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Community health worker involvement across domains and national infectious disease programmes in rural Madagascar: evidence of fragmentation and determinants of engagement

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ABSTRACT

Introduction Community health workers (CHWs) are central to primary healthcare (PHC) delivery and infectious disease control in low-income settings. In Madagascar, CHWs are mandated to contribute across multiple national disease programmes, yet evidence on their actual involvement and its determinants remains limited, particularly for HIV/AIDS and tuberculosis (TB).

Methods We conducted a cross-sectional survey between March and June 2024 among CHWs in four regions (Analamanga, Atsimo Andrefana, Androy and Anosy). Using two-stage cluster sampling, districts and public primary health centres were randomly selected and all eligible affiliated CHWs were invited to participate. We assessed CHWs' self-reported involvement in health domains and disease response programmes, including HIV/AIDS, TB and malaria, over the preceding 2 years. Mixed-effects logistic regression models with random intercepts at the health facility level were used to identify factors associated with involvement.

Results Among the 408 participating CHWs (response rate 81.8%), engagement was near-universal in maternal and child health (100%) and malaria-related activities (98.5%), but was limited for TB (23.8%) and HIV/AIDS (21.6%). Across regions, involvement in HIV/AIDS and TB was largely limited to sensitisation activities. Possession of written work guidance and previous disease-specific training were consistently associated with higher odds of involvement in HIV/AIDS (OR 3.73; 95% CI 2.09 to 6.66) and TB (OR 2.55; 95% CI 1.48 to 4.40). Reliance on non-governmental organisation-led support was not associated with increased engagement.

Conclusions In rural Madagascar, CHW involvement in HIV/AIDS and TB is low compared with malaria and maternal and child health. Engagement in HIV/AIDS and TB is driven by the availability of clear work guidance and disease-specific training. Strengthening integrated responses can draw on the malaria platform and anchor both diseases within routine activities of the national operational framework for CHWs. Public health donors and

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Community health workers (CHWs) are essential to primary healthcare (PHC) in rural, low-income settings, where progress towards universal health coverage remains limited and service delivery is often shaped by fragmented or vertically organised models.

⇒ Madagascar faces a high burden of tuberculosis (TB) and malaria, a rising HIV incidence and a PHC system strongly influenced by external support, including non-governmental organisations (NGOs), donor financing and government-led efforts.

WHAT THIS STUDY ADDS

⇒ Using multiregional data from rural Madagascar, this study shows that CHW engagement is near-universal in malaria and maternal and child health but remains limited for HIV/AIDS and TB.

⇒ CHW involvement in HIV/AIDS and TB is strongly associated with the availability of written work guidance and disease-specific training, while NGO-led or vertically organised support is not associated with higher engagement.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ These findings highlight the importance of integrating HIV/AIDS and TB activities into routine PHC platforms, for example, by drawing on successful malaria programming through the Integrated Community Case Management model, and aligning disease-specific investments with core health system structures, including clear guidance, training and sustainable financial support for CHWs.

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actors need to align disease-specific investments and actions with core PHC structures.

INTRODUCTION

In nearly 100 countries, community health workers (CHWs) are a cornerstone of primary healthcare (PHC) and a critical component in achieving universal health coverage (UHC). CHWs live in and are trusted by the communities they serve, and they extend essential health services, including preventive, promotive and basic curative care, to populations often underserved by facility-based health staff and services. Their roles include health education, outreach, case finding, referral and delivery of basic preventive and curative interventions.[1 2] For endemic and emerging health threats, including HIV/AIDS, tuberculosis (TB) and malaria, CHWs serve as the sustained last-mile arm of health systems, enabling continuous and timely action in epidemic preparedness, prevention and response. During outbreaks and other health emergencies, CHWs support community surveillance, early case detection, contact tracing, behaviour change communication and continuity of essential services.[3] When adequately supported and effectively integrated within health systems, CHWs can improve access to prevention, diagnosis, treatment and follow-up care and contribute to improved population health outcomes.[1 4] Conversely, weak integration, fragmented programme design and insufficient system support can substantially limit CHWs' contributions and their potential to improve population health.[2 5 6]

In Madagascar, the role of CHWs is particularly critical. With a UHC service coverage index of 35, the country's progress towards UHC is among the lowest in Africa.[7 8] Madagascar also bears a high burden of infectious diseases and is among the countries with the highest malaria incidence in the region, with an estimated 130–200 cases per 1000 population at risk per year, which is substantially higher than in many neighbouring countries.[9] The estimated TB incidence has remained high and surprisingly stable at 233 per 100 000 population since 2013 within a context of extreme socioeconomic vulnerability (approximately 80% of the population lives below the international extreme poverty line of US$2.15/day, expressed in 2017 Purchasing Power Parity [PPP]) and widespread undernutrition (around 40% of children under 5 years of age stunted).[10–12] The national HIV burden, although relatively low compared with other countries in the region, included an estimated 76 000 people living with HIV in 2023 and is suspected to be transitioning from a concentrated to a more generalised epidemic, posing a significant public health threat in a context of highly limited access to PHC for large segments of the population.[13 14]

Strengthening PHC through community-based service delivery has long been a central policy objective of Madagascar's health system. The role of CHWs was formally institutionalised in national health policy in 2009 and reaffirmed in 2017, with the explicit aim of improving access to essential health services in remote areas.[15] An estimated 50 700 CHWs are currently active nationwide, the majority serving on a voluntary basis.[16] Multiple national policy frameworks assign CHWs a broad range of responsibilities across disease-specific programmes, including the Expanded Programme on Immunization, the national malaria programme, the national HIV programme and the national TB programme.[15 17] The community-based malaria response differs from TB and HIV in programme design and delivery. Malaria diagnosis and treatment have been embedded within routine PHC through the Integrated Community Case Management (iCCM) strategy and the *Guide du Paquet d'Activités Communautaires* (Guide PAC).[17 18] In contrast to the more vertical models used for TB and HIV, malaria services are framed as an essential component of child health and increasingly as a routine service for all age groups delivered through community-level PHC. Recent policy reforms and implementation research have expanded CHW-delivered malaria case management beyond children under five, reinforcing malaria's integration within PHC.[19 20]

Although representative national data are lacking, indirect evidence and key informant knowledge suggest differential levels of CHW involvement across programmes. For example, national surveillance data indicate that CHW-initiated TB referrals account for no more than 12% of TB case notifications (Ministry of Health, unpublished data). Similar concerns have been raised regarding limited CHW engagement in the HIV response. These patterns suggest that uneven CHW involvement across disease programmes may reflect modifiable system-level design and support factors rather than inherent workforce limitations.

Evidence from low- and middle-income countries indicates that CHW engagement and performance are largely shaped by system-level factors, including role clarity, training, supervision, incentive structures and the extent to which specific services are embedded within routine PHC rather than delivered through vertical or project-based programmes.[5 21–23] In Madagascar, documented constraints such as limited training coverage, irregular supervision, inadequate supplies and reliance on voluntary labour have been identified as potential barriers to sustained CHW engagement, particularly within TB and HIV/AIDS care.[24] Qualitative research investigating the perspectives of the workforce themselves in Madagascar identifies structural and organisational barriers, predominantly concerning CHWs in rural areas, rather than lack of motivation, as the primary constraints on their effective engagement.[25]

Despite the considerable burden of TB and malaria and a rising incidence of HIV in Madagascar, comprehensive evidence on how CHWs engage across PHC domains and national infectious disease programmes remains limited. In particular, little is known about geographical variation

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in involvement and what influences their engagement in HIV/AIDS, TB and malaria activities. This cross-sectional study aimed to (1) describe CHW involvement across health domains and infectious disease programmes in rural Madagascar and (2) identify determinants of engagement in HIV/AIDS and TB-related activities, with the objective of informing strategies to strengthen integrated, equitable and sustainable PHC delivery.

METHODS

Study design and setting

We conducted a cross-sectional survey between March and June 2024 in four regions of Madagascar (Analamanga, Atsimo Andrefana, Androy and Anosy; online supplemental figure 1). The regions were selected to capture geographic, epidemiological and health-system diversity. Feasibility considerations, including the logistical capacities of the implementing non-governmental organisations (NGOs) in some of these regions, also guided their selection.

Madagascar is a low-income country in eastern Africa with an estimated population of 30.3 million, of whom approximately 59% live in rural areas.[26 27] At the local level, health services are organised within the district health system, which comprises three tiers: (1) the District Referral Hospital (Centre Hospitalier de Référence de District); (2) primary health centres (Centres de Santé de Base (CSB)), which constitute the first level of facility-based care; and (3) CHWs, who operate as a distinct community-based tier providing frontline services at household and community level.

CHWs operate under the Ministry of Public Health's National Strategic Plan for Community Health Strengthening (Plan Stratégique National de Renforcement de la Santé Communautaire) and the technical framework defined in the Guide PAC.[15 17] These frameworks specify CHW responsibilities across multiple disease programmes, including the National TB Programme (Programme National de Lutte contre la Tuberculose) and the National HIV and Sexually Transmitted Infections (STI) Programme (Programme National de Lutte contre les IST et le SIDA). Within these programmes, CHWs are expected to contribute to activities such as health education and sensitisation, symptom screening, referral to health facilities, treatment adherence support and patient follow-up.

The national HIV/AIDS, TB and malaria responses are implemented through a mixed delivery model involving government services, NGOs, civil society organisations and church-based health facilities, particularly in underserved areas. While the Malagasy Ministry of Public Health leads programme implementation, a substantial proportion of programme activities are financed through external funding mechanisms, primarily the Global Fund, with additional support from other partners. These actors and financing arrangements shape the operational environment in which CHWs engage and are therefore relevant for interpreting patterns of CHW involvement observed in this study.

Study population and sampling

The study population comprised active CHWs affiliated with rural public primary health centres (CSBs) in the four selected regions. A two-stage cluster sampling design was used to select districts, health facilities and CHWs. In the first stage, among all predominantly rural districts, 2 (out of 24) from each region were randomly selected (8 districts in total) (online supplemental figure 1). Districts that had received focused TB support for CHWs within the 3 years preceding sampling by the implementing NGO were excluded from the sampling frame to minimise confounding from recent programme-specific support. In the second stage, 10% of public CSBs within each selected district were randomly sampled using an updated list obtained from the Department of Primary Healthcare Services (June 2023). While the initial protocol specified the inclusion of 10% of centres, we oversampled to 15% to allow for replacement of facilities that were inaccessible. CSBs that were inaccessible by the road network and could only be reached on foot were excluded for feasibility and safety reasons (n=2). Based on administrative data and field constraints, this procedure resulted in the selection of 20 CSBs. All CHWs officially affiliated with the selected CSBs were invited to participate if they met the following inclusion criteria: (1) aged 18 years or older; (2) at least 1 year of service as a CHW at the time of the survey; and (3) provision of informed consent. CHWs not listed on the official CSB roster were excluded. Sample size estimation was based on a single-population proportion formula, assuming an estimated 8,000 CHWs across the four regions, a 95% confidence level and a 5% margin of error, yielding a minimum required sample of 367 CHWs (OpenEpi). To account for non-response and exclusions, a target sample size of 420 CHWs was defined.

Sampling assumptions were informed by national administrative data indicating an average of one to two CHWs per Fokontany (administrative level-4 unit) and approximately 15 Fokontany per CSB, based on 17 485 Fokontany nationwide and 2677 health facilities (2019). Ultimately, 499 CHWs were approached, of whom 448 met eligibility criteria and 408 consented to participate, corresponding to a response rate of 81.8%.

Data collection

Data were collected using an interviewer-administered structured questionnaire adapted from previously validated CHW assessment tools and contextualised to the Madagascar setting (online supplemental material 1). The questionnaire covered six domains: (1) demographic and professional characteristics, (2) work environment, (3) tasks performed, (4) training received, (5) supervision and (6) economic aspects. The tool was piloted among CHWs in districts neighbouring those of the Analamanga region to refine question wording,

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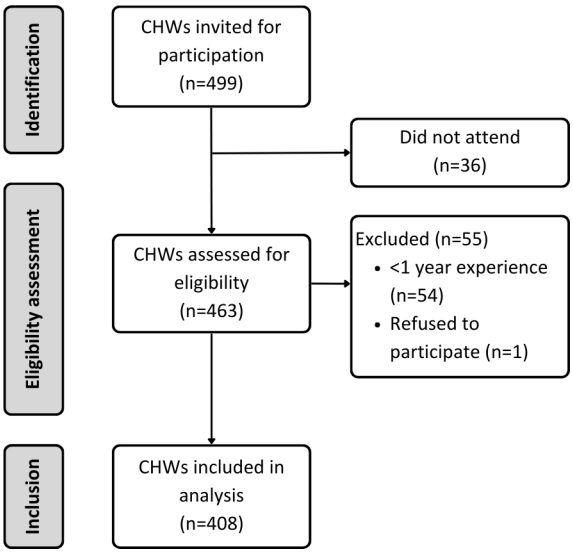


Figure 1 Study flow diagram of community health worker (CHW) selection and participation in a cross-sectional survey assessing characteristics and involvement of CHWs in Madagascar, 2024.

response options and skip patterns. Data were collected electronically using the REDCap Mobile App on tablets, enabling offline data entry and secure synchronisation to a central server. To reduce interviewer and information bias, data collectors received 5 days of standardised training covering study objectives, questionnaire content, interview techniques, ethical conduct and confidentiality procedures. Interviews were conducted privately, and responses were entered directly into electronic tablets to avoid transcription errors. Recall bias was minimised by restricting questions on programme involvement to activities within the preceding 2 years. In this study, *official supervision* refers to formal, structured and scheduled oversight conducted by designated supervisors in accordance with national guidelines or programme standards. *Practical supervision*, by contrast, refers to the day-to-day, informal and hands-on support that CHWs receive during routine field activities.

Measures and variables

Primary outcomes

The primary outcomes were CHWs' participation in HIV-related/AIDS-related, TB-related and malaria-related response activities. Participation was assessed using self-reported data on engagement in any national guideline-defined community-level tasks within the preceding 2 years. For each disease area, CHW participation was classified as follows:

- HIV/AIDS:
  - *Sensitisation:* delivery of community-based health education and sensitisation activities on HIV/AIDS and STIs.
  - *Referral:* identification of individuals or couples and referral or encouragement to attend a health facility for HIV testing services.
  - *Follow-up:* support for treatment adherence among people living with HIV, including follow-up visits and monitoring of medication use, in accordance with national guidelines.
- TB:
  - *Sensitisation:* delivery of community-based education on TB symptoms, transmission, prevention and the availability of free diagnosis and treatment.
  - *Referral:* identification and referral of individuals with presumptive TB to a health facility for diagnostic evaluation.
  - *Contact tracing:* identification and follow-up of individuals who have been in close contact with a person diagnosed with active TB disease.
  - *Treatment follow-up:* support for treatment adherence and monitoring during TB treatment, including home visits, in accordance with national guidelines.
- Malaria:
  - *Sensitisation:* delivery of community-based education on malaria prevention, recognition of symptoms and the importance of timely diagnosis.
  - *Treatment:* provision of home-based management and preventive treatment of malaria, as defined in national malaria control guidelines.
  - *Referral:* identification and referral of individuals with suspected severe or complicated malaria to a health facility.

Potential determinants

Potential explanatory variables were selected based on existing literature on CHW motivation and engagement within the broader context of volunteer work and livelihoods, as well as national policy and technical documents.[17 24] Variables were grouped into two domains: sociodemographic characteristics and work-related characteristics.

Sociodemographic characteristics included sex, age (years), marital status (single or in a couple), education level (primary or lower vs secondary or higher), main occupation (requiring formal training vs not), household monthly income (in Malagasy Ariary) and region of residence. Work-related characteristics captured the CHW operational environment, incentives and support, including frequency of CHW activities (daily, fixed days per week or variable), completeness of working tools (related to management, function and communication), possession of any written work guidance, receipt of general CHW training and disease-specific training and the type of supervisor (head of CSB or delegate at the CSB, community relay agent or NGO staff). Financial incentives were categorised as receipt or non-receipt of a regular monthly payment, while non-financial incentives included public recognition by the community, formal introduction at the start of service, and provision of working tools. Collaboration with an NGO at the time of the survey was recorded as a binary variable (yes/no). All variables were coded and categorised prior

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Table 1 Sociodemographic characteristics, work modalities, resources, training and supervision of community health workers (CHWs, n=408) in Madagascar, 2024

Characteristics	n (%)	95% CI
Gender		
Male	178 (43.6)	38.8 to 48.6
Female	230 (56.4)	51.4 to 61.2
Age, years (median (IQR))	40 (30-51)	
18–30	109 (26.7)	22.5 to 31.3
31–40	96 (23.5)	19.6 to 28
41–50	92 (22.5)	18.6 to 27
>50	111 (27.2)	23 to 31.8
Marital status		
Single	51 (12.5)	9.5 to 16.1
Living with partner	81 (19.9)	16.1 to 24.1
Married	229 (56.1)	51.2 to 61.1
Separated/divorced	31 (7.6)	5.3 to 10.7
Widowed	16 (3.9)	2.3 to 6.3
Education level		
No formal education	6 (1.5)	0.6 to 3.3
Primary or any lower	125 (30.6)	26.2 to 35.4
Secondary or higher	283 (69.4)	64.6 to 73.8
Primary occupation		
Informal occupation (not requiring formal training)	377 (92.4)	89.3 to 94.7
Formal occupation (requiring training)	31 (7.6)	5.3 to 10.7
Monthly household income (Ariary)*		
<50 000	190 (46.6)	41.6 to 51.5
50 000–99 999	127 (31.1)	26.7 to 35.9
100 000–149 999	45 (11.0)	8.2 to 14.5
150 000–199 999	24 (5.9)	3.8 to 8.6
≥200 000	22 (5.4)	3.4 to 8.1
Frequency of CHW work		
Works daily	31 (7.6)	5.3 to 10.7
Fixed days per week	280 (68.6)	63.8 to 73.1
Variable frequency	97 (23.8)	19.8 to 28.3
Weekly hours allocated (median (IQR))	6 (3–11)	
Monthly monetary incentives from CHW role (past month)		
None	93 (22.8)	18.9 to 27.2
Any	315 (77.2)	72.8 to 81.1
Community recognition		
Recognised by community†	171 (41.9)	37.1 to 46.9
Officially introduced to community	389 (95.3)	92.7 to 97.1
Work tools‡		
Management tools	336 (82.3)	78.2 to 85.9
Functional tools	298 (73.0)	68.4 to 77.2
Communication materials	232 (56.9)	51.9 to 61.2
Training (in past 2 years)		
Any CHW training	309 (75.7)	71.2 to 79.8

Continued

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Table 1 Continued

Characteristics	n (%)	95% CI
Training on infectious diseases (any)	38 (9.3)	6.8 to 12.7
Official supervision (by)		
Head of CSB	401 (98.3)	96.3 to 99.2
Delegate at CSB	130 (31.9)	27.4 to 36.7
Community relay agent	0 (0)	
NGO staff	142 (34.8)	30.2 to 39.7
Practical supervision (by)		
Head of CSB	404 (99)	98.1 to 100
Delegate at CSB	14 (3.4)	2 to 5.8
Community relay agent	3 (0.7)	0.13 to 1.25
NGO staff	12 (2.9)	1.6 to 5.2
Collaboration with NGO (past month)	165 (40.4)	35.7 to 45.4

Data are presented as n (%), unless otherwise indicated.
A more detailed version of this table is provided in online supplemental table 1.
*1 Malagasy Ariary = US$0.00022 (2024 exchange rate).
†Community recognition denotes instances where CHWs receive material or non-material support from the community, including direct assistance, transport, food or expression of gratitude.
‡Work tools include management tools (such as data record sheets), functional tools (such as visibility cloth, eg, vest) and communication materials (such as image box, telephone) and basic clinical tools (such as weighting scales, malaria rapid diagnostic tests and medications).
§Written work guidance refers to any manual, guide or protocol used to support CHWs in their role.
CSB, Centre de Santé de Base (primary health centre); NGO, non-governmental organisation.

to analysis according to the study protocol. Definitions were harmonised with those used in national CHW monitoring tools and guidelines (including the Guide PAC) to ensure comparability.

Data analysis

Descriptive analyses were conducted to summarise CHWs' sociodemographic characteristics, work environment and reported engagement in HIV/AIDS, TB and malaria-related activities. Continuous variables (age, income, years of experience) were categorised into predefined groups based on programmatic relevance and distribution in the sample. Categorical variables are presented as frequencies and percentages, and continuous variables as medians with IQRs.

Associations between CHW characteristics and participation in disease-specific activities were initially explored using chi-square tests or Fisher's exact tests when expected cell counts were below five. A two-sided p value≤0.05 was considered statistically significant.

To identify independent factors associated with CHW participation in TB-related and HIV-related activities, we fitted mixed-effects logistic regression models with random intercepts for each CSB to account for clustering and potential intracluster correlation (ICC). Univariable models were first fitted for each candidate determinant. Variables with p value<0.20 in univariable analyses, as well as those identified a priori as potential confounders, were included in multivariable models. Model building was guided by theoretical relevance and statistical criteria. A manual backward elimination approach was used to derive parsimonious models, retaining variables that significantly improved model fit based on likelihood-ratio tests (p value≤0.05) or resulted in a lower Akaike Information Criterion. Models were fitted using the glmer function in R (lme4 package) with a binomial distribution. ICCs were calculated from variance components to quantify the proportion of total variance attributable to clustering at the CSB level. Potential confounding was assessed by examining changes in fixed-effect estimates; variables that altered another coefficient by ≥20% were retained. Multicollinearity was evaluated using correlation matrices and variance inflation factors (all <2.5). Model diagnostics were performed using the DHARMa (Residual Diagnostics for Hierarchical (Multi-level/Mixed) Regression Models) package, including assessment of simulated residuals, dispersion and deviations from model assumptions. Model convergence and singularity were also checked. Subgroup analyses by region were conducted descriptively to explore geographic variation in CHW involvement; no formal statistical tests for interaction were performed. Missing data were minimal (<5% across variables) and were handled using complete-case analysis. All results are reported as ORs with 95% CIs.

Patient and public involvement

Patients and members of the public were not involved in the design or conduct of this research. Findings were disseminated to relevant stakeholders and CHWs through a dissemination workshop, during which

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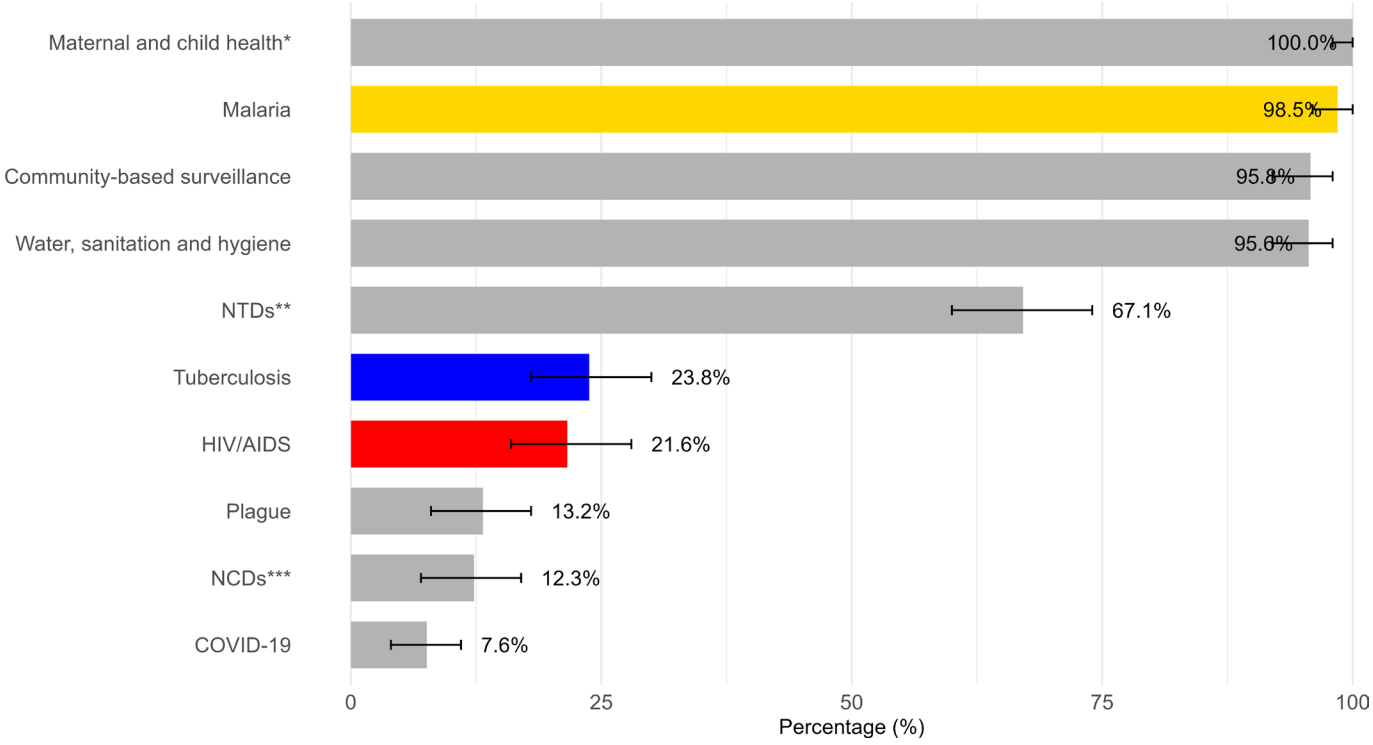


Figure 2 Community health worker involvement in health domains and specific disease responses over the preceding 2 years, Madagascar, 2024. *Includes vaccination and nutrition. **NTDs (neglected tropical diseases) include schistosomiasis, lymphatic filariasis and helminths. ***NCDs (non-communicable diseases) include diabetes, high blood pressure and chronic respiratory diseases. Community-based surveillance: includes identification, notification and follow-up of priority health events within the community (based on national guidelines).

contextual feedback was shared to support interpretation and inform programme and policy discussions.

RESULTS

Study participants

A total of 408 CHWs from four regions of Madagascar participated, representing 81.8% of all CHWs invited (n=499). The largest share of participants came from Anosy (n=182, 44.6%; 95% CI 39.7 to 49.6), followed by Androy (n=112, 27.5%; 95% CI 23.2 to 32.1), Analamanga (n=75, 18.4%; 95% CI 14.8 to 22.6) and Atsimo Andrefana (n=39, 9.6%; 95% CI 7.0 to 12.9) (figure 1). Missing data were <5% for all variables, and all analyses were based on complete cases.

Of 408 CHWs included, 56.4% were female and the median age was 40 years (IQR 30–51). More than half were married and had obtained at least secondary education, while no formal education was highly uncommon. More than three out of four reported a monthly household income below 150 000 Ariary (≈US$33.6). Most CHWs reported working on fixed days per week, dedicating a median of 6 hours per week to CHW activities. Financial incentives were received by 6 out of 10 CHWs and 4 out of 10 reported some form of community recognition. Nearly three-quarters possessed at least one working tool and had received CHW training in the preceding 2 years; however, only 1 in 10 reported specific training on infectious diseases. Supervision structures were formally well established: Almost all CHWs identified the head of the CSB as their official supervisor, while less than half also identified NGO staff as official supervisor. In practice, 99.0% and 2.9% reported receiving active supervision by the head of the CSB or an NGO staff, respectively. Collaboration with an NGO was reported by 40.4% of CHWs at the time of the survey (table 1).

CHW involvement across health domains and infectious disease responses

CHW participation was universal in maternal and child health, including vaccination and nutrition, followed by malaria, community-based surveillance and water, sanitation and hygiene (figure 2). Moderate involvement was reported for neglected tropical diseases. In contrast, involvement in TB and HIV/AIDS was limited. Even lower participation was reported for plague, non-communicable diseases and COVID-19.

Regional variation in TB, HIV/AIDS and malaria response activities

CHW involvement in the major infectious disease response activities in the past 2 years varied modestly across regions (figure 3). For HIV/AIDS, reported involvement ranged from 16.1% in Androy to 24.2% in Anosy. TB-related involvement varied slightly geographically, with the lowest participation observed in Anosy and the highest in Atsimo Andrefana (figure 3A). Across disease areas, involvement in specific subactivities showed

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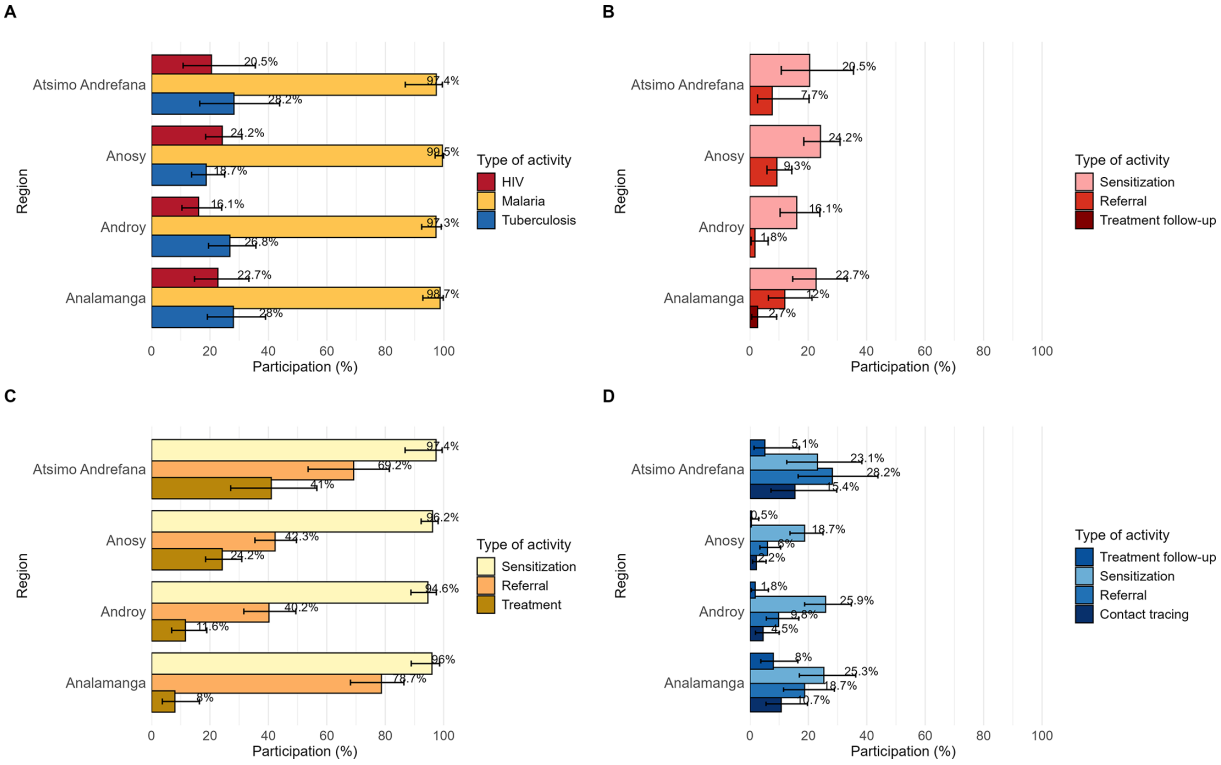


Figure 3 Regional distribution of community health worker (CHW) involvement in HIV/AIDS, tuberculosis (TB) and malaria activities, Madagascar, 2024. (A) overall CHW involvement in the three disease areas by region. (B) CHW involvement in HIV/AIDS subactivities. (C) CHW involvement in malaria subactivities. (D) CHW involvement in TB subactivities. Bars show the percentage of CHWs reporting participation in the last 2 years. Error bars represent 95% CIs.

a rather uniform pattern, with CHWs primarily engaged in sensitisation. For HIV/AIDS, all CHWs reporting any involvement indicated engaging in sensitisation activities, whereas involvement in referral and treatment follow-up was overall limited. Fewer than 10% of all CHWs reported referring individuals for HIV testing (figure 3B). In contrast, malaria-related subactivities, including sensitisation, treatment and referral, were consistently reported at high levels across all regions (figure 3C). For TB, sensitisation and referral were more commonly reported than contact tracing or treatment follow-up, which remained uncommon across regions (figure 3D).

Factors associated with CHW involvement in HIV/AIDS and/or TB programme activities

Across all models, possession of written work guidance was the most consistent determinant of CHW involvement in HIV/AIDS, TB and combined programme activities (table 2). Having received infectious disease-specific training was also strongly associated with CHW

Table 2 Factors associated with CHW involvement in HIV/AIDS, TB and combined HIV/AIDS and TB activities, Madagascar, 2024[13]

Determinants of involvement	HIV/AIDS OR (95% CI)	TB OR (95% CI)	HIV/AIDS and TB OR (95% CI)
Possession of written work guidance	3.73 (2.09 to 6.66)***	2.55 (1.48 to 4.40)***	6.59 (2.49 to 17.44)***
Disease-specific training (past 2 years)	2.38 (1.16 to 4.88)*	3.04 (1.50 to 6.18)**	—
Any training (past 2 years)	—	2.45 (1.18 to 5.10)*	4.51 (1.77 to 11.48)**
Occupation requiring formal training	2.38 (1.02 to 5.57)*	—	4.23 (1.44 to 12.42)**
Age>50 years	—	2.18 (1.06 to 4.49)*	2.98 (1.06 to 8.35)*
Supervision by CSB staff other than head of CSB	2.36 (1.35 to 4.13)**	0.52 (0.27 to 0.97)*	—
Supervision by NGO staff	—	0.39 (0.20 to 0.75)**	—

*** = p < 0.001. ** = p < 0.01. * = p < 0.05.
'—' indicates variables not retained in the final multivariable model for the corresponding outcome.
CSB, Centre de Santé de Base (primary health centre); NGO, non-governmental organisation; TB, tuberculosis.

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involvement across outcomes, with the largest effects observed for combined HIV/AIDS and TB involvement.

In contrast, patterns differed for supervision arrangements. While supervision by CSB staff other than the head of CSB was associated with increased involvement in HIV/AIDS activities, it was associated with reduced odds of TB involvement, as was supervision by NGO staff. Older age (>50 years) and having a primary occupation requiring formal training were associated with involvement in TB and combined involvement in HIV/AIDS and TB activities, but not with involvement in HIV/AIDS alone.

Clustering effects were modest across models, with intraclass correlation coefficients ranging from 1.7% to 7.5% at the CSB and district levels.

DISCUSSION

This study presents a multiregional assessment of CHW involvement across PHC domains and infectious disease response activities in Madagascar, with a particular focus on determinants shaping engagement in HIV/AIDS and TB responses. By including CHWs across regions and national programmes, it captures patterns of engagement beyond project-specific or NGO-led initiatives. This is particularly relevant in Madagascar, where a pluralistic implementation landscape, marked by the coexistence of national programmes, NGOs and externally funded initiatives, shapes the operational capacities of CHWs.

A key finding is that CHW engagement across PHC domains is highly uneven: While participation was near-universal in maternal and child health, including immunisation, and malaria-related activities, fewer than one in four CHWs reported any involvement in HIV/AIDS or TB response activities over the preceding 2 years. This fragmentation disproportionately undermines the HIV/AIDS and TB responses to two diseases of major public health importance in Madagascar. The country faces widespread socioeconomic vulnerability and recurrent food insecurity, both of which are well-established drivers of TB risk.[11 12] At the same time, mounting evidence indicates an escalating HIV epidemic: Recent analyses suggest that deteriorating socioeconomic conditions, combined with limited population-level access to HIV testing and treatment, are amplifying transmission risks, with epidemiological warnings of a potential transition from a concentrated to a more generalised epidemic.[28] Recent high-level calls to action by cross-sectoral stakeholders have underscored that failure to rapidly expand community-based HIV prevention, testing and care risks further epidemic acceleration, rendering the low engagement of CHWs in HIV-related activities observed in this study particularly concerning.[14 29]

The uneven involvement aligns with the unintended effects of vertical programme design, which has long characterised community health systems in low- and middle-income countries.[30 31] Multiple studies have documented how CHW roles are often expanded incrementally through disease-specific initiatives, resulting in fragmented task portfolios, inconsistent support and uneven service coverage across health domains.[5 32 33] In such contexts, CHWs may be highly active in some domains while remaining marginally involved in others—not due to lack of willingness, but because certain services may be more strongly institutionalised, resourced and monitored than others. Consistent with this, our findings indicate that fragmented supervision arrangements, including those delivered through NGO-led or vertically organised programmes, are not sufficient to ensure sustained CHW engagement in HIV/AIDS and TB, reflecting broader fragmentation in programme design and system integration. Our findings mirror this pattern and are consistent with evidence from a complementary qualitative assessment, in which CHWs in the study setting described being active and operational across multiple PHC domains, but reported that HIV/AIDS and TB activities are not integrated as routine components of community-level PHC due to gaps in essential support, such as the lack of personal protective equipment and training, and higher barriers to reaching affected populations, including stigma.[25] The consequences of non-integration of infectious disease programmes such as TB into routine PHC observed in this study mirror what is increasingly recognised as a major barrier to an effective and sustainable TB response.[34]

Importantly, the PHC domains in which CHWs are most engaged in Madagascar correspond closely to areas of strong political prioritisation and external investment. Over recent years, maternal and child health and immunisation have received high-level political attention and long-standing donor support, including through Gavi, the Vaccine Alliance and large bilateral investments such as the multiyear USAID ACCESS programme.[35 36] In contrast, TB and HIV/AIDS do not appear to occupy a comparable position: political visibility and advocacy are limited, and external financing remains concentrated within disease-specific mechanisms, primarily the Global Fund, with fewer investments supporting routine, integrated community-level delivery.[37 38] While disentangling whether national priorities drive donor investments or vice versa is beyond the scope of this study, the alignment between political attention, financing structures and CHW involvement is striking. In a resource-constrained setting, these dynamics likely send powerful signals and direct resources to frontline workers regarding which services are most valued, supported and expected within PHC. From a UHC perspective, this represents a critical risk: prioritisation of certain PHC domains cannot compensate for preventable morbidity and mortality from other high-burden or expanding diseases such as TB and HIV/AIDS. In contrast, malaria provides the example of successful integration within community-level PHC. Although equally financed through the Global Fund, malaria activities in Madagascar are closely and effectively embedded within maternal and child health activities and routine PHC delivery through the iCCM

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strategy and the Guide PAC. The Guide PAC organises CHW activities into three tiers: a basic package (communication and sensitisation), an essential package (high-impact interventions expected of all CHWs) and a specific package (activities requiring specialised competencies). Malaria is anchored within the essential package on two fronts: through Prise en charge intégrée des maladies de l'enfant (PCIME; Madagascar's operationalisation of iCCM) for children and through routine prevention for pregnant women, including sulfadoxine–pyrimethamine distribution. TB sits within the specific package, dependent on additional training. HIV/AIDS holds a more limited place: prevention of mother-to-child transmission (PMTCT) is integrated into antenatal care in the essential package, but no comprehensive HIV framework for CHWs exists beyond this MCH-related context. Understanding how malaria interventions were successfully integrated into routine PHC and aligned with national priorities and donor investments through iCCM offers an important opportunity to inform strategies for more effectively integrating HIV/AIDS and TB into community health systems.

Our findings also highlight the precarious socioeconomic conditions of CHWs: more than 7 out of 10 CHWs reported monthly household incomes below approximately US$30, underscoring the extreme financial vulnerability of the workforce. In this context, CHWs function not merely as volunteers but as essential frontline actors within the health system, highlighting the importance of predictable remuneration and support to ensure sustainability and performance. This reveals a clear mismatch between the voluntary engagement model promoted in national community health policy and the lived economic realities of CHWs in a high-poverty setting.[15] Similar tensions have been widely documented across low- and middle-income countries, where reliance on unpaid or minimally compensated CHWs has been shown to constrain performance, increase attrition and undermine programme sustainability.[3 39] Reflecting this evidence, the WHO explicitly recommends adequate and predictable remuneration and social protection as core components of ethical and effective CHW programmes.[2] Findings from our parallel qualitative study in Madagascar reinforce this interpretation, echoing concerns raised by CHW professionalisation and advocacy platforms that fair pay and financial protection are prerequisites for enabling CHWs to realise their full potential in advancing UHC.[25 40]

Finally, this study identifies opportunities to strengthen community-based HIV/AIDS and TB responses: possession of written work guidance and receipt of training were among the strongest and most consistent determinants of CHW engagement, indicating that limited involvement is driven largely by modifiable system-level factors rather than workforce capacity.[2] Clear role definition, job aids and regular training are widely recognised as essential for enabling CHWs to deliver complex services such as TB and HIV screening, referral and follow-up.[3 41] Recent global commentaries emphasise that meaningful integration of TB and HIV into PHC requires sustained investment in frontline capacity through standardised guidance, routine training and coherent supervision, rather than reliance on vertical or ad hoc programme inputs.[34]

In the Malagasy context, this translates into the following recommendations: HIV/AIDS and TB activities should be re-anchored within the routine task package of the Guide PAC, rather than implemented through a standalone vertical programme—for TB, by moving comprehensive activities from the specific package into routine practice, in the same way that malaria has been institutionalised through the essential package via PCIME communautaire; and for HIV/AIDS, by extending the existing essential-package PMTCT framework to encompass the broader community-level HIV response. Such integration should also remain aligned with the operational realities of existing rural CHW systems, where CHWs are commonly selected based on community trust and social acceptability and often work under part-time or incentive-based arrangements. In this context, the integration of HIV/AIDS and TB activities should rely on clearly defined and simplified tasks, supported by practical tools, including written work guidance, training and supervision, rather than substantial expansion of CHW roles. Realistic integration therefore requires a bounded task package that does not demand full-time engagement, paired with predictable remuneration. For HIV/AIDS specifically, this task package should incorporate explicit confidentiality safeguards, including private counselling, options for self-referral and information practices that minimise unintended disclosure, to ensure that community-level engagement supports rather than deters access to care. Prioritising these foundational supports therefore represents a pragmatic and feasible pathway to strengthening CHW engagement in HIV/AIDS and TB and to improving equity in community-based service delivery.

This study has limitations. First, CHW involvement was self-reported over the preceding 2 years and may be subject to recall or social desirability bias. Second, involvement was measured as a binary outcome (any engagement vs none), and we did not assess the quality, intensity or effectiveness of the reported activities. Third, the regions are not fully represented evenly in the sample, with CHWs from Anosy over-represented and those from Atsimo Andrefana under-represented. This was due to unanticipated variation in the number of CHWs across selected clusters that were not feasible to capture by available administrative data at the time of sampling. Consequently, findings may be most applicable to rural settings similar to those included in the study, and regional comparisons should be interpreted with caution, although the overall patterns observed were consistent across regions. Fourth, accessibility constraints required the replacement of two out of 20 CSBs originally selected through random sampling. As a result, CSBs

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located closer to road networks were more likely to be included, potentially under-representing CHWs attached to the most remote CSBs. Consequently, the findings may underestimate the challenges faced by CHWs working in highly geographically isolated areas.

CONCLUSION

In rural Madagascar, fewer than one in four CHWs are actively involved in the HIV/AIDS and TB responses, compared with near-universal involvement in malaria and maternal and child health. Clear work guidance and disease-specific training were the strongest determinants of CHW involvement in HIV/AIDS and TB, indicating that limited engagement reflects gaps in system design and support rather than workforce availability or motivation. Strengthening community-based HIV/AIDS and TB responses will require explicit integration of these activities into routine CHW protocols, work guidance documents (including the Guide PAC) and training packages, alongside coherent supervision and predictable financial and non-financial support. Such integration should comprehensively incorporate HIV/AIDS and TB activities into the routine task package of the Guide PAC, the national operational framework for Madagascar's existing CHW workforce, using clearly defined tasks adapted to rural CHW systems and ensuring confidentiality-sensitive approaches for HIV-related activities. Beyond individual programmes, effective community-level integration depends on alignment across national strategies, implementing actors and financing mechanisms to enable CHWs to engage across multiple programmes. In this context, political and donor prioritisation of selected disease areas, while essential for progress, should be balanced against potential trade-offs that may undermine integrated PHC delivery. Drawing on the successful integration of malaria through iCCM offers a pragmatic pathway for strengthening equitable and sustainable community-based responses to HIV/AIDS and TB.

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