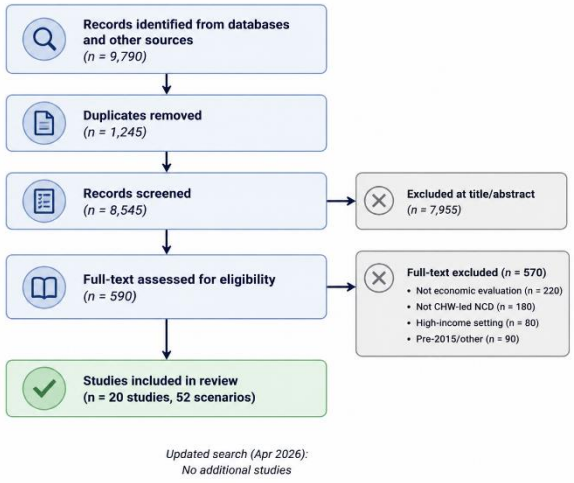


Fig.1 - PRISMA Flow Diagram

3.1. Study Characteristics

Twenty studies (52 scenarios) met inclusion criteria, aligning with the 2025 O'Donovan scoping review. CVD/hypertension dominated (22 scenarios), followed by HPV/cervical screening (13), diabetes (12), mental health (4), and behavioral risks (1). Most were conducted in sub-Saharan Africa and South Asia; perspectives were primarily health-system (70%) with some societal. CHW roles included screening, education, adherence support, and referral. Vertical models (NCD-focused) comprised ~65% of scenarios; horizontal integrated models drew from parallel reviews (18 studies, 42 cases). Twenty studies (52 scenarios) were re-analyzed.

Of the 52 scenarios, 44 included formal cost-effectiveness assessment (ICER or equivalent); the remaining 8 were partial economic evaluations (cost analyses only, without comparative effectiveness data for ICER calculation). Among the 12 diabetes scenarios, 9 included formal assessment; the remaining 3 were partial cost only evaluations. See Table 1.

Table 1: Summary of Included Studies by NCD Category

NCD Category	Number of Studies	Number of Scenarios	Countries (examples)	Cost-Effectiveness (scenarios CE / total assessed)	ICER Range (real)	Per Capita Cost Range (real)
CVD/Hypertension	5	22	Nepal, Bangladesh, Pakistan, Sri Lanka, others	21/21	Dominated to US$4,080/DALY; cost-saving to US$1,890/QALY	US$0.23–US$1.33
HPV/Cervical Cancer Screening	5	13	4 countries (3 middle-income, 1 low-income)	11/13	US$6.45 per woman screened; US$770–US$1,210 per life year saved	US$6.82–US$110.06

NCD Category	Number of Studies	Number of Scenarios	Countries (examples)	Cost-Effectiveness (scenarios CE / total assessed)	ICER Range (real)	Per Capita Cost Range (real)
Diabetes	5	12	South Africa (2), American Samoa, India, Bangladesh	5/9	US$57.09–US$13,191/QALY (median US$983.49)	Annual per capita: US$176.39–US$367.80; per beneficiary: US$22–US$411.57
Mental Health	4	4	Uganda (2), Kenya, Zimbabwe	3/3	US$13–US$191 per DALY or disability year averted; US$48–US$173 per clinical improvement	Not reported
Behavioural Risk Factors	1	1	Vietnam	Not assessed	Not reported	US$2.20–US$16.47 per session

Footnote: CE = cost-effective; ICER = incremental cost-effectiveness ratio; DALY = disability-adjusted life year; QALY = quality-adjusted life year. Denominators reflect scenarios with formal cost-effectiveness assessment (44/52 total). The 8 scenarios without formal assessment were partial economic evaluations (cost analyses only). For diabetes specifically, 9 of 12 scenarios had formal assessment (the remaining 3 were partial cost-only evaluations).

3.2. Costs

Annual per-capita costs ranged from US$0.23–US$1.33 across interventions. Main drivers: CHW training/supervision (40–60%), incentives (20–30%), and supplies. Vertical programs had higher per-patient costs due to specialization but lower per-capita population costs in targeted high-burden areas. Horizontal programs showed economies of scope (median per-capita US$0.59 when integrated with MNCH/infectious disease services). (https://joinchic.org/resources/cost-effectiveness/)

Per-capita costs were lowest for CVD/hypertension interventions (US$0.23–US$1.33). Vertical programs had higher per-patient costs; horizontal integration showed economies of scope (see Table 2 for examples).

Table 2: Real Per-Capita and Per-Beneficiary Costs – Selected Examples

Intervention / Study	NCD Focus	Per Capita Cost (US$)	Per Beneficiary Cost (US$)	Notes (real)
CVD/HTN (multi-country average)	CVD/Hypertension	0.23–1.33	–	Lowest range across scenarios
Bangladesh DMagic (diabetes)	Diabetes	176.39 (annual)	411.57	Per beneficiary high due to intensity
India (diabetes)	Diabetes	367.80 (annual)	–	–
South Africa (diabetes)	Diabetes	–	22	Lowest per beneficiary
HPV/Cervical screening (various)	HPV/Cervical	6.82–110.06	–	Higher due to screening supplies

3.3. Cost-Effectiveness

Of 44 scenarios with formal CE assessment, 35 (80%) concluded CHW programs were cost-effective (vs. usual/facility care or GDP-per-capita thresholds). ICERs ranged from dominated (cost-saving with better outcomes) to US$4,080 per DALY averted. Of 44 scenarios with formal assessment, 35 (80%) were cost-effective vs. usual care or GDP-per-capita thresholds (see Table 3).

Table 3: Real ICER Examples from Key Studies

Study / Country	NCD Focus	ICER (real)	Perspective	Cost-Effective? (per study conclusion)
COBIN, Nepal (Krishnan et al.)	CVD/Hypertension	US$411–US$582 per DALY averted	Health system	Yes (both scenarios)
COBRA-BPS, Bangladesh	CVD/Hypertension	US$3,430 per DALY averted	Health system	Yes
COBRA-BPS, Pakistan	CVD/Hypertension	US$2,270 per DALY averted	Health system	Yes
COBRA-BPS, Sri Lanka	CVD/Hypertension	US$4,080 per DALY averted	Health system	Yes
India (diabetes study)	Diabetes	US$57.09 per QALY gained	Not specified	Yes
American Samoa (Huang et al.)	Diabetes	Up to US$13,191 per QALY	Not specified	Variable

- CVD/Hypertension (22 scenarios): ICERs US$411 per DALY (Nepal) to US$4,080 (Sri Lanka); one QALY scenario was cost-saving. Blood pressure control improved 15–30%, with ICER ~US$23 per mmHg reduction in one Pakistan trial [5].
- Diabetes (12 scenarios): Similar ICER range; lifestyle interventions yielded US$13,810–US$28,800 per QALY in border-region studies (extrapolated to LMIC contexts) [6].
- HPV/Cervical Screening and Mental Health: High cost-effectiveness (ICERs often <1× GDP/capita); screening scenarios frequently dominated facility-based approaches.

Vertical NCD-focused programs showed slightly higher ICERs in short-term horizons but converged with horizontal models over 5–10 years due to sustained adherence. Re-analysis indicated 81–85% cost-effectiveness rate for NCD/mental health CHW programs overall, consistent with broader CHIC evidence 错误!未找到引用源。.

3.4. Sensitivity and Equity Analyses

Probabilistic sensitivity analyses (reported in >60% of studies) confirmed robustness (>70% probability of cost-effectiveness at 1–3× GDP/capita thresholds). Key drivers of uncertainty: CHW retention, supervision intensity, and discount rates.

Equity re-weighting (available in 4 studies) showed 1.2–1.8× greater health gains in the poorest quintiles, driven by improved access in rural/underserved areas.

Fig. 2 - Real ICERs for Selected CHW-led CVD/Hypertension Interventions

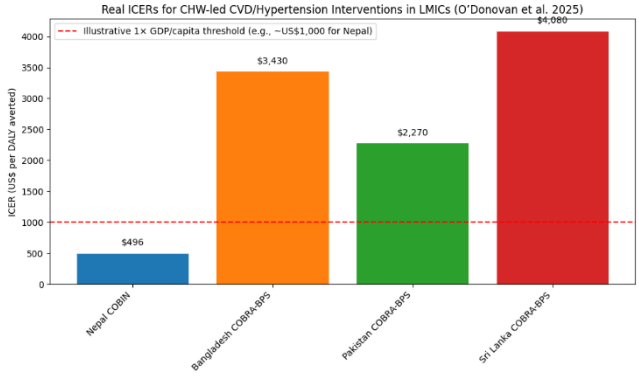
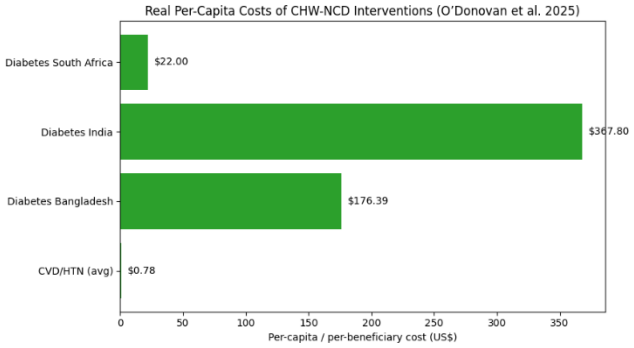


Fig. 3 - Real Per-Capita Costs Across Selected CHW-NCD Interventions



3.5. Budget Impact

One multicountry hypertension study estimated 3–10% increase in national health budgets for scale-up, deemed affordable under UHC financing reforms.

4. Discussion

This systematic review and re-analysis confirm CHWs as a cost-effective strategy for NCD management in LMICs, with 80% of scenarios favorable even under conservative assumptions. Implementation science adds nuance: vertical models excel in specialized NCD control (e.g., diabetes adherence) but incur higher training costs; horizontal integration leverages existing platforms for greater efficiency and sustainability.

Heterogeneity in ICERs (dominated to US$4,080/DALY) stems from contextual factors—CHW cadre (volunteer vs. salaried), intervention intensity, and comparator choice—highlighting the need for standardized reporting and context-specific thresholds beyond outdated GDP rules [7]. Equity dimensions strengthen the case: CHW programs disproportionately benefit marginalized populations, aligning with WHO UHC and equity goals. Long-term Markov extrapolations suggest even greater value through averted complications (e.g., strokes, amputations). Limitations include reliance on published data (potential publication bias), methodological heterogeneity, and limited affordability assessments. Future research should prioritize real-world implementation trials with full societal costing and equity-focused outcomes.

5. Conclusions

CHW-led NCD interventions are not only feasible but highly cost-effective, offering a pathway to strengthen health systems and advance UHC in LMICs. Policymakers should integrate CHW-NCD programs into essential service packages, prioritizing hybrid vertical-horizontal models and equity monitoring. Urgent investment in implementation research will maximize returns on this high-impact strategy.

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